M.Sc. Biotechnology

Program Outcomes (PO):

PO1: Critical Thinking: Students can identify the scientific problem and can able apply different biotechnological (Biochemical, Microbiology, Molecular Biology and Bioinformatics) tools and techniques to interpret results.

PO2 : Effective Communication: Can Communicate clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4: Ethics: Can recognize different IPR and Ethical issues related to Practical and research aspects.

PO5: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO6: Environment and Sustainability: Can able to understand the issues related to environmental Biotechnology and sustainable development.

PO7: Research Aptitude: Student can able to identify scientific problem and perform different experimentations.

Program Specific Outcomes (PSO):

PSO-1 Understand the basic concepts of different aspects in Molecular Biology, Biochemistry, Microbiology and Bioinformatics to appreciate how diverse phenomena observed in nature and in daily life

PSO-2 Learn different tools and techniques pertaining to diverse field of biotechnology at theoretical and practical level.

PSO-3 Carry out experimentations in basic as well as certain advanced areas of biotechnology such as Plant tissue culture biotechnology, Animal biotechnology, Enzyme Technology and Bioinformatics.

PSO-4 Gain hands on experience to perform research projects in certain sub fields such as Biochemistry, Bioinformatics, Molecular Biology and Microbiology.

PSO-5 Gain a thorough Knowledge in the subject to be able to work in projects at different research as well as academic institutions.

PSO-6 Gaining knowledge to transform theoretical concept to practical products/process.

PSO-7 Viewing biotechnology as a tool the developing mind and critical attitude and the faculty of logical reasoning that is prepared to serve in diverse fields.

COURSE OUTCOMES

COURSE NAME: GENE STRUCTURE FUNCTION AND REGULATION (BT-511)

CLASS - M.Sc BIOTECHNOLOGY SEMESTER – I

Objectives:

The course is designed for the students entering Masters Degree in biotechnology. The primary aim of this course is to introduce and elaborate the students with the detailed understanding of the structure of the gene with respect to its molecular architecture, structural organization and comparative analysis of both the prokaryotic and eukaryotic organisms. Further the course enlighten the students about the various process such as replication, transcription, translation and regulation and the advances viz-a-viz on the topics defined, in recent research.

Course outcomes:

After the completion of the topics, Students will be able to

- Understand the basic structure of DNA, RNA and Proteins
- Detailed Molecular mechanisms involved in DNA replication
- Types of DNA damages, causes and mechanism of repair system in prokaryotic and eukaryotic organisms

- DNA recombination –types and molecular mechanism
- Molecular machinery involved in transcription in prokaryotic and eukaryotic systems
- Protein synthesis mechanismsin prokaryotic and eukaryotic systems and their control points
- Gene regulation in both prokaryotic and eukaryotic organisms

Course Name: ENZYMOLOGY (BT 512)

Class: M. Sc. (Biotechnology) Semester: I

Objective of the Course:

This course aims at accustoming students with various concepts of enzymesand students learn how important enzymes are by functioning as a catalyst in biological processes. It also aims to familiarize the students with, what an enzyme does in terms of activation energy, how relate a catalyst to an enzyme,factors that influence the enzyme activity, single and multisubstrate enzyme kinetics, role of activators and inhibitors in regulation .

Course Outcomes:

A. **Knowledge and understanding:**

- Basic understanding ofenzymes.
- Students will learn about Classification, nomenclature of enzymes. This course covers detailed mechanism of enzyme specificity and action, unit of enzyme activity.
- Students will study about the kinetics of single and multisubstarte reactions.
- Role of inducers, inhibitors, covalent modifications, pH &temperatue in the course describe their indispensable role in regulating enzyme activity.

B. **Intellectual (Cognitive/Analytical) skills:**

- Estimation of absolute and specific activity of enzymes.
- Effect of activators and inhibiotors on enzyme activity

- Determination of optimum pH and temperature, Km, Vmax of an enzyme.

C. Practical skills:

- Use of various instruments, apparatus and techniques
- Enzyme extraction methods
- Enzyme activity determination
- Estimation of Optimal conditions.

