COURSES FOR M. Sc. BIOCHEMISTRY AND M. Sc. BIOTECHNOLOGY

M.Sc. Biochemistry and M. Sc. Biotechnology

Semester I

Semester II

M.Sc. BIOCHEMISTRY

Semester III

Semester IV

M.Sc. BIOTECHNOLOGY

Semester III

Semester IV

Couse Code	Course Title	Credit Hours	Page No.
IBB.458	Microbial Biotechnology	2	36
IBB.459	Environmental Biotechnology	2	36
IBB.460	Current Research Trends in Biotechnology	2	37
IBB.457	Thesis/Project Report/Internship/Special Paper	3	38
Elective Courses (any three out of Nine Courses)			
IBB.412	Advanced Immunology	2	38
IBB.416	Advanced Microbiology	2	39
IBB.421	Protein Structure, Function and Engineering	2	40
IBB.461	Agriculture Biotechnology	2	41
IBB.462	Food Biotechnology	2	42
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IBB.464	Marine Biotechnology	2	43
IBB.465	Safety Considerations for Biotechnology Processes	2	44
IBB.466	Cost Accounting, Marketing and Management	2	45
	Total Credits	15	

M. Sc. Biochemistry and M. Sc. Biotechnology

SEMESTER-I

Course Code: **IBB.301**

Course Title: **Principles of Biochemistry and Cell Biology**

Course Rating: **3 Credits**

Course Objectives

Aim of this course is to let the students know about the basic biochemical principles of living systems in a logical and coherent fashion. The course aims to develop an understanding of role of different biomolecules in the living systems and introducing students with basics of cell biology helping them understand biochemistry in the context of a cell.

Course Contents

Introduction to the science of biochemistry and nature of organic matter; properties of water and aqueous solutions; thermodynamic principles; prebiotic molecular evolution and origin of life.

Structure and function of cell organelles of prokaryotic and eukaryotic cells; biological membranes: organization and fluidity of membrane components; organization of intracellular compartments and protein sorting, junctions between cells, intracellular vesicular traffic. Mitochondria, chloroplasts and their genomes; human mitochondrial genome. Energy conversion: genetically controlled energy delivering process in mitochondria.

Cytoskeleton, motility and shape; composition and structural diversity of extracellular matrix. Cell division: mitosis, maturation division, crossing over and formation of gametes; differentiation and development; cell cycle and apoptosis.

Course Impacts

After studying this course, students will be able to appreciate the nature, chemical basis and evolution of life and will develop a better understanding of the concepts relating to interactions of biomolecules in the living systems. Students will also understand fundamental concepts of cell biology that will provide a foundation for more advance cell biology courses.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc
2. Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 5th edition (2008), Garland Science.
3. Life: The Science of Biology, W.K. Purves, G.H. Orians, 8th edition (2008), Sinauer Associates/W.H. Freeman.
4. Biology, N.A. Campbell, 9th edition (2010), Benjamin/Cummings Publishing Co. Inc.
5. The Physiology and Biochemistry of Prokaryotes, David White, 4th edition (2011), Oxford University Press.

Course Code: **IBB.302**

Course Title: **Amino Acids, Proteins and Enzymes**

Course Rating: **3 Credits**

Course Objectives

This course is designed to broaden student's outlook and deepen his/her interest in everything that concerns general and specialized roles of amino acids and protein structure evolution. In this course, the students will also be exposed briefly to certain specific areas of protein chemistry. Aim of this course is to let the students know about enzyme properties, catalytic mechanism and substrate interaction in a comprehensive and systematic way.

Course Contents

Structure, classification and properties of amino acids. Classification and functions of proteins. Primary structure of proteins; end terminus analysis; purification and sequence analysis of peptide. Secondary structure of proteins; helical and beta-structure of protein; Ramachandran hypothesis of peptide. Tertiary structure of protein; arrangement of alpha-helix and beta-pleated sheets in protein, Quaternary structure of proteins; symmetry and determination of subunit composition. Globular and fibrous proteins; structure, function and arrangement of keratin, elastin, and collagen. Structure and function of hemoglobin and myoglobin; allosteric regulation; hemoglobinpathies. Reversible binding of proteins with ligands. Protein denaturation and forces for protein stability. Structure and functions of muscle proteins (myosin and actin). Nomenclature; classification of enzymes; effect of different factors (temperature, pH, substrates etc.) on enzyme activity; enzyme specificity; co-enzymes; regulation of enzyme activity.

Course Impacts

After studying this course, students will be able to appreciate: properties and functions of amino acids, unique secondary, tertiary and quaternary structures of proteins, rapid and correct folding of proteins. The students will understand about the specificity of enzymes and their importance in catalysis of multiple dynamic processes.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 5th edition (2008), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 5th edition (2010), J.B. Lippincott Company.
4. Biochemistry, Geoffrey Zubay, 4th edition (1999), W.C. Brown Pub.
5. Harper's Illustrated Biochemistry, 29th edition (2012), McGraw-Hill Medical.
6. Biochemistry, L. Stryer, 7th edition (2012), W.H. Freeman and Co.

Course Code: **IBB.303**

Course Title: **Carbohydrates, Lipids and Membranes**

Course Rating: **2 Credits**

Course Objectives

Carbohydrates and lipids are important elements in our daily dietary intake. Aim of this course is to let the students know about structure, biochemical nature, biological functions and importance of these macromolecules in details, as well as the structure and functions of biological membranes.

Course Contents

Carbohydrate classification, structure and functions; monosaccharides; oligosaccharides; polysaccharides, sugar derivatives; structural and storage polysaccharides; other carbohydrates of biological interest; structure and function of proteoglycans and glycoproteins; carbohydrate analysis; bacterial cell wall synthesis; lipid classification; structure and functions of different types of lipids; properties of lipid aggregates; micelles; bilayers and liposomes; biological membranes; Fluid mosaic model of membrane structure; bilayer dynamics; peripheral and integral membrane proteins; glycophorin and bacteriorhodopsin; kinetics and mechanism of membrane transport; membrane assembly and protein targeting; secretory pathway; structure and functions of lipoproteins.

Course Impacts

After studying this course, students will be able to appreciate the biochemical nature and physiological significance of carbohydrates, lipids and biological membranes.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 5th edition (2008), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 5th edition (2010), J.B. Lippincott Company.
4. Biochemistry, Geoffrey Zubay, 4th edition (1999), W.C. Brown Pub.
5. Harper's Illustrated Biochemistry, 29th edition (2012), McGraw-Hill Medical.
6. Biochemistry, L. Stryer, 7th Edition (2012), W.H. Freeman and Co.

Course Code: **IBB.304**

Course Title: **Fundamentals of Immunology**

Course Rating: **2 Credits**

Course Objectives

To develop a clear understanding of the body defense mechanism is the basic objective of this course. This course also aims to provide insight as to how haematopoietic system may be considered as a target in therapy of inherited and acquired diseases of different tissues.

Course Contents

Introduction of immune system; cells of the immune system; primary secondary and tertiary organs of the immune system. Immunogenicity and antigenicity; properties of immunogens for B and T lymphocytes activation. Innate immune response; toll like receptors; signal transduction pathways in toll like receptors. Antibodies; structure, classification and functions of immunoglobulin, Genetic model of immunoglobulin; structure, mechanism and rearrangement of immunoglobulin; gene diversity of antibody. Bispecific and humanized antibodies. Pathways and regulation of complement system. Major histocompatible complexs; structure function and organization of genes. Transplantation immunology; clinical manifestation of graft acceptance and graft rejection. Hybridoma technology. Immunoglobulin as tool for diagnostic and therapeutic uses.

