



**List of Courses Focus on Employability/ Entrepreneurship/  
Skill Development**

**Department : *Biotechnology***

**Program Name : *M.Sc.***

**Academic Year : *2016-17***

***List of Courses Focus on Employability/ Entrepreneurship/Skill Development***

| Sr. No. | Course Code | Name of the Course                    |
|---------|-------------|---------------------------------------|
|         | LBTM- 103   | Bioinstrumentation                    |
|         | LBTL-105    | High Throughput Screening Techniques  |
|         | LBTL-106    | Laboratory-I<br>Based on Core-1 & 2   |
|         | LBTL-107    | Laboratory-II<br>Based on Core-1 & 2  |
|         | LBTM - 201  | Recombinant DNA Technology            |
|         | LBTM - 202  | Enzymology and Enzyme Technology      |
|         | LBTM - 203  | Genomics and Proteomics               |
|         | LBTM - 204  | Computational Biology                 |
|         | LBTL - 206  | Laboratory-III<br>Based on Core-1 & 2 |
|         | LBTL - 207  | Laboratory-IV<br>Based on Core- & 4   |
|         | LBTM- 301   | Animal Biotechnology                  |
|         | LBTM- 302   | Advanced Immunology                   |
|         | LBTM- 303   | Plant Biotechnology                   |



|           |  |
|-----------|--|
| LBTM- 304 | Bioprocess engineering and technology                          |
| LBTM- 304 | Molecular modeling   |
| LBTM- 304 | Molecular diagnostics  |
| LBTM- 304 | Plant metabolic engineering                                    |
| LBTM- 305 | Laboratory – V Based on Core - Core-1 & 2                      |
| LBTM- 306 | Laboratory – VI Based on Core - Core-3 & Elective              |
| LBTL- 307 | Review writing and Seminar                                     |
| LBTM- 401 | Immunotechniques   |
| LBTM-402  | Environmental Technology                                       |
| LBTM-403  | Paper -4a Microbial and Fermentation technology                |
| LBTM-403  | Paper-4b. Chemoinformatics and drug designing                  |
| LBTM-403  | Paper-4c. Gene therapy and Nano medicine                       |
| LBTM-403  | Paper-4d. Plant Genetics Engineering and<br>molecular breeding |
| LBTM- 404 | Laboratory VII<br>Based on Core- 1 & 2                         |
| LBTM- 405 | Project Dissertation & Viva                                    |
| LBTM- 406 | Entrepreneurship and Management in Biotechnology               |

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MINUTES OF THE MEETING OF BOARD OF STUDIES IN BIOTECHNOLOGY HELD ON 01/07/2015

A meeting of the BOS was held on 01.07.2015 at 3 pm to discuss the following:

1. To discuss and approve the course structure and scheme of examination of Int. UG/PG and M.Sc. courses in Biotechnology as per CBCS scheme of the UGC effective from academic session 2015-2016.
2. Any other matter by permission of the Chair.

The following member were present:

|       |                                       |          |
|-------|---------------------------------------|----------|
| (i)   | Prof. B.N. Tiwary, Head               | Chairman |
| (ii)  | Dr. Renu Bhatt, Associate Professor   | Member   |
| (iii) | Dr. D.K. Parihar, Assistant Professor | Member   |

A copy of the draft of course structure and scheme of examination was sent in advance by email for persual and comment to Prof. Ashok Kumar, Department of Biotechnology, BHU, the external subject expert. However, no reply was received till the time of meeting on 01.07.2015.

At the very outset the HOD and Chairman of BOS welcomed all the esteemed members and placed the draft prepared to revise course structure and scheme of examination in the light of UGC directives as per CBCS scheme to be implemented from 2015-2016. Further the chairman brought to the notice of all members about the resolution of meeting called by the Dean on 23.06.2015 regarding following changes to be made for undergraduate courses:

1. There should be 03 core subjects at entry level of integrated courses in addition to AECC (Ability Enhancement Core Courses) and elective courses.
2. There should be at least 02 groups in each undergraduate course of every Department of the school. The students may opt any one of the two groups for Biotechnology (Hons.)

The course structure and scheme of examination was approved by all members.

The chairman categorically pointed out that in UG courses only 03 core subjects have to be defined and the student shall have choice to opt for any of the subject to pursue, the Honors degree course in 05<sup>th</sup> sem.

The BOS resolved to have two groups

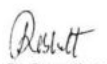
Group A : Biotechnology-Chemistry-Zoology

Group B: Biotechnology-Chemistry-Botany

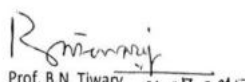
Each of the groups shall have a maximum of 30 seats, i.e. within the total approved seat of 60 in Biotechnology Honors. The number of students of other Departments of School of Life Sciences, opting Biotech as one of the core subjects in no case shall exceed 60.