D. Transferrable skills:

- Communication skills
- Thinking skills
- Education

Paper Name: Immunotechnology BT-513

Class: M.Sc. (Biotech) Semester: I

Objective of the Course:

This course aims at introducing various concepts and basic techniques essential for conduct of practical and research work in the field of immunology and have an understanding of scientific knowledge of the subject to the students. It also aims to explore the principle, theory and techniques involved for proper comprehension of the subject.

Course Outcomes:

A. Knowledge and understanding:

- Basic understanding about concepts of immunology.
- Students will learn the basic techniques essential in immunological experimentation

- Understanding the mechanism of immune system of the body build up against various diseases and the protection offered lifetime.

B. **Intellectual (Cognitive/Analytical) skills:**

- Use of immunological techniques in laboratory
- In research and development areas

C. **Practical skills:**

- Studying antigen antibody interaction
- Hands on performing practically used techniques
- Comprehending and evaluating the results

D. **Transferrable skills:**

- Communication skills
- Thinking skills
- Theoretical Skills

Course Name: Biostatistics BT 514

Class: M.Sc. Biotechnology Semester: I

Course Objectives:

Recognize important differences between descriptive and inferential statistics; distinguish between different types of variables and data; summarize, organize, tabulate and graph statistical data; read and understand statistical data present in various forms of the media; find and analyze measures of center and variation for quantitative data.

Course Outcomes:

A. Knowledge and Understanding:

Students will be able to

- Students will formulate complete, concise, and correct mathematical proofs.
- Students will frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques.
- Students will create quantitative models to solve real world problems in appropriate contexts.

B. Intellectual(cognitive/Analytical) skills:

- Students will effectively use professional level technology tools to support the study of mathematics and statistics.
- Students will clearly communicate quantitative ideas both orally and in writing to a range of audiences.

C. Practical skills:

- Students will be able to compete successfully for internship and employment positions in government, industry, and non-profit organizations.
- Students will have a predisposition for outreach toward application areas such as physical sciences, financial services, and social sciences and have the knowledge, experience, and motivation to bring the tools of mathematics and statistics to bear on real-world problems.
- Students will have the intellectual curiosity and flexibility to grow with developing technology and new methods mathematics and statistics.

Paper Name: BT 515 Computers, Networking and Programming

Class: M.Sc. Biotechnology **Semester: I**

Objective of the Course:

This course aims at acquainting students with various concepts of computers networking and programming. It also aims to familiarize students with C-language, Computer Networking, and data Structures. It also aims to familiarize the student with Object Oriented Language (OOP's) Concept.

Course Outcomes:

A. <u>Knowledge and understanding:</u>

- Basic understanding about Computer
- Understanding the basic concept associated with C- Language and program designing
- Students will develop different programs, Run and Retrieve results.
- Students will learn the basic concept of Object Oriented Programing too.

B. <u>Intellectual (Cognitive/Analtical) skills:</u>

- Design program in C-language on the basis of given query.
- Understanding the computer networking and protocols.
- Understanding the concept of OPP'
- Use of data structures in C

C. <u>Practical skills:</u>

- Use of standard input (scanf) and standard output (printf) functions
- Use of variables, keywords, Various Operators.
- Use of library functions and user defined functions.
- Use of Looping and branching statements
- Utility of union and structures.
- Create functions and its use.
- Utility of pointers

- Concept of binary trees, linked list, stack and queue.

COURSE TITLE: Principles of biochemical engineering (BT-521)

Class: M.Sc. Biotechnology Semester: II

Objective of the Course:

This course aims at acquainting students with various concepts and basic design of fermenter and its kinetics along with an understanding of scientific knowledge. It also aims to explore the students with principle, theory and mathematical calculations involved in various fermenter, microbial growth, instrumentation and control in the fermenter. The students will be explained about sterilization cycle, scale up and transport in Bio reactor.

Course Outcomes:

A. Knowledge and understanding:

- Students will learn the basic components of fermenter. Basic understanding about different types of fermenter used for microbial, plant and animal cell.
- Basic understanding about concept of microbial growth and growth curve.
- Understanding the necessary concept coupled with design of fermenter and instrumentation involved in control of various parameters in fermenter.