Course Impacts

At the end of this course, students will be able to discuss confidently the unique mechanism of body defense and its role during pathogenic and transplant conditions.

Recommended Books

1. Immunology, J. Kuby, 6th edition (2006), W.H. Freeman and Co.
2. Immunobiology - The Immune System in Health and Disease, C.A. Janeway, P. Travers, 6th edition (2004), Garland Publication Inc. New York.
3. Roitts's Essential immunology, Peter J Delvis, Seamus J Martin, Dennis R. Burton and Ivan M Roitt, 11th edition (2006), Blackwell Publishing Company.
4. Cellular and Molecular immunology, Abul K Abbas, Andrew H Lichtman, 6th edition (2007), Wlsevier company, Philadelphia, PA, USA.
5. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.

Course Code: **IBB.305**

Course Title: **Molecular Biology**

Course Rating: **3 Credits**

Course Objectives

In this course, starting from the nature of chromosomes, DNA and RNA, student will be introduced to the processes of transcription and translation along with their regulatory mechanisms. The aim is to further enhance their knowledge of molecular biology and introduce them with recent discoveries and trends in the field.

Course Contents

Chromosomes, Mendelian inheritance and DNA as a carrier of genetic information; double-helical structure of DNA; forces stabilizing nucleic acid structure; super-coiled DNA; DNA polymerase; DNA replication, general aspects and enzymes involved; prokaryotic and eukaryotic replication mechanisms; repair of DNA, recombination and mobile genetic elements; epigenetics and DNA methylation.

RNAs and their role in protein synthesis; RNA polymerase and transcription; regulation of transcription in prokaryotes; post-transcriptional processing; the genetic code; structure of transfer RNA; ribosome structure; RNA splicing; translational process, protein synthesis inhibitors; control of eukaryotic translation, post-translational modification; protein degradation; non-ribosomal polypeptide synthesis; structure and genomic organization, regulation of eukaryotic gene expression: cell differentiation; gene families. Post genome era; ethical and social considerations.

Course Impacts

This course will stimulate the intellectual abilities of the students. After studying the course, students will be able to appreciate the structure and role of DNA as a carrier of genetic information. They will understand the role of RNA in protein synthesis and will conceptualize the regulation of eukaryotic gene expression as the underlying mechanism responsible for phenotypic representation.

Recommended Books

1. Biochemistry, D. Voet, J. G. Voet, 4th edition (2011), John Wiley and Sons, New York.
2. Molecular Biology of the Cell, B. Albert, D. Bray, 5th edition (2008), Garland Publishing Inc. New York.
3. Molecular Biology, Robert F. Weaver, 5th edition (2011), McGraw-Hill Science.
4. Molecular Biology of the Gene, James D. Watson, 6th edition (2003), Cold Spring Harbor Laboratory Press.
5. Molecular Cell Biology, Lodish H, Berk A, Zipursky S L, Matsudaira P, Baltimore D, Darnell J, 6th edition (2007), W.H Freeman and Company.

Course Code: **IBB.306**

Course Title: **Recombinant DNA Technology**

Course Rating: **2 Credits**

Course Objectives

This course is designed to distill in comprehensible way, the mysteries of recombinant DNA technology and its role in biotechnology. This course aims to let the students know about contribution of recombinant DNA technology to our understanding of gene function, biological processes and human genetics. In this course, nucleic acid sequencing, DNA cloning methods, site directed mutagenesis, PCR, and other related techniques will be discussed in detail.

Course Contents

Introduction and potential of recombinant DNA technology; Nucleic acid fractionation, DNA sequencing methods including next generation sequencing; chemical synthesis of oligonucleotides; Southern and Northern blotting; PCR, RT-PCR, inverse PCR; site directed mutagenesis; restriction fragment length polymorphism and genotyping; microarray; chip technology. Outline of DNA cloning experiment; cloning vectors including plasmids, bacteriophages, cosmids, YAC vectors; shuttle and expression vectors; genomic libraries; screening methods of gene libraries; tumor induction (Ti)

plasmids; production of recombinant proteins; tissue culture techniques; transgenic organisms and gene therapies.

Course Impacts

Studying this course, students will be able to appreciate the principal advancements that have been made in the field of recombinant DNA technology along with their possible socio economic implications.

Recommended Books

1. Biochemistry, D. Voet, J. G. Voet, 4th edition (2011), John Wiley and Sons, New York.
2. Molecular Biology of the Cell, B. Albert, D. Bray, 5th edition (2008), Garland Publishing Inc. New York.
3. Molecular Biology, Robert F. Weaver, 5th edition (2011), McGraw-Hill Science.
4. Gene Cloning and Manipulation, Christopher Howe, 2nd edition (2007), Cambridge University Press.
5. Principles of gene manipulation, Sandy B Primrose, Richard M Twyman and Robert W Old. 6th edition (2002), John Wiley & Sons.
6. From Genes to Genomes: Concepts and Applications of DNA Technology. Jeremy W Dale and Malcom von Schantz, 2nd edition (2007), John Wiley & Sons, Ltd.
7. The Physiology and Biochemistry of Prokaryotes, David White, 4th (2011), Oxford University Press.

Course Code: **IBB.307**

Course Title: **Lab I: Carbohydrates, Lipids and Proteins**

Course Rating: **2 Credits**

Course Objectives

This course is designed to make the student able to turn over the abstract knowledge to practical purposes. This course emphasizes the isolation, estimation and characterization of different biological samples and study of some properties of amino acids, proteins, sugars, lipids and nucleic acids. The course shall include extraction, fractionation and characterization of these biomolecules.

Course Contents

Introduction to laboratory instrumentation; use and working of routine instruments; qualitative and quantitative estimation of carbohydrates; isolation and assay of glycogen; enzymatic and acid hydrolysis of glycogen; qualitative tests for lipids; determination of acid, saponification and iodine value of fats; estimation of blood cholesterol; assessment of lipid soluble vitamins; fractionation of brain lipids; titration and separation of amino acids; isolation of protein from biological samples; quantitative analysis of protein by UV, Dye binding, Lowry method etc.; isolation of DNA, RNA and their estimation.

Course Impacts

At the end of this course, students will be able to learn basic practices carried out in a biochemistry laboratory. Students would not only be able to carry out quantitative analysis of biological macromolecules in the laboratory independently but would also be in a position to interpret the experimental data more effectively.

Recommended Books

1. An Introduction to Practical Biochemistry, D.T. Plummer, 3rd edition (1987), McGraw-Hill Book Co.
2. Modern Experimental Biochemistry, Boyer, R. (2007), Pearson Education, Inc
3. The Basic Protein & Peptide Protocols, J.M. Walker (1994), Humana Press.

Course Code: **IBB.308**

Course Title: **Lab II: Molecular Biology**

Course Rating: **2 Credits**

Course Objectives

Objective of this course is to emphasis the practical applications of the principles learnt in course 505 and 506.IBB.

Course Contents

Isolation and characterization of DNA and RNA from bacteria, human blood, tissues; basic techniques in molecular biology like native and agarose gel electrophoresis, Southern and Northern blotting, Primer designing and PCR, RT-PCR amplification, DNA sequencing, DNA finger printing, RFLP, In vitro transcription and translation using reticulocyte lysate.

Miniproject to clone a specific gene in *E. coli*; plasmid mini/maxipreparation, restriction digestion, ligation, cloning in expression host; study of lac operon model and its inducers.

Course Impacts

After studying this lab course, students would develop a clear and better understanding of the mysteries of recombinant DNA technology and will be able to clone and detect the selected genes in *E. coli*.