However, one of the esteemed members, Dr. D.K. parihar, showed his descent ~~mentoring~~ mentioning that segregating students in Botany and Zoology will lead to incomplete and inadequate knowledge of Biological sciences, as this is an integral component of Biotechnology.

The meeting ended with a vote of thanks by the Chair.

  
Dr. Renu Bhatt  
(Member)

  
Dr.D. K. Parihar  
(Member)

  
Prof. B.N. Tiwary  
(Chairman) 01.07.2015



**M.Sc. Biotechnology (Four Semesters)**  
**Semester I**

| Code         | Course Opted                    | Subject                                  | Hours/Semester | Hours/Week | Credits   |
|--------------|---------------------------------|--|----------------|------------|-----------|
| LBTM-101     | Core-1                          | Molecular Cell Biology                   | 48             | 3          | 3         |
| LBTM-102     | Core-2                          | Microbial Genetics and Physiology        | 48             | 3          | 3         |
| LBTM-103     | Core-3                          | Bioinstrumentation                       | 48             | 3          | 3         |
| LBTM-104     | Core-4                          | Biochemistry (Metabolism and regulation) | 48             | 3          | 3         |
| LBTM-105     | Soft Skill Development Course-1 | High Throughput Screening Techniques     | 48             | 3          | 3         |
| LBTM-106     | Core-1 & 2                      | Laboratory-I<br>Based on Core-1 & 2      | 96             | 6          | 3         |
| LBTM-107     | Core-3 & 4                      | Laboratory-II<br>Based on Core-3 & 4     | 96             | 6          | 3         |
| <b>Total</b> |                                 |  | <b>432</b>     | <b>27</b>  | <b>21</b> |

**Semester II**

| Code         | Course Opted | Subject                                 | Hours/Semester | Hours/Week | Credits   |
|--------------|--------------|---|----------------|------------|-----------|
| LBTM-201     | Core-1       | Recombinant DNA Technology              | 48             | 3          | 3         |
| LBTM-202     | Core-2       | Enzymology and Enzyme Technology        | 48             | 3          | 3         |
| LBTM-203     | Core-3       | Genomics and Proteomics                 | 48             | 3          | 3         |
| LBTM-204     | Core-4       | Computational Biology                   | 48             | 3          | 3         |
| LBTM-205     |              | Seminar                                 | 32             | 2          | 2         |
| LBTM-206     | Core-1 & 2   | Laboratory III<br>(Based on Core-1 & 2) | 96             | 6          | 3         |
| LBTM-207     | Core-3 & 4   | Laboratory IV<br>(Based on Core-3 & 4)  | 96             | 6          | 3         |
| <b>Total</b> |              |   | <b>416</b>     | <b>26</b>  | <b>20</b> |



| Semester III |                   |   |                    |                |           |
|--------------|-------------------|---|--------------------|----------------|-----------|
| Code         | Course Opted      | Subject   | Hours/<br>Semester | Hours/<br>Week | Credits   |
| LBTM-301     | Core-1            | Animal Biotechnology  | 48                 | 3              | 3         |
| LBTM-302     | Core-2            | Advanced Immunology   | 48                 | 3              | 3         |
| LBTM-303     | Core-3            | Plant Biotechnology   | 48                 | 3              | 3         |
| LBTM-304     | Elective          | Paper-4a.: Bioprocess Engineering and Technology<br>Paper-4b.: Molecular modeling<br>Paper-4c.: Molecular Diagnostics<br>Paper-4d.: Plant Metabolic Engineering | 48                 | 3              | 3         |
| LBTM-305     | Core-1 & 2        | Laboratory V<br>Based on Core-1 & 2   | 96                 | 6              | 3         |
| LBTM-306     | Core-3 & Elective | Laboratory VI<br>Based on core-3 & elective   | 96                 | 6              | 3         |
| LBTM-307     |                   | Review writing and Seminar  | 32                 | 2              | 2         |
| <b>Total</b> |                   |   | <b>416</b>         | <b>26</b>      | <b>20</b> |

