# PhD- Animal Biochemistry
## With Minor-Animal Biotechnology

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>2nd Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Courses</strong></td>
<td><strong>Major Courses</strong></td>
</tr>
<tr>
<td>AB-711 Advanced Enzymology (2+0)</td>
<td>AB-721 Biochemistry of Biotic &amp; Abiotic Stresses (2+0)</td>
</tr>
<tr>
<td>AB-712 Advanced Molecular Biology (2+0)</td>
<td>AB-722 Current Topics in Biochemistry (2+0)</td>
</tr>
<tr>
<td>AB-713 Functional Genomics, Proteomics &amp; (2+0)</td>
<td>AB-723 Advanced techniques in Biochemistry (2+0)</td>
</tr>
<tr>
<td>Metabolomics</td>
<td>AB-724 Advanced Bioinformatics (2+0)</td>
</tr>
<tr>
<td>AB-714 Biomembranes (2+0)</td>
<td></td>
</tr>
<tr>
<td><strong>Seminar</strong></td>
<td><strong>Seminar</strong></td>
</tr>
<tr>
<td>AB-719 (1+0)</td>
<td>AB-729 (1+0)</td>
</tr>
<tr>
<td><strong>Minor Courses</strong></td>
<td><strong>Minor Courses</strong></td>
</tr>
<tr>
<td>BT-711 Gene Cloning and Expression (3+0)</td>
<td>BT-722 Advances in Animal Cell Culture (3+0)</td>
</tr>
<tr>
<td>BT-713 Advances in Reproductive Biotechnology (3+0)</td>
<td></td>
</tr>
<tr>
<td>BT-611 Fundamentals of Cell &amp; Molecular Biology (3+0)</td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Course</strong></td>
<td><strong>Supporting Course</strong></td>
</tr>
<tr>
<td>For students obtained M Sc degree from other University</td>
<td>For students obtained M Sc degree from NDRI</td>
</tr>
<tr>
<td>CS-621 Statistical packages for Statistical Computing (3+0)</td>
<td>DM-622 Microbial Genetics (2+1)</td>
</tr>
<tr>
<td><strong>Total credits</strong></td>
<td><strong>Total credit</strong></td>
</tr>
<tr>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

- **Grand total credit** = 33
- **Thesis credit** = 45

The minimum credit requirement for Doctoral degree as per requirement of Dairy Science College

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
<th>Supporting</th>
<th>Seminar</th>
<th>Thesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>06</td>
<td>03</td>
<td>02</td>
<td>45</td>
<td>75</td>
</tr>
<tr>
<td>Major Courses</td>
<td>2nd Semester</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB-711 Advanced Enzymology</td>
<td>AB-721 Biochemistry of Biotic &amp; Abiotic Stresses (2+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2+0)</td>
<td>AB-722 Current Topics in Biochemistry (2+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB-712 Advanced Molecular Biology (2+0)</td>
<td>AB-723 Advanced techniques in Biochemistry (2+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB-713 Functional Genomics, Proteomics &amp; Metabolomics (2+0)</td>
<td>AB-724 Advanced Bioinformatics (2+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB-714 Biomembranes (2+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Seminar</strong></td>
<td><strong>Seminar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB-791 (1+0)</td>
<td>AB-791 (1+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minor Courses</strong></td>
<td><strong>Minor Courses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP-711 Biotechniques in Animal Production (3+0)</td>
<td>AP-722 Advances in Reproductive Physiology (3+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP-714 Advances in Biosynthesis &amp; Secretion of milk (3+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP-614 Physiology of Animal Reproduction (3+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Course</strong></td>
<td><strong>Supporting Course</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For students obtained M Sc degree from other University</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CS-621 Statistical packages for Statistical Computing (3+0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For students obtained M Sc degree from NDRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DM-622 Microbial Genetics (2+1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total credits = 18</strong></td>
<td><strong>Total credit = 18</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Grand total credit = 33</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thesis credit = 45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The minimum credit requirement for Doctoral degree as per requirement of Dairy Science College

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
<th>Supporting</th>
<th>Seminar</th>
<th>Thesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>06</td>
<td>03</td>
<td>02</td>
<td>45</td>
<td>75</td>
</tr>
</tbody>
</table>