Recommended Books

1. Short Protocols in Molecular Biology, A. Ausubel, R. Brent, 5th edition (2002), John Wiley and Sons.
2. Joseph Sambrook and David W. Russell (2012), 4th edition, Molecular Cloning A laboratory Manual, Cold Spring Harbor laboratory Press.
3. Gene Cloning and Manipulation, Christopher Howe, 2nd edition (2007), Cambridge University Press.
4. From Genes to Genomes: Concepts and Applications of DNA Technology. Jeremy W Dale and Malcom von Schantz, 2nd edition (2007), John Wiley & Sons, Ltd.

M. Sc. Biochemistry and M. Sc. Biotechnology

SEMESTER-II

Course Code: IBB.309

Course Title: Carbohydrate and Lipid Metabolism

Course Rating: 2 Credits

Course Objectives

This course aims to cover the thermodynamics, bioenergetics and intermediary metabolism of carbohydrates, and to enable the students to learn the key concepts about the biosynthesis, metabolism and regulation of lipids. This course will also cover certain specific areas related to disorders of metabolic pathways.

Course Contents

Experimental study of metabolic pathways; role of ATP and other high energy compounds; glycolytic pathway and its significance; fermentation; metabolism of hexoses other than glucose; glycogen metabolism and regulation, citric acid cycle and its regulation; mechanism of electron transport chain; oxidative phosphorylation and regulation of ATP production; gluconeogenesis; glyoxylate pathway; biosynthesis of oligosaccharides and glycoproteins; mechanism and regulation of pentose phosphate pathway; mechanism of light reactions and dark reactions in photosynthesis.

Lipid digestion, absorption and transport; fatty acid oxidation; ketone bodies; fatty acid and triglyceride synthesis; biosynthesis, transport and utilization of cholesterol; prostaglandins, prostacyclines, thromboxanes and leukotrienes; phospholipid and glycolipid metabolism.

Course Impacts

Students will be able to appreciate the bioenergetics, regulation and clinical aspects of carbohydrate and lipid metabolism.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 5th edition (2008), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 5th edition (2010), J.B. Lippincott Company.
4. Biochemistry, Geoffrey Zubay, 4th edition (1999), W.C. Brown Pub.
5. Harper's Illustrated Biochemistry, 29th edition (2012), McGraw-Hill Medical.
6. Biochemistry, L. Stryer, 7th Edition (2012), W.H. Freeman and Co.

Course Code: **IBB.310**

Course Title: **Amino Acid and Nucleic Acid Metabolism**

Course Rating: **2 Credits**

Course Objectives

To enable the students to keep the key concepts about the biosynthesis, metabolsim and regulation of proteins and nucleic acids is main objective of this course. This course will also cover certain specific areas related to disorders of metabolic pathways.

Course Contents

Amino acid deamination mechanisms; urea cycle and its regulation; metabolism of essential and non-essential amino acids; amino acids as biosynthetic precursors; nitrogen fixation.

Chemical nature and synthesis of purine and pyrimidine ribonucleotides; formation of deoxyribonucleotides; nucleotide degradation; synthesis of nucleotide coenzymes; integration and organ specialization of energy metabolism; controls and disorders of metabolic pathways.

Course Impacts

Students will be able to describe and explain the metabolic processes of nitrogenous macromolecules in detail.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 5th edition (2008), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 5th edition (2010), J.B. Lippincott Company.
4. Harper's Illustrated Biochemistry, 29th edition (2012), McGraw-Hill Medical.
5. Biochemistry, L. Stryer, 7th Edition (2012), W.H. Freeman and Co.

Course Code: **IBB.311**

Course Title: **Microbiology**

Course Rating: **3 Credits**

Course Objectives

This course is designed to give an extensive knowledge of classification and identification of microbes, their role in daily life, interaction of microbes with other forms of life and microbiology and public health. The course will also cover principles of virology and emergences of new viruses.

Course Contents

Basic concepts of microbiology; classification and properties of microorganisms; morphology and anatomy of bacteria; reproduction and growth of bacteria; bacterial recombination; transformation and transduction; growth under extreme environments; archaebacteria. Structure, replication and

characteristics of viruses; structure and biology of tobacco mosaic virus; spherical viruses; bacteriophages; RNA and DNA viruses.

Bacterial diseases of humans; airborne, foodborne, waterborne, soil borne and anthropo borne, sexually transmitted, contact and miscellaneous bacterial diseases; viral diseases; HCV; poliomyelitis, pneumotropic, dermotropic, viscerotropic and neurotropic diseases; fungal diseases of humans; control of microorganisms; physical and chemical control; chemotherapeutic agents and antibiotics; susceptibility testing; bacterial testing.

Course Impacts

At the end of this course the student will be familiarized with the microorganisms, their different types and classifications, microbial interaction with air, water, soil and food. The student will be able to explain the principles of virology and different types of new viruses.

Recommended Books

1. The Physiology and Biochemistry of Prokaryotes, David White, 4th edition (2011), Oxford University Press.
2. Microbial Models of Molecular Biology, Rowland H. Davis, (2003), Oxford University Press.
3. Principles of Virology, Flint et al., 2nd edition (2004), American Society for Microbiology.
4. Microbiology, Principles and Exploration, J. G. Black, 6th edition (2005) John Wiley and Sons.
5. Fundamentals of Microbiology, E. Alcamo, 9th edition (2011). The Benjamin-Cummings Publishing Co.

Course Code: **IBB.312**

Course Title: **Physical Techniques**

Course Rating: **2 Credits**

Course Objectives

This course is an attempt to introduce student with latest trends in the field of biological science research techniques. Students will learn about chromatographic, spectroscopic and electrophoretic techniques.

Course Contents

General methods for isolation, fractionation and characterization of proteins and nucleic acids; physical and chemical methods for cell lysis, homogenization, sonication, french press; dialysis; ultrafiltration; lyophilization, centrifugation; adsorption, partition, ion-exchange, hydrophobic, gas, affinity and two dimensional chromatography; chromatofocussing; HPLC; FPLC; native and SDS-PAGE; 2D-PAGE, isoelectric focusing; agarose gel electrophoresis; immunoelectrophoresis; capillary electrophoresis; immunoblotting; spectrophotometry; mass spectrometry, MALDI-TOF, LC-MS; probes for protein identification.

Visible, UV, IR, mass, fluorescence, NMR spectroscopy; atomic absorption spectroscopy; flame photometry; scattering circular dichroism, optical rotatory dispersion; X-ray diffraction; electron microscopy; fluorescence microscopy including confocal laser microscopy and super-resolution microscopy.

Course Impacts

Successful completion of this course will update students understanding of the principles and applications of latest techniques used to study biomolecules. The course will enable students to comprehend the life science literature and better design their own research projects.

Recommended Books

1. Biochemistry, Donald Voet, Judith G. Voet. (2011), John Wiley & Sons, INC.
2. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.
3. A Biological Guide to Principles and Techniques of Practical Biochemistry, K.Wilson, K.H. Goulding, 3rd edition (1991), ELBS.
4. Protein Methods, D.M. Bollag, M. D. Rozycki, S.J. Edelstein, 2nd edition (1996), Wiley- Liss.
5. Fundamentals of Light Microscopy and Electronic Imaging, Douglas B. Murphy, Michael W. Davidson, 2nd edition (2012), Wiley-Blackwell

Course Code: **IBB.313**

Course Title: **Bioinformatics**

Course Rating: **2 Credits**

Course Objectives

Individuals with skills in bioinformatics are, today, keenly sought by biotechnology industry and academia to derive forward research and development in many areas of biology. Aim of this course is to provide up-to-date biological information and use of computer methods/databases for the generation, storage, analysis and interpretation of this information, to the students.