| Semester IV  |                          |  |                    |                |           |
|--------------|--------------------------|--|--------------------|----------------|-----------|
| Code         |                          | Subject  | Hours/<br>Semester | Hours/<br>Week | Credits   |
| LBTM-401     | Core-1                   | Immunotechniques   | 48                 | 3              | 3         |
| LBTM-402     | Core-2                   | Environmental Technology   |                    |                |           |
| LBTM-403     | Elective Paper           | Paper-4a.: Microbial and fermentation technology<br>Paper-4b.: Chemoinformatics and drug designing<br>Paper-4c.: Gene therapy and Nano medicine<br>Paper-4d.: Plant Genetic Engineering and molecular breeding | 48                 | 3              | 3         |
| LBTM-404     | Core-1 & 2               | Laboratory VII<br>Based on Core-1 & 2  | 96                 | 6              | 3         |
| LBTM-405     |                          | Project Dissertation & Viva  | 288                | 18             | 6+3       |
| LBTM-406     | Soft Skill Development-2 | Entrepreneurship & Management in Biotechnology   | 48                 | 3              | 3         |
| <b>Total</b> |                          |  | <b>528</b>         | <b>42</b>      | <b>21</b> |

**Baskets of Electives:** Microbial Technology, Bioinformatics, Animal Biotechnology and Plant Biotechnology

\* B.Sc Biotechnology (Hons.) students shall opt one Elective from the Basket of electives offered by the Department.

\* Project work/ Field Study will be based on major elective paper (s) opted by the student, in consultation with the faculty concerned and on recommendation of the Head of the Department.



Course: **Bioinstrumentation**  
Course Code:  
Course Credit: (3-0-0) 3

**Unit - 1**

Microscopy: Principles and applications, simple, compound, phase-contrast and fluorescent microscopes. Electron microscopy: SEM and TEM. X-Ray Crystallography, X-ray diffraction, Bragg equation, Application in structural analysis of biomolecules, Centrifugation Techniques: Principles, types of centrifuges, density gradient centrifugation in isolation of cells, cell organelles and biomolecules

**Unit - 2**

Electromagnetic spectrum, Beer Lambert's Law, Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy, Mass spectroscopy (LC-MS, GC-MS, MALDI - TOF), Fluorescent spectroscopy, Applications of different Spectroscopic techniques in Biology

**Unit - 3**

Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion-exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology

**Unit - 4**

Paper and gel, electrophoresis, Polyacrylamide gel electrophoresis (native and SDS) Agarose gel electrophoresis, Immunoelectrophoresis, Principle and application of blotting (Southern, Western and Northern and South Western blotting) ELISA

**Unit - 5**

Nature and types of radiations, preparation of labeled biological samples, Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Safety measures in handling radioisotopes. RIA, Non radiolabelling, Role of ionizing and non ionizing radiation in Structural and functional analysis of biological sample

**Evaluation Scheme:**

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1 hour        | 30         |
| 2     | Internal Assessment II                  | 1 hour        | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

**Note:** The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Nuclear Magnetic Resonance: Williams
2. Biochemical Techniques theory and practice: White R
3. Analytical Chemistry: Christian GD
4. A Biologist Guide to Principle and Techniques: Willson K and Gounding KH
5. An Introduction to Practical Biochemistry: Plummer DT



Course: **High Throughput Screening Technology**  
Course Code:  
Course Credit: (3-0-0) 3

**Unit -1**

Introduction to High throughput screening techniques and applications. Microarrays: introduction to microarray technologies, the different platforms by which microarrays are manufactured, and the laboratory process involved in microarray use, sequence databases that are used for microarray design and annotation

**Unit -2**

Computer Design of Oligonucleotide Probes, methods by which oligonucleotide probes for microarrays can be designed, screening and evaluation of good probe. Microarray image processing: the computational algorithms used to convert microarray images into quantitative data, image segmentation and data acquisition, data normalization, data analysis and clustering

**Unit -3**

Measuring and Quantifying Microarray Variability, describes methods for measuring and quantifying the stratified variability that is a feature of microarray data. Analysis of Differentially Expressed Genes, looks at the analysis of microarray data where the microarray is being used to identify genes that may be up-regulated or down-regulated in different tissues or conditions

**Unit -4**

Analysis of Relationships Between Genes, Tissues or Treatments, describes methods that are used to explore the relationships between different genes or samples, including clustering and other related methods. Classification of Tissues and Samples, discusses methods that can be used to build predictive models that use gene expression for diagnostic or prognostic purposes

**Unit - 5**

Screening of proteins: protein array, antibody array, case studies. Bioinformatics approaches of screening of important genes and proteins from genome, comparative genomics, comparative metabolomics, functional annotation. Structure based and ligand based (3D QSAR and nD QSAR) techniques for screening of lead molecule, case studies

**Evaluation Scheme:**

| S.No. | Examination                  | Duration      | % of Marks |
|-------|------------------------------|---------------|------------|
| 1     | Internal Assessment I        | 1 hour        | 30         |
| 2     | Internal Assessment II       | 1 hour        | 30         |
| 3     | End Semester                 | 3 hours       | 60         |
| 4     | Assignment/Class performance | Each semester | 10         |

**Note: The best one out of two Internal Assessments will be taken into consideration.**



Course: **Laboratory (Based on Core-1 & 2)**  
Course Code:  
Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Laboratory (Based on Core-3 & 4)**  
Course Code:  
Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.