**PhD- Animal Biochemistry**

**With Minor-Dairy Microbiology**

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>2nd Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Courses</strong></td>
<td><strong>Major Courses</strong></td>
</tr>
<tr>
<td>AB-711 Advanced Enzymology (2+0)</td>
<td>AB-721 Biochemistry of Biotic &amp; Abiotic Stresses (2+0)</td>
</tr>
<tr>
<td>AB-712 Advanced Molecular Biology (2+0)</td>
<td>AB-722 Current Topics in Biochemistry (2+0)</td>
</tr>
<tr>
<td>AB-713 Functional Genomics, Proteomics &amp; Metabolomics (2+0)</td>
<td>AB-723 Advanced techniques in Biochemistry (2+0)</td>
</tr>
<tr>
<td>AB-714 Biomembranes (2+0)</td>
<td>AB-724 Advanced Bioinformatics (2+0)</td>
</tr>
<tr>
<td><strong>Seminar</strong></td>
<td><strong>Seminar</strong></td>
</tr>
<tr>
<td>AB-719 (1+0)</td>
<td>AB-729 (1+0)</td>
</tr>
<tr>
<td><strong>Minor Courses</strong></td>
<td><strong>Minor Courses</strong></td>
</tr>
<tr>
<td>DM-712 Advances in Microbial Genetics (3+0)</td>
<td>DM-721 Advances in Dairy and food Microbiology (3+0)</td>
</tr>
<tr>
<td>DM-612 Microbial Physiology (3+0)</td>
<td>DM-722 Mechanism of Microbial Pathogenesis (3+0)</td>
</tr>
<tr>
<td><strong>Supporting Course</strong></td>
<td><strong>Supporting Course</strong></td>
</tr>
<tr>
<td>For students obtained M Sc degree from other University</td>
<td>For students obtained M Sc degree from NDRI</td>
</tr>
<tr>
<td>CS-621 Statistical packages for Statistical Computing (3+0)</td>
<td>DM-622 Microbial Genetics (2+1)</td>
</tr>
</tbody>
</table>

**Total credits =**

| 18 |

**Grand total credit =**

| 33 |

**Thesis credit =**

| 45 |

The minimum credit requirement for Doctoral degree as per requirement of Dairy Science College

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
<th>Supporting</th>
<th>Seminar</th>
<th>Thesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>06</td>
<td>03</td>
<td>02</td>
<td>45</td>
<td>75</td>
</tr>
</tbody>
</table>
M.Sc.- Animal Biochemistry
With Minor-Animal Biotechnology

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>2nd Semester</th>
<th>3rd Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Courses</strong></td>
<td><strong>Major Courses</strong></td>
<td><strong>Non credit courses</strong></td>
</tr>
<tr>
<td>AB-611 Basic Biochemistry (3+1)</td>
<td>AB-621 Intermediary metabolism (4+0)</td>
<td>GS-601 Library and information services (0+1)</td>
</tr>
<tr>
<td>AB-612 Enzymology (2+1)</td>
<td>AB-622 Molecular Biology (3+1)</td>
<td>GS 602 Technical writing (1+1)</td>
</tr>
<tr>
<td>AB-613 Biochemical Techniques (3+1)</td>
<td>AB-623 Immunochemistry (2+1)</td>
<td>GS 603 Intellectual Property and its management in agriculture (1+0)</td>
</tr>
<tr>
<td>AB-614 Food &amp; Nutritional Biochemistry (3+0)</td>
<td>AB-624 Animal Biochemistry (3+0)</td>
<td>GS 604 Basic concepts in laboratory techniques/practices (0+1)</td>
</tr>
<tr>
<td><strong>Minor Courses</strong></td>
<td><strong>Minor Courses</strong></td>
<td><strong>Supporting Courses</strong></td>
</tr>
<tr>
<td>BT-612 Animal Cell Culture: Principles &amp; Applications (3+0)</td>
<td>ABT-623 Animal Genomics (2+1)</td>
<td>CS-621 Statistical packages for Statistical Computing (3+0)</td>
</tr>
<tr>
<td>BT-614 Reproductive Biotechnology (2+1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Courses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total credits</strong></td>
<td><strong>Total credits</strong></td>
<td><strong>Total credit</strong></td>
</tr>
<tr>
<td>20</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Grand total credit = 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thesis credit = 20</td>
<td></td>
</tr>
</tbody>
</table>