Course Contents

Introduction to bioinformatics: basic principles of computing and bioinformatics; collecting and storing sequence data in laboratory; alignment of pairs of sequences and multiple sequence alignments; phylogenetic analysis of homologous sequences; database searches for similar sequences; structural bioinformatics; predicting secondary structure from protein sequences; gene prediction; proteomics data analysis; bioinformatics in pharmaceutical industry.

Course Impacts

After studying this course, students will be able to appreciate the enormous contribution of bioinformatics in the studies of biological diversity, evolution etc. and they would be in a position to use various computer databases which have allowed the generation, storage and analysis of biological data required to study complex biological problems, independently.

Recommended Books

1. Bioinformatics - Databases and Systems, S.I. Letovsky, (1999), Kluwer Academic Publishers.
2. Bioinformatics for Dummies, Jean-Michel Claverie and Cedric Notredame, 2nd edition (2007), Wiley Publishing Inc.

Course Code: **IBB.314**

Course Title: **Enzymology**

Course Rating: **2 Credits**

Course Objectives

Essentially, all biochemical reactions are enzyme catalyzed. The course will give students a solid foundation in principles and recent advances in enzymology. The course will also introduce the understanding of the kinetics, structure and mechanism of action of different enzymes. Their applications in various fields of life will also be studied.

Course Contents

Chemical and enzyme kinetics; Michaelis-Menten equation and its significance; effect of activators, inhibitors, temperature, and pH on enzyme activity; bisubstrate reactions. General catalytic mechanism of enzymes. Catalytic activity; specificity of various enzymes such as lysozymes, serine proteases (trypsin, chmotrypsin and elastase), carbonic anhydrases, restriction enzymes, nucleoside monophosphatase kinase, lactate dehydrogenase, phosphorylase; enzyme immobilization; Application of enzymes in paper, food and beverages industry.

Course Impacts

Students will be able: to appreciate the specificity of enzymes and their importance in catalysis of multiple dynamic processes, to discuss the structures, kinetics, modes of actions and regulation of biological catalysts (enzymes) more confidently to understand the structure and mechanism of action of different enzymes and their significance as biological tools in industries and clinical diagnosis.

Recommended Books

1. The Structure and Function of Enzymes, Colin Hayden Wynn (2003), Stanley Blackburn.
2. Biochemistry, D. Voet, J.G. Voet, 4th edition (2011), John Wiley and Sons Inc.
3. Biochemistry, L. Stryer, 7th edition (2012), W.H. Freeman and Co.
4. Harper's Illustrated Biochemistry, 29th edition (2012), McGraw-Hill Medical.
5. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 5th edition (2010), J.B. Lippincott Company.

Course Code:: **IBB.315**

Course Title: **Lab III: Cell Fractionation, Enzymology and Metabolism**

Course Rating: **2 Credits**

Course Objectives

This course is designed to familiarize the students with different centrifugation techniques used for the fractionation of biological compounds. This course will also give practical understanding about enzyme assays, purification and is kinetic studies.

Course Contents

Differential and density gradient centrifugation for fractionation of biological molecules and cellular components.

Isolation of enzymes, their purification and characterization (peroxidase, cellulase etc). To study the physical parameter such as effect of pH, temperature and shelf life on enzyme activity. Kinetic analysis of enzymes and effect of inhibitors on enzyme activity, immobilization.

Isolation and characterization of erythrocyte membrane; effects of different agents on permeability of membrane; analysis of amino acids, lipids and carbohydrates by various techniques such as thin layer chromatography, paper chromatography and HPLC.

Course Impacts

Students will be able to isolate and characterize the various important biomolecules independently. This knowledge will advocate the practical aspects of the students.

Recommended Books

1. Modern experimental biochemistry, Boyer, R. (2007), Pearson Education, Inc
2. Experimental Biochemistry, Rao B.S. (2007), I.K. International Pvt. Ltd.
3. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.
4. Protein Methods, D.M. Bollag, M. D. Rozycki, S.J. Edelstein, 2nd edition (1996), Wiley- Liss.

Course Code: **IBB.316**

Course Title: **Lab IV: Physical Techniques and Microbiology**

Course Rating: **2 Credits**

Course Objectives

This course is designed to equip the students with techniques used for analysis of biomolecules and microbiological techniques. Students will be able to get expertise in various experimental approaches and methods used in biochemistry and microbiology.

Course Contents

Protein isolation, centrifugation, lyophilization. Chromatographic techniques; gel filtration chromatography, ion exchange chromatography, affinity chromatography. Gel electrophoresis, HPLC, Microscopy; Dialysis; ELISA and immunoblotting.

Microbiology laboratory safety rules; bacterial and fungal cultivation, isolation techniques for microbes (gram +ve and gram -ve), staining techniques; pure culture techniques; identification and counting of microorganisms; anti-microbial sensitivity testing; bacterial mutagenicity assays; bacterial growth curves.

Course Impacts

Students will be able to understand the importance of various biochemical and microbiological laboratory techniques. The course will augment the skills of students and they will be able to discuss the principles and applications of variety of techniques used in biochemistry and biotechnology.

Recommended Books

1. Modern experimental biochemistry, Boyer, R. (2007), Pearson Education, Inc.
2. Experimental Biochemistry, Rao B.S. (2007), I.K. International Pvt. Ltd.
3. A manual for biochemistry protocols, Wenk M.R. & Fernandis, A.Z. (2007). World Scientific Publishing Co. Pte. Ltd.
4. Applied Microbiology Laboratory Manual, Duncan, F. (2005), Academic Press.
5. Laboratory exercises in Microbiology, Prescott H. (2002), The McGraw–Hill Companies.

M. Sc. Biochemistry

SEMESTER-III

Course Code: **IBB.401**

Course Title: **Molecular Physiology**

Course Rating: **3 Credits**

Course Objectives

This course is designed to enhance the understanding of the etiology and pathology of various human diseases like hypertension, atherosclerosis, angina, aneurysms, uremia, etc. This would help the student to identify novel strategies to prevent the diseases. In this course students will also learn each and everything regarding molecular basis of the functions of various body organs.

Course Contents

Cell physiology: membrane transport, resting membrane potential and action potential, synaptic transmission, muscle contraction. Neurophysiology: autonomic nervous system, sensory systems including cutaneous, audition, vision, taste and olfaction, spinal reflexes, motor control system, sleep and consciousness. Cardiovascular physiology: blood vessels, heart, cardiac disturbances, cardio dynamics, control of the cardiovascular system, responses to stress. Blood cells, blood clotting, blood groups, haemostatis and blood clotting. Respiratory physiology: respiratory mechanics, gas transport, respiratory control, hypoxia. Renal physiology: glomerular and tubular functions, reabsorption and secretion, acid-base and fluid balance, gastrointestinal physiology. Endocrine physiology: chemistry, function, control and major abnormalities of pituitary, thyroid, adrenal, endocrine pancreas, parathyroid, sex and GEP hormones.

Course Impacts

After studying the course, students will be able to reveal the fundamental causes and mechanisms of diseases and to suggest rational treatments of diseases.

Recommended Books

1. Human Physiology – from Cells to Systems, Lauralee Sherwood, 4th edition (2004), Brooks/Cole Publishing Co.
2. Review of Medical Physiology, W.F. Ganong, 22nd edition (2005), McGraw-Hill Medical.
3. Medical Physiology: A Cellular and Molecular Approach, 2nd Revised edition (2008), Saunders.