Course: **Recombinant DNA Technology**

Course Code:

Course Credit: (3-0-0) 3

**Unit - 1**

Isolation of DNA and RNA, Quantification of nucleic acids, Radiolabelling of nucleic acids: End labelling, nick translation, labelling by primer extension, DNA sequencing: Maxam-Gilbert (Chemical) and Sanger- Nicolson (dideoxy/ enzymatic) sequencing method, Pyrosequencing

**Unit - 2**

Restriction endonucleases: Types of restriction endonucleases, classification and uses. Analysis of restriction fragments, Restriction mapping, DNA modifying enzymes, Nucleases, Polymerases, Phosphatases and Polynucleotide kinase

**Unit - 3**

Cloning vectors; Plasmid, Bacteriophage, and other vectors, Cosmid expression vectors, DNA ligases; Joining of DNA Fragments *in vitro*, cohesive and blunt end ligation, linkers, adaptors, Homo polymer tailing, Preparation of the Gene construct, Construction of genomic and c-DNA libraries, Selection, screening and analysis of recombinants

**Unit - 4**

Principle of hybridization, Northern blotting, Southern blotting, Western blotting, South-Western blotting, Polymerase chain reaction, Restriction fragments length polymorphism, RAPD, AFLP

**Unit - 5**

Strategies of gene delivery, *in vitro* translation, expression in bacteria and yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants, Chromosome engineering, Targeted gene replacement, gene editing, gene regulation and silencing

**Evaluation Scheme:**

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1hour         | 30         |
| 2     | Internal Assessment II                  | 1hour         | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Principles of Gene manipulation: Old RN and Primrose SB
2. From Genes to Clones: Winnaeker EL
3. Recombinant DNA: Watson JD, Witreowski J, Gilman M and Zooller M
4. An Introduction to Genetic Engineering: Nicholl DST
5. Molecular Biotechnology: Pasternak
6. The Biochemistry of Nucleic acid: Adam
7. Genetic Engineering: JankeKswtlow



Course: **Enzymology and Enzyme Technology**  
Course Code:  
Course Credit: (3-0-0) 3

**Unit - 1**  
Introduction to Enzymes, enzyme commission numbers, and classification of enzymes, Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turnover number, Marker enzymes

**Unit - 2**  
Enzyme Kinetics: Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the  $K_m$  and  $V_{max}$  and their significance

**Unit - 3**  
Factor affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis, Enzyme inhibition.

**Unit - 4**  
Structure and function of enzymes in brief: Enzyme regulation and control of their activity, Introduction to allosteric enzymes and isozymes

**Unit - 5**  
Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, abzymes, Protein and Enzyme engineering.

**Evaluation Scheme:**

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1 hour        | 30         |
| 2     | Internal Assessment II                  | 1 hour        | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

**Note:** The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Enzyme Kinetics: Palmer
2. IUPAC Enzyme nomenclature series
3. Enzyme kinetics: Dixon WB
4. General Enzymology: Kulkarni & Deshpande
5. Enzyme Assays: J Raymond
6. Biochemistry: Voet and Voet
8. Lehninger Principles of Biochemistry: Nelson, Cox



Course: **Genomics and Proteomics**

Course Code:

Course Credit: (3-0-0) 3

#### Unit -1

Transcription: RNA polymerase, RNA polymerase II Promoters, Eukaryotic Promoters for RNA polymerase III, Hypersensitive sites, Upstream activation sites and enhancers, Mechanism of Eukaryotic Transcription (Initiation, Elongation, Termination), Processing of RNA,

#### Unit - 2

Translation: Outline of Protein Synthesis, The Genetic Code, Codon Anticodon interaction, Ribosomes, Mechanism of Protein Synthesis in Eukaryotes (Initiation, Elongation, Termination), Inhibitors of protein synthesis

#### Unit - 3

Whole Genome Sequencing Technologies (Next generation sequencing, Pyrosequencing & Reverse termination sequencing). Whole transcriptome sequencing.

#### Unit - 4

Proteomics: Isoelectric focusing. Protein profiling by one Dimensional and 2 Dimensional gel electrophoresis, Protein sequence analysis by mass spectroscopy. Protein microarrays.