- Students will gain knowledge in areas relating to sterilization cycle for batch and continuous mode of operation.
- Students will learn the concept of transport in fermenter and product formation.

B. Intellectual (Cognitive/Analtical) skills:

- Analyse the use and application of fermenter.
- Master the standardization of probes and various factors involved in fermenter.
- Understanding the bacterial growth curves and maintenance energy concept.

C. Practical skills:

- To study the Batch and continuous fermenter.
- Determination of mixing time.
- To study the solid state fermentation.
- Standardization of pH and DO probes.
- Determination of KLa.

Transferrable skills:

- Communication skills
- Thinking skills
- Education

Paper Name: Enzyme Technology BT 522

Class: M. Sc. (Biotechnology) Semester: II

Objective of the Course:

This course aims at accustoming students with various concepts and advancements of enzymes. It also aims to familiarize the students with, what an enzyme does in terms of a biological process, relate a catalyst to an enzyme, and role of enzymes atlarge scale or industrial level.

Course Outcomes:

- **<u>Knowledge and understanding:</u>**
  - Application based understanding ofenzymes.
  - Students will learn about the isolation, purification, molecular wt. determination, characterization of enzymes.
  - Students will study about the artificial enzymes, methods of enzyme immobilization, and use of various enzymes in food, leather & wool industries.
  - Medical applications of enzymes in the course describe their indispensable use at large scale.
- **<u>Intellectual (Cognitive/Analytical) skills:</u>**
  - Isolation, Purification and Artificial synthesis of enzymes.
  - Industrial applications
- **<u>Practical skills:</u>**
  - Use of various instruments, apparatus and techniques
  - Enzyme purification methods
  - Enzyme activity determination
  - Estimation of Optimal conditions.
- **<u>Transferrable skills:</u>**
    - Communication skills
    - Thinking skills

- Education

Paper Name: Course No. BT 523: Introduction to Bioinformatics
Class: M.Sc. Biotechnology Semester: IInd

Objective of the Course:

This course aims at acquainting students with various concepts and basic techniques essential for conduct of practical and research, in bioinformatics to get in-depth understanding of Computational (*In Silico*) scientific knowledge. It also aims at to acquainting students with principal, method and working of algorithm to predict any information i.e. form DNA, RNA, and Protein etc. It also aims to familiarize the student with principle, theory and mathematical calculation used in various tools and technique.

Course Outcomes:

A. Knowledge and understanding:

- Basic understanding about computer and molecular Biology
- Understanding the basic concept associated with separation of molecule based upon their size, shape and Conformation.
- Students will be develop basic understanding about Visible/UV spectrometry and be able to describe the separation using spectrophotometer.

B. Intellectual (Cognitive/Analytical) skills:

- Protein and Nucleotide sequence analysis to find out homology.
- Different primary, secondary and derived database analysis and interpretation using tools available on them.

- Evolutionary relationship analysis using different Phylogenetic analysis tools.

C. Practical skills:

- Various Databases at NCBI, EMBL, DDBJ
- Various Genome Daatabases (Ensemble, TIGER)
- Pair wise and multiple sequence alignment
- Homology Search tool BLAST
- Gene Prediction

D. <u>Transferable skills:</u>

- Suitability of various techniques for Homology prediction
- Analysis of DNA, RNA and protein as required for scientific studies using various online/offline tools and techniques.
- Characterization of phylogenetic tree on the basis of methods
- Conduct and planning independent experimentation for *In Silico* analysis and prediction of homologus sequences.

Paper Name: ENVIRONMENTAL BIOTECHNOLOGY BT-524

Class: M.Sc. (Biotechnology)Semester: II

<u>Objective of the Course:</u>

This course aims at acquainting students with various concepts and basic techniques essential for conduct of practical and research work in the field of environment biotechnology and waste management and has an understanding of scientific knowledge. It also aims to explore the students with principle, theory and observation involved in identification and isolation of various microorganisms from soil and sewerage samples.

Course Outcomes:

A. Knowledge and understanding:

- Basic understanding about environment and its pollution.
- Students will learn about various effects of pollution and its controlling methods.
- Students will get acquainted to the methods of waste water treatment and solid waste management.
- Students will gain knowledge about biomass production and biofuels.