Course Code: **IBB.402**

Course Title: **Clinical Biochemistry**

Course Rating: **2 Credits**

Course Objectives

This course is designed to give an overall picture about the molecular basis of diseases and use of biochemical approaches in diagnosis and therapy.

Course Contents

Interpretation of test results; investigation of renal, water, electrolyte disorders, hydrogen ion disturbances and blood gases; investigation of endocrine disorders: hypothalamus, pituitary, adrenal, gonadal and thyroid functions; investigation of disorders of calcium metabolism, carbohydrate metabolism; investigation of suspected hyperlipidemia and malabsorption, liver diseases. Plasma enzymes in diagnosis; clinical chemistry of new born; inborn errors of metabolism; investigation of disorders of purine and urate metabolism, heme pigments, iron metabolism, suspected porphyria; procedures for analysis of CSF and urine; drug monitoring; toxicology. Clinical significance of enzyme inhibition.

Course Impacts

At the end of this course, students will be able to identify targets for therapeutic interventions and novel strategies to prevent the diseases.

Recommended Books

1. Biochemistry for Medical Sciences, S.J.Higgins, A.J. Turner. E.J. Wood, (1994), Longman Scientific and Technical Harlow.
2. Tietz Fundamentals of Clinical Chemistry, C.A. Burtis, E.R. Ashwood, 6th edition (2008), Saunders.
3. Clinical Chemistry, Principles Procedures, Correlations, Michael L. Bishop 5th edition, (2005), Lippincott, Williams & Wilkins

Course Code: **IBB.403**

Course Title: **Biostatistics**

Course Rating: **2 Credits**

Course Objectives

Statistical methods are widely used in biology for measurement of living organisms like plants, animals and human beings. In this course, students will learn as to how statistical methods enable us to analyze the experimental results, to test their significance, to explain the resemblance and differences amongst organisms and to check the effectiveness of different treatments and medicines. Students will also be able to present the facts in a definite form and to simplify the complexities in any experimental data.

Course Contents

Samples and populations. Accuracy and precision of data. Frequency distributions. The handling of data. Descriptive statistics; the arithmetic mean, other means; the median; the mode; the range; the standard deviation; the coefficient of variation. Introduction to probability distributions; the poisson and binomial distributions. The normal probability distribution. Estimation and hypothesis testing; distribution and variance of means and other statistics; confidence limits; student's distribution; the chi-square distribution; tests of simple hypothesis employing the distribution. Introduction to ANOVA. Regression; models in regression; linear regression; tests of significance in regression; uses of regression. Correlation and regression; significance tests in correlation; applications of correlation. Case studies and problem solving for all topics.

Course Impacts

Students will be able to appreciate the role of statistical methods in simplifying the complexities of any experimental data.

Recommended Books

1. Statistics with applications to the Biological and Health Sciences, R.D. Remington, M.A. Schork, 3rd edition (2000), Prentice Hall, Inc.
2. Primer of Biostatistics, Stanton A. Glantz, 7th edition (2011), McGraw-Hill Co.
3. Fundamentals of Biostatistics, Bernard Rosner, 7th edition (2011), Thomson Learning.

Course Code: **IBB.404**

Course Title: **Skills Enhancement**

Course Rating: **2 Credits**

Course Objectives

This course is designed to train the students in the survey of primary literature in a particular research area and develop their skills for delivering oral and poster presentations of their findings.

Course Contents

Students will be allotted research project in the beginning of third semester. They will prepare an extensive review in the subject area. Evaluation will be based on the quality of the review, oral presentation and comprehension of the subject and it will be done before the commencement of third semester.

A variety of activities including seminars on assigned topics, written assays, presentation of reviews of research publications, etc. shall also be undertaken throughout the semester. The exact details of the activities will be described by the Faculty from time to time accordingly.

Course Impacts

At the end of this course, students will be well equipped to judge others' work and to decide the appropriateness of their own methodological choices for future research.

Recommended Books

1. Preparing Scientific Illustrations - A guide to Better poster presentations and publications, M.H. Briscoe, 2nd edition (1996), Springer, New York.
2. Resource - Based Learning, S. Boowa, B.Smith, (1996), Kojan page, London.

Course Code: **IBB.405**

Course Title: **Lab V: Clinical Biochemistry**

Course Rating: **2 Credits**

Course Objectives

This course is designed to make the students understand the various principles and methods employed for the estimation of fatty acids, vitamins, mineral constituents and cooking losses of food, as well as the routine clinical tests carried out in a biochemistry lab. This course also aims to enable the students to learn the principles of advanced techniques like RIA and ELISA.

Course Contents

SI units and inter conversion of SI units and conventional units of chemistry tests. Determination of glucose in serum; Renal profile: creatinine level, uric acid and urea; liver function tests; bilirubin and serum proteins; lipid profile: triglycerides, LDL and HDL; cardiac enzymes; complete blood count and hematology tests; determination of hormones by ELISA; thyroid profile by radioimmunoassay; and chemiluminiscence techniques, pregnancy test; determination of drugs and poisons by HPLC. Determination of vitamin D in serum. Tumour markers like AFP, CEA, CA-125 and PSA. Screening of metabolic disorders of amino acid metabolism by paper chromatography e.g. PKU, Cysteimuria, Homocystein urea, Maple syrup urine disease, Albinism.

Isoenzyms of LDH,CK, AST, ALP, their separation by PAGE and their clinical significance.

Course Impacts

At the end of this lab. course, students would be able to determine the energy values, cooking losses, vitamins and minerals constituents of food more accurately and precisely. Students will also be able to appreciate the use of various biochemical laboratory tests/ techniques as an integral component of diagnosis and prognosis.

Recommended Books

1. Nutritional Biochemistry, T. Brody, (1994), Academic Press
2. Harlow ED, David L., Antibodies - A laboratory Manual, (1988), Cold Spring Harbor laboratory Press.
3. The Protein Protocols Handbook, J.M. Walker (1996), Humana Press.
4. Clinical Chemistry: Techniques, Principles, Correlations, Michael L. Bishop, Edward P. Fody, Larry E. Schoeff, 7th edition (2012), Lippincott Williams & Wilkins
5. Varley's Clinical Biochemistry, 6th edition (2006), CBS Publishers

Course Code: **IBB.406**

Course Title: **Lab VI: Biochemical analysis by Immunological Techniques**

Course Rating: **2 Credits**

Course Objectives

This course aims to enable the students to learn the principles of advanced immunological techniques for the analysis of important biomolecules by immunochemical techniques. Immunoassays will be conducted to analyze the various kinds of antigens in different samples such as bacteria, plant, animals and human beings cells and body fluids. The monospecificity of immunoglobulins will be checked by western blot analysis

Course Contents

Enzyme-linked immunosorbent assay (ELISA) such as (direct antibody ELISA, direct antigen ELISA, indirect ELISA, sandwich ELISA), immunodotblot, immunodiffusion and immunoelectrophoresis techniques, Ouchterlony analysis, radioimmunoassay, western blot analysis, immunofluorescent techniques.

Course Impacts

Students will be able to appreciate the use of various biochemical laboratory tests/ techniques as an integral component of diagnosis and prognosis.

Recommended Books

1. Harlow ED, David L., Antibodies - A laboratory Manual, (1988), Cold Spring Harbor laboratory Press.
2. Methods for protein analysis, R.A. Copeland, (1994), Chapman and Hall.
3. The Basic Protein and Peptide Protocols, J.M. Walker (1994), Humana Press.
4. The Protein Protocols Handbook, J.M. Walker (2009), Humana Press.
5. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.