The minimum credit requirement for Master degree as per requirement of Dairy Science College

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
<th>Supporting</th>
<th>Seminar</th>
<th>Thesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>06</td>
<td>03</td>
<td>01</td>
<td>20</td>
<td>60</td>
</tr>
</tbody>
</table>

M.Sc.- Animal Biochemistry
With Minor-Animal Physiology

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>2nd Semester</th>
<th>3rd Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Courses</strong></td>
<td><strong>Major Courses</strong></td>
<td><strong>Non credit courses</strong></td>
</tr>
<tr>
<td>AB-611 Basic Biochemistry (3+1)</td>
<td>AB-621 Intermediary metabolism (4+0)</td>
<td>GS-601 Library and information services</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4
<table>
<thead>
<tr>
<th>Major Courses</th>
<th>Minor Courses</th>
<th>Supporting Courses</th>
<th>Non credit courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB-611 Basic Biochemistry (3+1)</td>
<td>AB-621 Intermediary metabolism (4+0)</td>
<td>GS-601 Library and information services (0+1)</td>
<td></td>
</tr>
<tr>
<td>AB-612 Enzymology (2+1)</td>
<td>AB-622 Molecular Biology (3+1)</td>
<td>GS 602 Technical writing (1+1)</td>
<td></td>
</tr>
<tr>
<td>AB-613 Biochemical Techniques (3+1)</td>
<td>AB-623 Immunochemistry (2+1)</td>
<td>GS 603 Intellectual Property and its management in agriculture (1+0)</td>
<td></td>
</tr>
<tr>
<td>AB-614 Food &amp; Nutritional Biochemistry (3+0)</td>
<td>AB-624 Animal Biochemistry (3+0)</td>
<td>GS 604 Basic concepts in laboratory techniques/practices (0+1)</td>
<td></td>
</tr>
</tbody>
</table>

The minimum credit requirement for Master degree as per requirement of Dairy Science College is 45 credits, with 20 credits allocated for the Thesis. The total course duration is 3 years, divided into 3 semesters:

**1st Semester**
- Major Courses
- Minor Courses
- Supporting Courses
- Non credit courses

**2nd Semester**
- Major Courses
- Minor Courses
- Supporting Courses
- Non credit courses

**3rd Semester**
- Major Courses
- Minor Courses
- Supporting Courses
- Non credit courses
<table>
<thead>
<tr>
<th>Major Courses</th>
<th>Minor Courses</th>
<th>Supporting Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS 604 Basic concepts in laboratory techniques/practices (0+1)</td>
<td>Seminar AB-691 (1+0)</td>
<td>ES 629 Design of Experiments (3+1)</td>
</tr>
<tr>
<td>DM-612 Microbial Physiology (2+1)</td>
<td>DM-622 Microbial Genetics (2+1)</td>
<td>ES 630 Statistical packages for Statistical Computing (3+0)</td>
</tr>
<tr>
<td>DM-615 Microbiology of processed foods (2+1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total credits</th>
<th>Total credits</th>
<th>Total credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>25</td>
<td>4</td>
</tr>
</tbody>
</table>

Grand total credit = 45
Thesis credit = 20

The minimum credit requirement for Master I degree as per requirement of Dairy Science College

<table>
<thead>
<tr>
<th>Major</th>
<th>Minor</th>
<th>Supporting</th>
<th>Seminar</th>
<th>Thesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>06</td>
<td>03</td>
<td>01</td>
<td>20</td>
<td>60</td>
</tr>
</tbody>
</table>
COURSE CONTENTS (BIOCHEMISTRY)

Ist Semester

AB- 611 BASIC BIOCHEMISTRY 3+1

Objectives
To provide elementary knowledge/overview of structure and functions and metabolism of biomolecules.

Theory

UNIT I
Scope and importance of biochemistry in agriculture; fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to techniques for determination of structure of biopolymers.

UNIT II
Classification, structure and function of carbohydrates, lipids, amino acids, proteins, nucleic acids and biomembranes.

UNIT III
Classification, structure, functions and mechanism of action of vitamins and hormones and enzymes. Vitamins as hormones. Principles of Bioenergetics; concepts of entropy and free energy changes related to biological process.