#### Unit -5

Epigenetics: Definition, Mechanisms of Epigenetic control of gene expression. DNA methylation, histone methylation and histone acetylation, Genomic imprinting.

#### Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1hour         | 30         |
| 2     | Internal Assessment II                  | 1hour         | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.



Course: **Computational Biology**  
Course Code:  
Course Credit: (3-0-0) 3

**Unit -1**

Introduction: sequence similarity, homology, meaning of alignment. Pairwise Sequence Alignment: Substitution matrices (PAM and BLOSUM), Pairwise Alignment: Concept of Global and Local Alignment, Dot matrix method, Dynamic programming (Needleman-Wunsch algorithm, Smith-Waterman algorithm, FASTA and BLAST algorithms)

**Unit -2**

Multiple Sequence alignment: Multiple Sequence Alignment methods (MSA), Scoring of a MSA, Progressive (CLUSTALW), tree guided method of MSA and Pattern searching

**Unit -3**

Phylogenetic Analysis: Phylogenetic tree and terminology, different methods of Phylogenetic tree prediction.

**Unit -4**

Structural Alignment Tools and Protein Tertiary Structure Prediction: Homology modeling, simulation techniques in protein structure minimization, molecular dynamics simulation.

**Unit -5**

Sequence Analysis: DNA sequencing & Human Genome Project, Dinucleotide abundance, Codon biases, GC reach prediction, Pattern searches, Primer design for PCR, Methods for gene finding. RNA Structure Analysis: RNA secondary structure prediction.

**Evaluation Scheme:**

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1 hour        | 30         |
| 2     | Internal Assessment II                  | 1 hour        | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

**Note: The best one out of two Internal Assessments will be taken into consideration.**

**Suggested Readings**

1. BLAST, Oreilly Publisher, 2003; Ian Korf, Mark & Josaph
2. R. Durbin and S. Eddy and A. Krogh and G. Mitchison, Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
3. Bioinformatics and Functional Genomics: J Pevsner
4. Oulette Bioinformatics - A practical guide to the Analysis of Genes and Proteins: AD Baxevanis and BFF
5. DNA and Protein Sequence Analysis---A Practical Approach: MJ Bishop and CJ Rawlings



Course: **Laboratory (Based on Core-1 &2)**  
Course Code:  
Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Laboratory (Based on Core-3 & 4)**  
Course Code:  
Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessment will be taken into consideration.



Course: **Animal Biotechnology**

Course Code:

Course Credit: (3-0-0) 3

**Unit - 1**

Laboratory requirements for animal cell culture: Sterile handling area. Sterilization of different materials used in animal cell culture, Aseptic concepts. Instrumentation and equipments for animal cell culture, History of cell culture, Primary and secondary cell culture

**Unit - 2**

Media and reagents: Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growth supplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, serum and other reagents

**Unit - 3**

Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture, Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants

**Unit - 4**

Stem cell research: Current status and application in medicine. Application of animal cell culture for *in vitro* testing of drugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Types of blood substitutes, Artificial blood, General account of *in vitro* regulation of blood cells production

**Unit - 5**

Gene transfer technology in animals: Viral and non-viral methods, Production of transgenic animals and molecular pharming, current status of production of transgenic animals. Animal cloning: Techniques, relevance and ethical issues

**Evaluation Scheme:**



Course: **Advanced Immunology**

Course Code:

Course Credit: (3-0-0) 3

**Unit - 1**

Introduction: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organisation and structure of lymphoid organs

**Unit - 2**

Cells of immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dendritic cells, natural killer and lymphokine activated killer cells. Eosinophils, neutrophils and mast cells. Differentiation and activation of B and T lymphocytes, cytokine structure and function, cytokine receptor.

**Unit - 3**

Nature and Biology of antigens and super antigens, Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA, Generation of antibody diversity and complement system, Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity

**Unit - 4**

Antigen processing and presentation, generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, Immunological tolerance, Hypersensitivity, Autoimmunity.