Course Code: **IBB407**

Course Title: **Thesis/ Project Report/ Internship/ Special paper**

Course Rating: **3 Credits**

Course Description

The students will undertake experimental work on the topic of research allotted and submit a thesis by the end of fourth semester which will be evaluated on the basis of experimental results obtained, quality of manuscript and a viva voce examination.

M. Sc. Biochemistry

SEMESTER-IV

Course Code: **IBB.408**

Course Title: **Biochemical Communication**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to impart an appreciation for the varied nature of endocrine system, neurotransmission and related regulators. In this course, students will learn about biosynthesis, modification, mode of action, feed back control and clinical applications of different hormones, neurotransmitters and other regulators.

Course Contents

Biochemical regulation mechanisms; hormone receptor action; agonist and antagonist; steroid and peptide hormones and their receptors; metabolism, biological functions and clinical aspects of pancreatic, pituitary and other hormones; radioimmunoassay.

Neurotranmission, neurones and nerve conduction, role of acetylcholine and other neurotransmitters. Senile dementia, Alzheimer and other neurological disorders.

Course Impacts

The students will be able to understand how hormones, neurotransmitters and other regulators work intracellularly, what is their mode of action to regulate the expression of specific genes and what are the biological bases of certain hormonal and neurological disorders.

Recommended Books

1. The Biochemistry of Cell Signaling, Ernst J. M. Helmreich, (2001), Oxford University Press.
2. Signal Transduction, B.D. Gomperts, I. M. Kramer and P.E.R. Tatham (2002), Academic Press.

Course Code: **IBB.409**

Course Title: **Pharmaceutical Chemistry**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to impart an understanding of design and development of pharmaceutical agents, metabolites and the applications of the biochemical and biotechnological to the continuous innovations for safer and effective substitutes.

Course Contents

Origin and development of the drugs by design; discovery of the lead compounds and their transformation to more efficacious and safer analogues. Correlation between structure and

pharmacological activity; pH and pKa values and solubility and pharmacological activity. Structure-activity relationships (SAR); Quantitative structure activity relationship (QSAR); stereochemistry and pharmacological activity; bioisosterism. Computer aided drug design (CADD); drug delivery and pharmacokinetics; drugs effecting biological membranes, drugs and enzymes; drugs acting on receptors and messengers; drugs targeting the nucleic acids, complexing and chelating pharmaceutical agents; anti cancer drugs; nano drugs and gene therapeutics.

Course Impacts

At the end of this course, students will be able to explain molecular, pharmacological, technological and clinical aspects of various biopharmaceuticals.

Recommended Books

1. Advanced technologies in biopharmaceuticals. Roshni L et al. (2007). Wiley-Blackwell.
2. Biopharmaceuticals: biochemistry and biotechnology. Gary Walsh. 2nd edition (2003). John Wiley & Sons.
3. Biopharmaceutical drug design and development. Susanna Wu-Pong and Yongyut Rojanasakul. 2nd edition (2008). Humana Press.
4. Foye's Principals of Medicinal Chemistry, D.A Williams et al., 5th edition(2002) Lippincott Williams and Wilkins.

Course Code: **IBB.410**

Course Title: **Current Research Trends in Biochemistry**

Course Rating: **2 Credits**

Course Objectives

This course aims at offering insights into front-line research being carried out in Biochemistry throughout the world. Students shall also be introduced to topics such as signal transduction, cell communication and metabolic regulation, disease processes and cell injury, structure, function and dynamics of specialized proteins, mitogenesis, oncogenesis etc. so as to extend their knowledge of molecular biology, medical and clinical biochemistry.

Course Contents

Topics included in the course would be those which although considered important but could not be covered in any other course.

Course contents will be based on reviews and research publications and the contents will be determined by the faculty from time to time.

Course Impacts

At the end of this course, students will know the latest developments in the areas of biochemistry.

Recommended Books:

Current literature, Journals in the subject

Course Code: **IBB.407**

Course Title: **Research Thesis/Project Report/ Internship/Special Paper**

Course Rating: **3 Credits**

Course Description

The students will undertake experimental work on the topic of research allotted during the third semester and submit a thesis by the end of fourth semester which will be evaluated on the basis of experimental results obtained, quality of manuscript and a viva voce examination.

Elective Courses

Course Code: **IBB.411**

Course Title: **Nutritional Biochemistry**

Course Rating: **2 Credits**

Course Objectives:

In third world countries disease prevalence is significantly associated with improper intake of diet in one or other way. In this context, a common person is bombarded with conflicting advises. The aim of this course is to develop clear understanding of the balance diet and its role in growth, development and diseases.

Course Contents:

Energy value of food chemicals; energy and protein metabolism, composition of macronutrients in diet; assessment of malnutrition; recommended dietary allowances; fat-soluble vitamins; energy releasing; hematopoietic and other water soluble vitamins; macro minerals and trace minerals in the diet. Assessment of nutritional status in clinical practice, cooking and wastage; food infections and natural food toxins, role of nutrition in growth, development, disease and dental health. Nutritional disorders.

Course Impacts

Students will be able to know the qualitative and quantitative requirements of the diet necessary to maintain good health.

Recommended Books

1. Nutritional Biochemistry, T. Brody, (1994), Academic Press
2. Human Nutrition and Dietetics, J.S. Garron, W.P.T.James, 9th Edition (1998), Churchill Livingstone
3. Understanding Clinical Nutrition, C.B. Catalodo, 2nd edition (1998), Wadsworth Publication Co.
4. Lipids: Categories, Biological Function and Metabolism, nutritional and health,
5. Paige L. Gilmore (2009), Nova Science Publishers, Inc.

Course Code: IBB.412

Course Title: Advanced Immunology

Course Rating: 2 Credits

Course Objectives

The course covers central topics in immunology for students who already have a basic knowledge of immunology. The aim is to provide in depth knowledge of selected topics in immunology.

Course contents

Lymphocyte development and expression of antigen receptors (BCR/TCR). Antigen recognition in adaptive and innate immunity. Cell adhesion; role in lymphocyte recirculation, trafficking, and microenvironment specific homing. NK recognition receptors. Antigen processing and presentation. Advances in understanding inflammatory disease. Tumor immunology. New and emerging immune therapies. Principles of vaccinology and application. Immune Response to pathogens; new concepts in the pathogenesis of asthma, immunotherapeutic, cytokines and cytokines based therapies, autoimmunity and hypersensitivities. Signaling pathways in the immune response; MAP kinase pathway, Akt cell signaling, inflammatory response pathway, integrin cell signaling, interferon (IFN) cell signaling, JAK-STAT cell signaling, Toll-like receptor (TLR) cell signaling.

Course Impacts

At the end of this course, students will be able to describe and explain the advanced topics of immunology.

Recommended Books

1. Cellular and Molecular Immunology, Abbas, Abul K., and Andrew Lichtman.. 6th edition. Philadelphia, PA: Saunders, 2005.
2. Immunobiology: The Immune System in Health and Disease, Janeway, Charles A., et al.. New York, NY: Garland Science, 2004.
3. Case Studies in Immunology: A Clinical Companion, Rosen, Fred, and Raif Geha.. 4th edition. New York, NY: Garland Pub., 2004
4. Immunology, J. Kuby, 6th edition (2006), W. H. Freeman and Co.

Course Code: IBB.413

Course Title: Genetics

Course Rating: 2 Credits

Course Objectives

This course will cover the general and specified areas of genetics. Students will also be exposed to blood group genetics, chromosome mapping, chromosomal variations, gene flow and genetic drift.