UNIT IV

Practical
1. Preparation of standard solutions.
2. Preparation of buffer solutions.
5. Estimation of Proteins by Lowry’s method.
6. Estimation of DNA by Diphenylamine
7. Estimation of RNA by orcinol.
8. Estimation of Ascorbic acid using dye.
9. Separation of lipids by silicic acid column chromatography.

Suggested Readings
AB-612  ENZYMEOLOGY  2+1

Theory

UNIT I
Introduction and historical perspective, Enzyme nomenclature and IUPAC classification, enzyme compartmentalization in cell organelles, isolation, and purification of enzymes, measurement of enzyme activity. ribozymes, isozymes, abzymes, restriction endonucleases.

UNIT II
Enzyme structure, enzyme specificity, active site, active site mapping, mechanism of enzyme catalysis. cofactors, coenzymes- their structure and role.

UNIT III
Enzyme kinetics, enzyme inhibition and activation, multienzyme, complexes, allosteric enzymes and their kinetics, regulation of enzyme, activity. Monod Koshland Model

UNIT IV
Isolation and purification of enzymes, Applications of enzymes in chemical and food industry, enzyme immobilization, biosensors and clinical applications of enzymes.

Practical
1. Enzyme assay by taking any model enzyme like alpha-amylase or alkaline phosphatase.
2. Isolation and purification of any model enzyme like B-galactosidase or acid phosphatase.
3. Study of the effect of enzyme and substrate concentrations and determination of Km and Vmax.
4. Determination of pH and temperature optima of alkaline phosphatase.
5. To study the effect of various inhibitors of enzymatic activity.

Suggested Readings
Objective
To impart practical knowledge about various techniques used in purification and characterization and estimation of cellular constituents.

Theory
Unit I
Spectroscopy: Principles and applications of UV, Visible, fluorescence, NMR, ESR. X-ray diffraction, mass spectrometry.

Unit II
Chromatographic Techniques: Principles and applications of chromatographic techniques viz., TLC, HPLC, GLC, ion-exchange, gel-filtration, affinity, hydrophobic interaction chromatography, metal chelate chromatography.

Unit III
Electrophoretic Techniques: Concepts in electrophoresis, PAGE, SDS-PAGE, molecular weight determination; isoelectrofocussing, 2D-PAGE, Agarose electrophoresis, Capillary Electrophoresis;

Unit IV
Principles and applications of Northern blot, Western Blot and Southern Blot: ELISA, RIA, PCR. Protein sequencing

Unit V

Practicals:
1. Determination of absorption maxima and molar extinction coefficient of p-Nitrophenol from its absorption spectrum.
2. Effect of pH and solvent polarity on absorption spectrum of p-Nitrophenol.
3. Effect of slit width on absorption spectrum.
4. Estimation of proteins using Bradford/ BCA method
5. Separation of proteins and M, Determination using SDS-PAGE.
6. Separation of Lipids using TLC
7. Separation of fatty acid methyl esters using GLC
8. Separation of proteins using gel filtration
9. Separation of proteins using Ion-exchange chromatography
10. Demonstration of HPLC for separation of Biomolecules
Objective
To impart knowledge regarding the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration.

Theory
UNIT I

UNIT II
Nutritional requirements for different age groups and physiological status, factors effecting nutritional requirements, Biochemical and nutritional aspects of vitamins, minerals. Nutraceuticals, antioxidants, food toxins, antinutritional factors, probiotics and cultured dairy products.

UNIT III
Carbohydrates with special references to nutritional importance of lactose and dietary fibers, Fats-types of fatty acids and their significance in obesity and cardiovascular diseases, role of calcium in hypertension, cancer and osteoporosis, Biological availability of calcium.

UNIT IV
Effect of cooking, processing and preservation of different food products on nutrients, Biochemical aspect of post harvest storage specifically food spoilage. Enzymes in food industry, food additives (coloring agents, preservatives etc.), biogenesis of food flavours and aroma.

Suggested Readings
Swaminathan,M.S. Essentials of Foods and Nutrition VoL-I and II
Goodhart and Shils. Modem Nutrition in Health and Diseases
Wildwan and Mederios. Advanced Human Nutrition
Martin, East wood and Edenburg. Principles of Human Nutrition
Viswanath M. Sardesai.Introduction to Clinical Nutrition
II\textsuperscript{nd} Semester

AB-621 \hspace{2pt} INTERMEDIARY METABOLISM \hspace{2pt} 4+0

Objective
To teach metabolic pathways, their regulation, and methods used in their elucidation.