**Unit - 5**

Transplantation, Immunity to infectious agents (intracellular parasites, helminths & viruses,) Tumor Immunology, AIDS and other immunodeficiencies, Hybridoma Technology and Monoclonal Antibodies

**Evaluation Scheme:**



Course: **Plant Biotechnology**

Course Code:

Course Credit: (3-0-0) 3

**Unit - 1**

Introduction to the techniques of plant tissue culture, Concept of cellular totipotency, Nutritional requirements, single cell culture, micro-propagation, somaclonal variation, somatic embryogenesis and production of embryoids

**Unit -2**

Haploid and double haploid production, Protoplast isolation and culture, Somatic hybridization and cybrid production and their applications in crop improvement, Productions of virus free plants using meristem culture

**Unit - 3**

Basis of tumor formation, hairy roots, features of Ti and Ri plasmids, mechanisms of transformation, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, transformation on monocots, Transgene stability and gene silencing, Herbicide and insect resistance, Plant Genetic Engineering: Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal)

**Unit - 4**

Photoregulation and phytochrome regulation of nuclear and chloroplast genes expression, Molecular biology of light and dark reactions of photosynthesis, Molecular mechanism of nitrogen fixation, Genetics of *nif* genes

**Unit - 5**

Plant secondary metabolites: Control mechanisms and manipulation metabolic pathways of production of alkaloids and industrial enzymes, biodegradable plastics, therapeutic proteins, Edible vaccines, purification strategies, Green house Technology, Biotic and Abiotic stress

**Evaluation Scheme:**





### Bioprocess Engineering & Technology

Course Code:

Course Credit: (3-0-0) 3

#### Unit - 1

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media formulation for industrial fermentation, Air and media sterilization Designing of a fermenter/Bioreactor

#### Unit - 2

Types of fermentation process, analysis of batch fed batch and continuous bioreactions, biotransformation, stability of microbial reactors, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.), Measurement and control of bioprocess parameters

#### Unit - 3

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization

#### Unit - 4

Industrial production of chemicals: alcohols, acids (citric, acetic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins

#### Unit - 5

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages, petro crops, Mushroom-types, isolation and culture



**Course:** Molecular Modeling

**Course Code:**

**Course Credit:** 3 0 0 (3)

**Unit - 1**

The fundamental concepts of molecular modeling (chemical building blocks, structure, superstructure, folding, etc.); the physical forces that shape macromolecules; structural databases (protein data bank, SCOP database, CATH database and other structure based databases)

**Unit - 2**

Protein structure prediction: computational methods for secondary structure prediction (Chou-Fasman, GOR and Neural Networks) and reliability (Q3 value and SOV score); prediction of tertiary structures of protein (Homology and Threading methods); structure quality assessment

**Unit - 3**

Protein structures comparison and alignment: comparison algorithm & optimization, multiple structural alignment. Analysis of 3D structures: secondary structure assignment, assignment of hydrogen bonds, coulomb hydrogen bond calculation, empirical hydrogen bond calculation, assignment methods of secondary structure (DSSP, STRIDE, DEFINE, P-Curve)

**Unit - 4**

Identifying structural domains in protein: first and second generation algorithms for domain assignments, domain assignment based on graph theoretical methods, prediction of binding sites and characterization; Inferring protein function from structure: enzyme/non-enzyme classification, gene ontologies, ab initio prediction, structural comparison, structural motifs.

**Unit - 5**

Ab initio protein structure prediction: Potential Energy Function (bond length potential, bond angle potential, torsional potential, van der wals potential and coulomb potential), Energy minimization techniques: concept of local and global minima, energy minimization protocol, energy minimization algorithms (steepest descent, conjugate gradient, Newton Raphson); Molecular Dynamics simulations, Monte Carlo Simulations, Calculation of Free energy using simulation techniques.

**Evaluation Scheme:**



Course: **Molecular Diagnostics**

Course Code:

Course Credit: (3-0-0) 3

**Unit - 1**

Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Use of polyclonal or monoclonal antibodies in enzyme immunoassays. Applications of enzyme immunoassays in diagnostic microbiology

**Unit - 2**

Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

**Unit - 3**

Laboratory tests for microbial infection, Antimicrobial Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Diffusion test procedures. Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests

**Unit - 4**

Rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Immunodiagnostic tests. Immunofluorescence. Radioimmunoassay, Immunohistochemistry.

**Unit - 5**

Genetic disorders, Molecular techniques to detect genetic disorders, Genetic test for Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease.

**Evaluation Scheme:**

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 1 hour        | 30         |
| 2     | Internal Assessment II                  | 1 hour        | 30         |
| 3     | End Semester                            | 3 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

**Note: The best one out of two Internal Assessments will be taken into consideration.**



Course: **Plant Metabolic Engineering**

Course Code:

Course Credit: (3-0-0) 3

#### Unit-1

The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways

#### Unit-2

Flavanoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

#### Unit-3

Terpenoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

#### Unit-4

Polyketoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

#### Unit-5

Production of secondary metabolites from plant cell cultures; Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals; Bioreactors systems and models for mass cultivation of plant cells, Plant Therapeutic proteins, Edible vaccine, Bioplastic.