Course Contents

Foundation of genetics; Mendel's experiments and laws of inheritance: allele segregation, independent assortment; Alleles and their interactions: dominance and codominance; Gene

interactions; Genes and chromosomes: karyotype analysis; Recombination patterns and chromosome mapping; Sex determination and sex linkage; Non-nuclear inheritance. Human genetic analysis: constructing pedigrees; human genetic disorders, Changes in chromosomal number: categories and mechanisms of change, Turner syndrome, Klinefelter syndrome, XYY condition. Changes in chromosome structure: duplication, translocation, deletion.

Course Impacts

Students will be able to explain general and specified areas of genetics more confidently.

Recommended Books

1. Principles of Genetics, D. Snustad, M.J. Simmons (2003), John Wiley and Sons.
2. Genetics: Analysis of Principles, R.J. Brooke (2005), McGraw-Hill Co.
3. Life: the Science of Biology, W.K. Purves, 5th edition (1997), Sinauer Associates Inc.
4. Genetics: from genes to genomes, L.H. Hartwell, L. Hood, M.L. Goldberg, R.C. Nerse (2004), McGraw-Hill Co.

Course Code: **IBB.414**

Course Title: **Membrane Structure Function and Transport**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to make the students to realize the importance of the membranes serving as barrier to the passage of molecules. The students will learn the role of carrier proteins in transport, electrochemical gradients driving transport processes and conveying electrical signals in electrically excitable cells. The students will also learn functions of ion channels in neurons.

Course Contents

Membrane structure and functions: fluid mosaic model, asymmetry of lipid bilayers. Membrane proteins; glycosylation of membrane proteins; principles of membrane transport, carrier proteins and active transport; ATP driven pumps; ion channels and electrical properties of membranes; water channels; propagation of action potential along nerve cells. Nuclear pore complexes and transport across the nuclear membrane; transport of proteins into cell organelles.

Course Impacts

The students will be able to understand the architecture of membranes, transport across the membranes, carrier proteins and active transport, the role of transport pumps and ion channels in transport.

Recommended Books

1. Membrane structure and Function, John R.Thornborough, (1995), Mc Graw Hill.
2. Transport and receptor proteins of plant membranes: Molecular structure and function, Clarkson DT and Cook DT, (1992), Plenum Pub Corp.
3. Bruce Albert et al, (2008), 5th edition Molecular Biology of the Cell, Garland Science, USA

Course Code: **IBB.415**

Course Title: **Biosensors and Bioregulators**

Course Rating: **2 Credits**

Course Objectives

The course aims at providing students first hand knowledge about biosensors, their onstruction and applications in the field of industry and medicine.

Course Contents

Principles of enzyme, microbial and affinity biosensors; enzyme biosensors based on: pH electrode, gas electrode, ISFETs (ion-sensitive field effect transistor), oxygen detection, hydrogen peroxide electrode, redox polymers, metalizecarbon electrode, conducting polymers, conductimetric measurements, thermistor, fluorometric detection. Microbial biosensors based on oxygen electrode, respiratory inhibition, potentiometric detection, optical detection. Immuno biosensors based on thermistors, surface plasmon resonance detection, piezoelectric crystal device, optical detection, biosensors related techniques based on ISE (ion selective electrodes) light polarization, bilayer lipid membranes and cytosensors.

Course Impacts

After studying the course student will become familiar with current research trends in this field of biotechnology and will be able to keep themselves updated with new developments in this rapidly expanding field.

Recommended Books

1. Biosensors, edited by Jon Cooper and Tony Cass, 2nd edition (2004), Oxford University Press.
2. Chemical Sensors and Biosensors, Brian R. Eggins (2004), John Wiley and Sons.
3. Biosensors: Fundamentals, Technologies and Applications, edited by F. Scheller and R.D. Schmid (1992), VCH Publishers.

Course Code: **IBB.416**

Course Title: **Advanced Microbiology**

Course Rating: **2 Credits**

Course Objectives

This course is designed to give an extensive knowledge of use of microbes in improving quality of human life, interaction of microbes with other forms of life, microbiology and public health. The course will focus on impact of microbes on economy as well.

Course Contents

Continuous culture technologies for strain improvement; useful microorganisms for industry; role of microorganisms in soil and water; use of microbes in waste treatment, food and dairy industry; fermentation for the production of pharmaceutical products including antibiotics, hormones, vaccines

etc.; microbial metal leaching; xenobiotic metabolism by microbes, biogeochemical cycling of C, N, S & P; microbial degradation of toxic and poorly degradable compounds; newly emerging pathogens; major microbial plant diseases.

Course Impacts

At the end of this course the student will be well familiarized with the use of microorganisms in daily life, their role in environment. The course will provide an understanding to get benefit from microbes by utilizing them in food, pharmaceutical industries. The student will be able to explain the major bacteria and viruses destroying crops in Pakistan and different types of new emerging microbes.

Recommended Books

1. Microbiology, Principles and Exploration. Black, J. G., 6th edition (2005) John Wiley and Sons.
2. Renewable Bioresources. Scope and Modification for Non-Food Applications. Stevens, C., Verhe, R., Verhé , R., (2004) John Wiley & Sons.
3. Industrial Pharmaceutical Biotechnology. Klefenz, H., (2002) Wiley-VCH Verlag GmbH.
4. Applied Dairy Microbiology. Steele Sr., J. L., Marth, E. H. (2001) Marcel Dekker
5. Modern Food Microbiology. J. M. Jay, M. J. Loessner, D. A. Golden, 7th edition (2006) Springer Science, Inc., USA.
6. Modern Soil Microbiology. Elsas, J. D. V., Jansson, J. K. and Trevors, J. T. (2006) 2nd edition. CRC Press
7. Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products. 3rd edition. Robinson, R. K. (2005) John Wiley & Sons.
8. Environmental Microbiology of Aquatic and Waste Systems. Okafor, Nduka. (2011) 1st edition. Springer.
9. Pharmaceutical Biotechnology. Concepts and Applications. Walsh., G. (2007) John Wiley & Sons.
10. Bioresources and human environment. Mohanka, R. and Singh, M.P. (2009) APH Publishing Corporation. New Delhi
11. Fungal Plant Pathogens. Principles and Protocols Series. Lane, C. R., Beales, P. and Hughes, K. J. D. (2012) CABL publishers.

Course Code: **IBB.417**

Course Title: **Environmental Biochemistry**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to comprehend the basics of environmental biochemistry in a precise and compact way. The student will learn about the different levels of environment and microbial transformation of inorganic and organic substances.

Course Contents

An introduction to the environment, biosphere, lithosphere and hydrosphere. Earth water, pollutants, biological demand of oxygen, microbes in the environment, microbial transformation of carbon, sulfur, phosphorus, nitrogen, microbial transformation of organic substances, carbon cycle of a typical fresh water lake, environmental geochemistry, microbial redox transformations, redox ladder, environmental poisoning, pesticides in environment.

Course Impacts

At the end of the course the students will be able to understand biochemical reactions and transformations in the environment involving recycling of the natural and synthetic compounds.

Recommended Books

1. An Introduction to Environmental Chemistry, Andrews and Reid, 2nd edition (2003), Blackwell Publishers.

2. Environmental and Ecological Biochemistry, Hochachka, and Mommsen (2008), Elsevier Science Publishers.

Course Code: **IBB.418**

Course Title: **Neurochemistry**

Course Rating: **2 Credits**

Course Objectives

This course is designed to bring up-to-date information on selected biochemical processes occurring in the nervous system. Special emphasis is on the structure and function of neurons and factors modulating neurotransmitters release and uptake as well as clinical aspects of nervous system biochemical processes.