Theory
UNIT I
Introduction to metabolism, methods of studying metabolism, transport mechanism, bioenergetics, biological oxidation.

UNIT II
Catabolic and anabolic pathways of carbohydrates: glycolysis, citric acid cycle, pentose phosphate pathway, glyoxylate cycle, gluconeogenesis, metabolism of glycogen.

UNIT III
Fatty acid catabolism & biosynthesis, lipid biosynthesis, Electron transport and oxidative phosphorylation.

UNIT IV

UNIT V
Compartmentation of metabolic pathways, regulation of different metabolic pathways, major metabolic disorders, Integration of metabolism, metabolic profiles of major organs, regulation of body mass, altered metabolism in starvation & diabetes mellitus

Suggested Readings
Objective
To provide knowledge regarding genes, their functions, expression, regulation and transfer in heterologous systems.

Theory
UNIT I
Historical development of molecular biology, nucleic acids as genetic material, chemistry and structure of DNA and RNA, Genome organization in prokaryotes and eukaryotes, repetitive and non-repetitive DNA, satellite DNA; chromatin structure and function.

UNIT II
DNA replication, DNA polymerases, topoisomerases, DNA ligase, reverse transcriptase, RNA polymerases, transcription process, RNA editing, RNA processing. molecular mechanism of mutation.

UNIT III
Ribosomes structure and function, organization of ribosomal proteins genetic code, aminoacyl tRNA synthases' inhibitors of replication, transcription and translation; translation and Post translational modification; nucleases and restriction enzymes, regulation of gene expression in prokaryotes and eukaryotes, translation in eukaryotes.

UNIT IV
DNA sequencing, recombinant DNA technology, vectors, isolation of genes, recombinants vector, selection of recombinants, PCR and its variants; site directed mutagenesis, in vitro transcription, gene silencing

Practical
1. Isolation and purification of DNA
2. Isolation and purification of RNA
3. Purity-check of isolated DNA and RNA
4. Restriction fragmentation of DNA and agarose gel electrophoresis
5 RAPD analysis of DNA,
6. cDNA synthesis using PCR,
7. Plasmid isolation
Objective
To give an insight into the biochemical basis of immunity.

Theory
UNIT I
History and scope of immunology, cellular basis of immunity-adaptive and non-adaptive immunity, memory, specificity and diversity, self and non self discrimination, immune system, organs, tissues and cells, cell mediated vs humoral immunity, immunoglobulins, concept of antigen, immunogen, adjuvant, hapten

UNIT II
Classes of antibodies, Antibody diversity, theories of generation of antibody diversity, Monoclonal antibodies, polyclonal antibodies, Hybridoma, Recombinant antibodies, complement system-classical and alternate.

UNIT III
Cellular interactions in the immune response, affinity, avidity, B-cell and T-cell response, major histocompatibility complex, cell mediated immune response, cytokines, Vaccine.

UNIT IV
Immunoregulation, immunological tolerance, hypersensitivity, innate resistance and specific immunity. Current immunological techniques Immunodiffusion, Immunelectrophoresis, immunofluorescence, rocket electrophoresis, fluorescence-activated cell sorter.

Practical
1. Handling, inoculation and bleeding of laboratory animals,
2. Preparation of antigens and antisera
3. Separation of lymphocytes from blood, viable lymphocyte count,
4. Phagocytosis,
5. Detection of antibody by precipitation, agglutination, immunodiffusion,
6. Immunelectrophoresis,
7. Quantitation of immunoglobulins by zinc sulphate turbidity and by ELISA,
8. Selective salt fractionation of immunoglobulins and removal of salts from precipitated immunoglobulins using dialysis.
9. Characterization of immunoglobulins by PAGE.

Suggested Readings
Abbas AK & Lichtman AH. 2003. Cellular and Molecular Immunology. 5th Ed. WB Saunders.
Ivn Roitt (Eds.) 1997. Essential Immunology Publisher -Blackwell Scientific Publication, Oxford
Van Oss. Immunochemistry
Objectives
To impart knowledge regarding biochemistry of various physiological processes, specialized tissues and hormone action in animal system.