Course: **Laboratory (Based on Core 1 & 2)**

Course Code:

Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hours       | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessment will be taken into consideration.

Course: **Laboratory (Based on Core-3 & elective)**

Course Code:

Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                             | Duration      | % of Marks |
|-------|---|---------------|------------|
| 1     | Internal Assessment I                   | 3 hours       | 30         |
| 2     | Internal Assessment II                  | 3 hours       | 30         |
| 3     | End Semester                            | 6 hour        | 60         |
| 4     | Attendance/Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.



Course: **Review writing & Seminar**  
Course Code:  
Course Credit: (3-0-0) 3

Each student will select a topic after consulting with faculty members and approval of the Head of the Department for the proposed area of the dissertation work. The students shall be required to submit a synopsis of the proposed project work giving rationale of the work, methodology to be used, methods of data analysis as hard copy before seminar presentation.



Course: **Environmental Biotechnology**

Course Code:

Course Credit:

(3-0-0) 3

**Unit - 1**

Components of Environment - Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject

**Unit - 2**

Global Environmental Problems - Green House Effect, Acid rain, Ozone depletion, salination, biodiversity loss; chemical and radiation hazards.

**Unit - 3**

Environmental pollution and degradation - Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc)

**Unit - 4**

Environmental Management - Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, health hazards due to pesticide and metal pollution, waste treatment, solid waste management

**Unit - 5**

Bioremediation - Oil spills, Wastewater treatment, chemical degradation, heavy Metals



Course: **Immunotechnology**  
Course Code:  
Course Credit: (3-0-0) 3

#### Unit - 1

Production and engineering of antibodies: Production of monoclonal and polyclonal antibodies, hybridoma technology, specific and cross reactivity, Anti-immunoglobulin antibodies; Antibody engineering, abzymes, Antigen-antibody interaction as a basis of precipitation and agglutination reactions, blood typing, RIA, ELISA, Microscopy, Imaging-Immunohistochemistry, Immunoprecipitation and co-immunoprecipitation, Immunoblotting

#### Unit -2

Isolation and enrichment of specific immune cells, ELISPOT, Flow-cytometer and FACS for quantitative/qualitative analysis and sorting of different immune cell subsets, Cell functional assays-lymphoproliferation, Cell cytotoxicity, mixed lymphocyte reaction, apoptosis

#### Unit -3

Immune response and bacterial, parasitic and viral infections, congenital and acquired immunodeficiency; tolerance and autoimmune diseases, Transplantation and Tumor Immunology, diagnosis and therapeutic approaches. Cytokine related diseases: diagnosis and therapeutic application of cytokines

#### Unit -4

Manipulation of the immune response: Regulation of unwanted immune responses and immunomodulation against autoimmunity, transplantation rejections, cancer therapy, Vaccination strategies: Active immunization: Sub unit vaccines; Recombinant DNA and protein based vaccines, Peptide vaccines, conjugate vaccines; Passive Immunization: Antibody, Transfusion of immuno-competent cells, Stem cell therapy; Cell based vaccines, Immunoinformatics and vaccine design

#### Unit - 5

Adoptive cell transfer therapy; Animal models: Transgenic mice and gene knockout by targeted disruption, *in vivo* cell tracking techniques, Cell imaging techniques-*in vitro* and *in vivo*. Molecular diagnosis of immunological disorders: ex. DiGeorge syndrome, humoral immunodeficiency, cellular immunodeficiency (due to defects in IFN $\gamma$  receptor  $\alpha$  and  $\beta$  chain, MHC Class I)

#### Evaluation Scheme:





Course: **Microbial & Fermentation Technology**

Course Code:

Course Credit: (3-0-0) 3

#### Unit-1

History and scope of microbial biotechnology, the bioreactor/fermenter-types and parts, scale-up, media design for fermentation processes, Economic aspects of fermentation

#### Unit-2

Biotechnological application of microorganisms, Production of chemicals and pharmaceuticals (bioconversion), Production of microbial enzymes and their applications, Microbes in mining, Ore leaching, oil recovery, Application of microbes in pharmaceutical industry

#### Unit-3

Role of microorganisms in the production and transformation of food and beverages -Food fermentation - Bread leavening - by yeast - by other micro organisms- chemical leavening, Brewing: Manufacture of Beer- microbiological aspects. Wine - Kinds of wines, manufacture, microbial spoilage, Distilled liquors. Vinegar -methods of manufacture

#### Unit-4

Fermented vegetables - Pickles - Fermented dairy products - Fermented milk, cheese, butter and other milk products - spoilage of milk - preservation of milk.