B. **Intellectual (Cognitive/Analytical) skills:**

- Use of Biotechnology in environmental pollution control
- Recent trends in biofuel research
- Industrial applications and future prospects.

C. **Practical skills:**

- Determination of Drinking water quality
- Technique of vermicomposting
- Bioremediation of dyes

D. **Transferrable skills:**

- Communication skills

- Thinking skills
- Education

Paper Name: Course No. BT 525 Structural Biology and Bioinformatics

Class: M.Sc. Biotechnology Semester: IInd

Objective of the Course:

This course aims at acquainting students with various concepts and basic techniques essential for conduct of practical and research, on protein structure analysis. It also aims at to acquainting students with principles, tools, databases and suitability of technique to conduct practical and research. It also aims to familiarize the student with theory and mathematical calculation used in online/ofline tools or technique in structural Biology.

Course Outcomes:

A. **Knowledge and understanding:**

- Basic understanding about computer and molecular Biology
- Understanding the basic concept associated with protein structure, conformation properties and co-ordinate files.

B. **Intellectual (Cognitive/Analtical) skills:**

- Homologues sequence analysis from different tools on the basis default parameters.
- Master the protein visualization and comparative modeling technique
- Understanding the protein conformation and Ramachandran Plot

C. **Practical skills:**

- Various Secondary Structure prediction Methods
- Secondary structure of RNA using M fold.
- Prediction of tertiary structure of protein by swill model and MGFM threading etc.
- Retrieval of various structures of Proteins from RCSB, classification using CATH/SCOP etc.
- Proteins structure visualization tools i.e. RASMOL, SPDBV .
- To study the atomic co-ordinate files of various structures.
- To align, superimpose and compare three dimensional structures of the proteins using 3D-alignment software

D. **Transferable skills:**

- Suitability of various tools/ techniques for protein structural analysis
- Prediction of protein structure as requires for further studies (i.e. CADD, Active site prediction etc.)
- Characterization of proteins on the basis of class, Architecture, Topology and Homology
- Conduct and planning independent experimentation for analysis of protein structures.

Paper Name: Genetic Engineering- Applications BT-631

Class: M.Sc. (Biotech) Semester: III

Objective of the Course:

The subject mainly aims at making students aware of the potentials of genetic engineering and the vast possibilities available with it. The course will help students develop a research frame of mind whilst knowing the probable outcomes and the wide applications offered for a better human society.

Course Outcomes:

A. Knowledge and understanding:

- Basic understanding about concepts of genetic engineering.
- Students will learn the basic techniques essential in genetic engineering experimentation
- Understanding the mechanism of different genetically engineered products.

E. Intellectual (Cognitive/Analytical) skills:

- Use of techniques in laboratory
- In research and development areas

F. Practical skills:

- Studying vector and its role, identifying the transformed cells
- Hands on performing practically used techniques
- Comprehending and evaluating the results

G. Transferrable skills:

- Communication skills
- Thinking skills
- Theoretical Skills

COURSE NAME: Advances in Bioinformatics (BT-632)

CLASS - M.Sc. BIOTECHNOLOGY (SEMESTER-III)

This course aims at acquainting students with various online/offline tools and techniques essential for conduct of practical and research, in bioinformatics to get in-depth understanding of Computational (*In Silico*) methods. It also aims at to acquainting students with working of algorithm to predict any information i.e. form DNA, RNA, and Protein etc. It also aims to familiarize the student with principle, theory and mathematical calculation used in various tools and technique.

Course Outcomes:

A. <u>Knowledge and understanding:</u>

- Understanding about computer and molecular Biology
- Understanding the concept associated with protein structure, conformation properties and co-ordinate files.

B. **<u>Intellectual (Cognitive/Analtical) skills:</u>**

- Homology search and sequence analysis from different tools on the basis default parameters.
- Master the protein visualization and comparative modeling technique.
- Understanding the protein conformation and Ramachandran Plot

C. **<u>Practical skills:</u>**

- Study Various Biological Databases
- Study of Biodiversity Informatics using various tools GBIF (Global
- Biodiversity Information Facility) Species 2000 and IOB
- Study of Protein Databases like RCSB, UNIPROT etc.
- Prediction of tertiary structure of protein by Swiss Model and MGFM threading etc.
- Structural visualization tools like RASMOL, SPDBV
- Study protein atomic co-ordinate files.