Theory
UNIT I
Digestion and absorption of food, Vitamins, Detoxification, Biochemistry of specialized tissues—connective tissue, skin, muscle, nervous tissue, blood and other body fluids, Biochemistry of Rumen functions.

UNIT II
Water, electrolyte and acid-base balance, Biochemistry of respiration, Structure, function and mechanism of action major trace elements.

UNIT III
Hormones of hypothalamus, pituitary, thyroid, pancreas, adrenals, gut, kidney and sex hormones. Membrane receptors of hormones.

UNIT IV
Molecular mechanism of signal transduction path-ways; structure, function and regulation of production of male and female gametes; in vitro fertilization. Molecular mechanism of milk biosynthesis in mammary gland; Potent biological tissue effectors viz Eicosanoids, interleukins, interferons, bioactive peptides and growth factors.

Suggested Readings


Ph.D  
Ist Semester  

AB-711  ADVANCED ENZYMEOLOGY  2+0

Objective:
To provide advanced knowledge about the models, mechanisms, kinetics, regulation and engineering of enzymes

Unit I
Various models for enzyme action, Enzyme catalysis in terms transition state theory, Active site titration, Identification of active site residues. Factors associated with catalytic efficiency: proximity and orientation, distortion and strain

Unit II
Pre-steady state kinetics, direct measurements of enzyme rate constants, continuous and stopped flow methods, relaxation techniques (pH jump, denaturation and temperature), kinetics for regulation of enzyme activity with allosteric effectors.

Unit III
Determination of energy of activation, Arrhenius equation, eyering equation. Determination of pK_a, factors affecting pK_a value. Determination of free energy, enthalpy and entropy of enzymatic reaction.

Unit IV
Enzyme stabilization, bifunctional enzymes, enzymes from extremophiles. Enzyme catalysis in abnormal aqueous and non-aqueous environment. Enzyme engineering.

Suggested readings
2. Review articles from research journals

AB-712  ADVANCED MOLECULAR BIOLOGY  2+0

Objective
To impart latest information on the molecular biochemistry of isolation, transfer and expression of genes in plants and biochemical approaches employed in gene therapy.

Theory
UNIT I
Organization of prokaryotic genome, nuclear and organelle genes, concept of genome mapping and Organization, molecular evolution

UNIT II
Prokaryotic and Eukaryotic gene regulation, RNA editing, Molecular Biology of viruses.

UNIT III
Methods of gene isolation and transfer in animals, molecular basis of male sterility, Applications of genetic engineering.
UNIT IV
Site directed mutagenesis, gene targeting and gene therapy, bioethics and biosafety guidelines and IPR in recombinant DNA research.

Suggested Readings
Selected articles from journals.

AB-713 FUNCTIONAL GENOMICS, PROTEOMICS AND METABOLOMICS

Objective
To impart knowledge in the upcoming areas of biochemistry, and to acquaint the students with the recent developments of job opportunities in pharmaceutical and other industries.

Theory
UNIT I
Protein and nucleic acid sequencing: Various methods of sequencing including automated sequencing and microarrays, whole genome sequence, co-regulated genes
UNIT II
Comparative genomics, functional genomics, transcriptomics and transcriptional network, gene identification, application of genomics, Quantitative PCR, SAGE, Massively Parallel Signature Sequencing (MPSS), Cap Analysis of Gene Expression (CAGE)/deep CAGE, Chip-Chip assay, epigenetic regulation
UNIT III
Proteome technology- 2D-PAGE, MSMS, MALDI-TOF, and Protein-protein interaction (Hybrid assay, DNA-Protein interaction and gene regulation (EMSA and Chip assay), comparative proteomics.

UNIT IV
Metabolic pathway engineering, Metabolomic definition, Metabolic fingerprinting, Metabolomics library, Application of Metabolomics for Translational and Biological Research, Introduction to nutrigenomics and nutrigenetics,

AB- 714 BIOMEMBRANES

Objective
To teach structure and functions of biomembranes, structure-function relationships, membrane biogenesis.

Theory
UNIT I
Concept of biomembranes and their classification based on cellular organelles; physico-chemical properties of different biological and artificial membranes, cell surface receptors and antigen.
UNIT II
Membrane biogenesis and differentiation; membrane components-lipids, their distribution and organization; proteins, intrinsic and extrinsic, their arrangement; carbohydrates in membranes and their function.