#### Unit-5

Biofertilizers- manufacture, formulation and utilization, Microbes as Biofertilizers -Chemically fixed Nitrogen versus biologically fixed Nitrogen, biopesticides.



Course: **Chemoinformatics & Drug Designing**  
Course Code:  
Course Credit: (3-0-0) 3

#### Unit -1

Defining chemical informatics; a glimpse of the future of chemical informatics. Representing 2D structures: Kinds of 2D structure representation; atom lookup and connection tables; graph theory; SMILES; SD files; Fragment codes & Fingerprints; descriptors. 2D chemical database applications. Types of searching; substructure searching with SMARTS; similarity searching with fingerprints; demonstrations of searching systems

#### Unit -2

Representing 3D structures. Sources of 3D information; experimental 3D databases; conformational flexibility; distance matrices; estimation of 3D structure; conformational search and minimization; 3D descriptors and fingerprint; representation of proteins

#### Unit -3

Molecular Descriptors: 2D descriptors. Kinds of descriptor; "mathematical" and topological indices; biological descriptors and their application in ADME/Tox; biological properties; property prediction software, 3D descriptors, data verification and manipulation

#### Unit - 4

Quantitative structure-property relationships(QSPR):Feature selection, Model building, examples of QSPR studies and application. QSAR in drug design: QSAR methodology, biological and physicochemical parameters, QSAR applications in drug design, QSAR model selection and validation, CoMFA, 3D and nD-QSAR methods

#### Unit - 5

Pharmacophore and Drug Discovery: pharmacophore generation, database building and conformer generation, query generation and submission, searches in the database, software for pharmacophore generation, application and limitation of pharmacophore concept. De-novo design system: generating the constraints model, finding structure, sorting and selection, synthetic accessibility, experimental validation. Computational models for ADME/Tox. The application of predictive models to pharmacology and toxicity testing.



Course: **Gene Therapy and Nano medicine**  
Course Code:  
Course Credit: (3-0-0) 3

**Unit - 1**

Clinical management and Metabolic manipulation - Phenylketouria, Familial Hyper- cholesterolemia, Rickets, ADA, Congenital hypo-thyroidism

**Unit - 2**

Gene therapy - Ex-vivo, *In-vivo*, *In-situ* gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy - retrovirus, adenoviruses, Herpes Synthetic vectors- liposomes, receptor mediated gene transfer. Gene therapy trials

**Unit - 3**

Stem cell and tissue engineering, Embryonic and adult stem cell, Potential use of stem cells - Cell based therapies

**Unit - 4**

Types of nanoparticles, uses in Nanomedicine and therapeutically applications in medical biotechnology

**Unit - 5**

Health and Environmental impact of Nanotechnology: Special emphasis to risk assessment and risk management of nanomaterials, ethical and legal aspects of nanotechnology, and nano-industry and nano-entrepreneurship.

**Evaluation Scheme:**



Course: **Plant Genetic Engineering & Molecular breeding**

Course Code:

Course Credit: (3-0-0) 3

**Unit-1**

Plant Transformation Technology: *Agrobacterium* based vectors, *Agrobacterium* mediated gene transfer; viral vectors and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment

**Unit-2**

Genetic engineering for biotic stress tolerance: Insects, fungi, bacteria, viruses, weeds; abiotic stress tolerance: drought, flooding, salt, heavy metals and temperature

**Unit-3**

Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency

**Unit-4**

Genetic engineering for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients

**Unit-5**

Introduction to molecular markers, construction of Molecular maps, Molecular tagging of genes/traits, Marker-assisted selection of qualitative and quantitative traits, The concept of map-based cloning and their use in transgenics



Course: **Laboratory (Based on Core-1 & 2)**

Course Code:

Course Credit: (0-0-6) 3

Evaluation Scheme:

| S.No. | Examination                  | Duration      | % of Marks |
|-------|------------------------------|---------------|------------|
| 1     | Internal Assessment I        | 3hours        | 30         |
| 2     | Internal Assessment II       | 3hours        | 30         |
| 3     | End Semester                 | 6 hours       | 60         |
| 4     | Assignment/Class performance | Each semester | 10         |

Note: The best one out of two Internal Assessments will be taken into consideration.

Course: **Project Dissertation (Based on Elective)**

Course Code:

Course Credit: (0-0-18) 09

Evaluation Scheme:

| S.No. | Examination         | Duration | % of Marks |
|-------|---------------------|----------|------------|
| 1     | Internal Assessment | 2 hours  | 90         |
| 3     | End Semester        | 3 hours  | 110        |