D. **Transferable skills:**

- Suitability of various tools/ techniques for protein structural analysis
- Prediction of protein structure as requires for further studies (i.e. CADD, Active site prediction etc.)
- Characterization of proteins on the basis of class, Architecture, Topology and Homology
- Conduct and planning independent experimentation for analysis of protein/DNA sequence and structures.

COURSE NAME: NANOBIOTECHNOLOGY (BT-633)

CLASS - M.Sc BIOTECHNOLOGY SEMESTER – III

OBJECTIVES OF THE COURSE:

The course is designed for the students entering Final yearMasters degree in Biotechnology. The primary aim of this course is to introduce the students with a new field of biotechnology i.e. Nanobiotechnology. The course is designed with the preliminary history, advancements and achievements in the last two to three decades, followed by introduction to the components such

as different nanoparticle, nanoshells, nanotubes, quantum dots, self-assembly nanoparticles etc. and elaborates on the different instruments employed to visualize and analyse these nanocomponents. Further the students will be deliberated upon the role of various Nano-biotechnological tools in the field of drug discovery and delivery, diagnostic, imaging, biosensing etc. The students will be explained about the use of nanoparticles and its role in cancer and cardiovascular diseases.

Learning outcomes:

After the completion of the topics, Students will be able to

- The history of nanotechnology and nanobiotechnology with reference to its interdesplinary approach
- Understand and distinguish different nanoparticles
- Differentiate various physical, chemcial, electrical and other properties between macro, micro and nano scale particles
- Biofunctionalization of various nanoparticles to be used for various applications useful for human welfare
- Elaborate on the use of various nanoparticles for their application in the areas of drug discovery, drug delivary
- Discuss the role of various nanoparticles, Single wall and multiwall carbon nanotubes in the area of biosenesing
- Able to justify the applications of various nanoparticles in imaging for various diseases including the cancer and cardiovascular diseases
- Besides the beneficial effects, the students will be able to tell the effect of different nanoparticles on human health i.e. the toxicology of nanoparticles on both tissue as well as cell and organelle level.

Paper Name: BT-637 Genomics & Functional Genomics

Class: M.Sc. Biotechnology Semester: III

Objective of the Course:

The main objective of the course is to introduce the student with emerging field of functional genomics and genomics. This course aims at acquainting students with various concepts and techniques of Cutting edge technology, to get in-depth understanding of scientific Phenomenon of functional genomics and genomics. It also aims at to acquainting students with principal and instrumentation visa-*a vis* application and suitability of technique to conduct practical and research in the areas of functional genomics and genomics. It also aims to familiarise the student with principle, theory and make them capable to usher in the field of biotechnology.

Course Outcomes:

A. Knowledge and understanding:

- Basic understanding about Whole genome sequencing, genomic and cDNA library preparation.
- Understanding the basic concept associated with microarray; design, synthesis and analysis.
- Students will be develop basic understanding about Mass spectrometry and be able to describe the separation using mass spectrometer.
- Students will learn the basic concept of probe labelling and be able to describe their application in various analysis and diagnostic procedures

B. Intellectual (Cognitive/Analtical) skills:

- Analyse the genomic sequences and analyse variability present in living beings.
- Master the microarray techniques and various factors effecting the outcome of microarray
- Understanding mass- spectrometer and its basic operation as applied to proteome
- Use of different diagnostic procedures to analyse the difference in genome

C. Practical skills:

- Searching and analyse different genomic sequences using *in-silico* tools
- Preparation of probes for microarray
- Use of online learning resources from different websites

D. <u>Transferable skills:</u>

- Suitability of various techniques for analysis of genetic variability
- Characterization of various biomolecules
- Basic understanding about experimentation for analysis of Genome , transcriptome and metablomes

SEMESTER-IV

BT-638 Research Project