UNIT III
Various membrane movements; transport across membrane and energy transduction.

UNIT IV
Role of membrane in cellular metabolism, cell recognition and cell –to –cell interaction; signal transduction, recent trends and tools in membrane research.

Suggested Readings

2nd Semester

AB-721 BIOCHEMISTRY OF Biotic And Abiotic Stresses 2+0

Theory

UNIT I
Metabolism of Xenobiotics :Classification, properties and isoforms of cytochrome P450; Phase I and Phase II reactions,

UNIT II
Oxidative stress and diseases : Biomarkers of oxidative stress , Adhesion, activation and respiratory burst by phagocytes , Molecular basis of hypertension, diabetes, obesity and cancer

UNIT III
Biochemical and genetic basis of disease: Monogenic and multifactorial disorders; Isolation of genes causing disease ; Human genome project and diseases; Protein misfolding during diseases

UNIT IV
Thermal & Cold tolerance: Molecular chaperones; Anti freeze proteins; Heat and cold adaptive enzymes ; Biochemistry of animal hibernation ; Biochemistry of cryo protection

UNIT V
Cytotoxic and genotoxic assays; Bioindicators, Biomarkers and Biosensors

Suggested Readings
Functional metabolism : Regulation and Adaptation by Kenneth B. Storey
Harper's Biochemistry 25th edition
UNIT I
Tissue Culture: Setting up a cell culture laboratory; Principles of aseptic handling; Cell line derivation; Cell freezing and quantitation; Contamination control; Cell freezing and thawings; Cell culture media constituents and their functions; Designing serum-free medium. Techniques for short-term and long-term culture of organs.

UNIT II
Enzyme–linked immunosorbent assay (ELISA: Basic principle and methodology; Classification and types of ELISA; Preparation of enzyme-immune body conjugates and their purification; ELISA versus RIA techniques for assay of hormones.

UNIT III
Hybridoma techniques: Principle of development of hybrids producing monoclonal antibodies; Fusion of myeloma cells with antibody producing B cells; Selection, screening and cloning methods; In vitro and in vivo for production of monoclonal antibodies; Purification and characterization of monoclonal antibodies.

UNIT IV
High performance liquid chromatography: Basic principle and theory. Types of pumping systems and their essential features; Column packing; Detection systems; Normal and modified stationary phases for adsorption, gel filtration and ion exchange chromatography.

UNIT V
Affinity chromatography: Basic principle and theory; matrices, spacer arms and ligands; Coupling gels; Group specific adsorbents; Preparation of different affinity media, Purification of biomolecules and applications.

UNIT VI
Radiotracer techniques: Basic principles for use of radiotracers in study of biological processes; Ionization based radiotracer techniques- Principle and historical perspectives of proportional and Gieger Muller counters; Liquid scintillation counting (LSC): Principle, Instrumentation; and technique; Double isotope counting; Scintillation cocktails and function of its constituents; Tissue solublization and sample preparation; Quenching and quinch correction; Principle of gamma ray detection

Suggested Readings:
1. Introduction to Radioimmunoassay and related techniques by T.Chard
2. Enzyme Immunoassay by Edward T.Maggio.
4. Animal Cell culture: A Practical Approach by Freshney, R.I.
6. Instrumental Methods of Analysis by Willard et al.
AB-724  ADVANCED BIOINFORMATICS  2+0

Theory

Unit I
Database Concepts, nucleic acid and protein sequence databases, Structure databases, and integration of databases,

Unit II
Genome organization, human genome, livestock and bacterial genomes

Unit III
Computational gene discovery, pair wise & multiple sequence alignments, sequence similarity search, phylogenetic analysis

Unit IV
Protein Structure analysis, Protein Secondary structure prediction, Homology modeling Principles and Procedures, Protein-protein docking.

Suggested Readings:
   S. B. Primrose and R.M. Twyman, Blackwell Publishing

   Ralph Rapley and Stuart Harbron (Eds.), John Wiley and Sons

   Andreas D. Baxevanis and B. F. Francis Ouellette(Eds.)  
   Wiley Interscience

   Richard J. Simpson, Cold Spring Harbor Laboratory

5. Online Resources over the Internet

AB-719  DOCTORAL SEMINAR I  1+0
AB-729  DOCTORAL SEMINAR II  1+0
AB-799  DOCTORAL RESEARCH