Course Contents

Introduction to neuroanatomy; biochemical mechanism underlying nervous system functions; nervous system cell types and morphology; neuronal excitability and chemical mediated transmission; cytoskeleton of neurons and ganglia; biochemistry of specific neurotransmitter, endocrine effect on brain; brain energy metabolism and cerebral ischemia; biochemical processes disrupted in human

Recommended Books

1. Bruce Albert et al, 2008, 5th edition Molecular Biology of the Cell, Garland Science, USA
2. Lodish H, Berk A, Zipursky S L, Matsudaira P, Baltimore D, Darmnell J, (2000), 4th edition, Molecular cell Biology, W.H Freeman and Company, 41 Madison avenue, New York, NY 10010.

Course Code: **IBB.420**

Course Title: **Agriculture Biochemistry**

Course Rating: **2 Credits**

Course Objectives

The course aims to equip students with a broad spectrum of scientific, technical and managerial skills needed to contribute to the future success of agriculture. The course aims to cover the basic principles of plant biology, such as photosynthesis, primary and secondary metabolism, mode of action of all the major groups of pesticides and plant biotechnology, but it also addresses the various commercial applications of plant biochemistry.

Course Contents

Importance of plant biochemistry; plant cell structure, cell organelles and their functions. Biomolecules: polysaccharides, storage polysaccharides; biological membranes. Metabolism of plant primary and secondary metabolites. Nitrate assimilation and biological nitrogen fixation, sulphur metabolism. Photosynthesis and respiration. Chemistry of natural products: mono and sesqui-terpenes, steroids (cholesterol and Vitamin D), alkaloids (pyrrolidine, piperidine, pyridine, pyrole groups). Soil fertility and land suitability; manures and fertilizers.

Biochemical basis of fruit ripening. Bacterial and fungal plant pathogens. Agrochemicals: properties, metabolism, and mode of action. Classification of pesticides, chemistry of botanical pesticides (pyrethroids, rotenoids, nicotinoids) and synthetic insecticides (DDT, BHC, malathion, phorate, carbaryl, carbofuran), fungicides (bordeaux mixture, zineb, captan), herbicides (2,4-D, atrazine, butachlor). Basic concepts of genetic engineering and its application in crop improvement, transgenic approaches for the generation of useful agricultural products.

Course Impacts

After studying this course, the students will not only be well aware of importance of biochemistry in agricultural sciences but also develop the better understanding to apply it for the solution of agricultural problems. The students will have a vision to adopt a technology-based approach to render the agricultural sector more productive, service-oriented, sustainable and competitive.

Recommended Books

1. Introduction to Agricultural Biochemistry, Raymond Adam Dutcher, Clifford Oliver Jensen, Paul M. Althouse (2005). Publishers: Biotech Books.
2. Plant Biochemistry, 4th Edition, Heldt, H.W & Piechulla, B (2010). Academic Press.
3. The Chemistry of Pesticides their Metabolism, Mode of Action and Uses in Crop Protection, Hassall, K.A. (2013).
4. Plant Pathology, 5th edition, Agrios, G (2005). Academic Press.

Course Code: IBB.421

Course Title: Protein Structure Function and Engineering

Course Rating: 2 Credits

Course Objectives

This course aims to deal with the various factors which determine protein structure, folding, targeting, modification and functions. The structure-function relationship on the basis of model proteins including myoglobin, haemoglobin and others shall be investigated.

Course Contents

Protein translation, codon usage and structure function, folding, functional design of proteins, membrane proteins, phosphorylation, dephosphorylation of proteins and regulatory mechanism, Protein sorting: synthesis and targeting of mitochondrial, chloroplast and peroxisomal proteins, overview of secretory pathway, Translocation of secretory proteins and insertion of membrane proteins, posttranslational modification, protein glycosylation, protein sorting and proteolytic processing, receptor mediated endocytosis and sorting of internalized proteins, molecular mechanism of vesicular traffic. Cell communication: general principles, signaling through G protein and enzyme linked cell surface receptors signaling pathways regulated by proteolysis. Motor proteins. DNA binding proteins including zinc fingers and leucine zipper. Mutagenesis its objectives and site directed mutagenesis, protein engineering, fusion protein and significance, assessment of mutant protein, alpha helix and turn helix proteins, cytokines protein for immune regulation, protein structural analysis and assessment.

Course Impacts

The students would have learnt the various factors which determine protein structure and thus its functions. Skills of computer modeling on the basis of given sequences shall have been learnt.

Recommended Books

1. Proteomics: From protein sequence to function, Pennington, S. and Dunn, M.J., (2001), Spring Verlag.
2. Subcellular Biochemistry: proteins, Structure function and engineering, Roy, S. and Biswas, B. B., (1995), Plenum Pub Corp.
1. Protein structure function relationship in foods, Jackman RJ, Smith JK and Ry Yada, (1995) Aspen Publisher Inc.

M. Sc. Biotechnology

SEMESTER-III

Course Code: **IBB.451**

Course Title: **Principles of Biochemical Engineering**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to teach the students the principles of chemical engineering, preparation of inoculum and fermenter, bioreactors for plant and mammalian systems and downstream process for product recovery.

Course Contents

Application of engineering principles in biological processes; exponential function representation by log and semi logarithm graphs; units and dimensions; concepts of pressure, viscosity and flow; basic laws of Fourier mixing, Reynolds number; viscous and turbulent flow; friction factor and head loses during flow; mechanism of heat transfer. Problems of large-scale operation; types of fermenters; extraction methods and equipment: centrifugation, filtration evaporation, drying. Principles of biotransformation.

Course Impacts

The students will be able to understand the basic principles underlying the construction of bioprocessors and their operation on pilot as well as large scale.

Recommended Books

1. Biochemical Engineering: Principles and concepts, Syed Tanveer Ahmed Inamdar (2008), 2nd edition, PHI.
2. Biochemical Engineering and Biotechnology, Ghasem Najafpour, (2006), Elsevier.
3. Bioprocess Engineering: Basic Concepts, Michael L. Shuler, Fikret Kargi (2001), Prentice Hall.

Course Code: **IBB.452**

Course Title: **Biostatistics**

Course Rating: **2 Credits**

Course Objectives

Statistical methods are widely used in biology for measurement of living organisms like plants, animals and human beings. In this course, students will learn as to how statistical methods enable us to analyze the experimental results, to test their significance, to explain the resemblance and differences amongst organisms and to check the effectiveness of different treatments and medicines. Students will also be able to present the facts in a definite form and to simplify the complexities in any experimental data.

Course Contents

Samples and populations. Accuracy and precision of data. Frequency distributions. The handling of data. Descriptive statistics; the arithmetic mean, other means; the median; the mode; the range; the standard deviation; the coefficient of variation. Introduction to probability distributions; the poisson and binomial distributions. The normal probability distribution. Estimation and hypothesis testing; distribution and variance of means and other statistics; confidence limits; student's distribution; the chi-square distribution; tests of simple hypothesis employing the distribution. Introduction to ANOVA. Regression; models in regression; linear regression; tests of significance in regression; uses of regression. Correlation and regression; significance tests in correlation; applications of correlation. Case studies and problem solving for all topics.

Course Impacts

Students will be able to appreciate the role of statistical methods in simplifying the complexities of any experimental data.

Recommended Books

1. Statistics with applications to the Biological and Health Sciences, R.D. Remington, M.A. Schork, 3nd edition (2010), Prentice Hall, Inc.
2. Primer of Biostatistics, Stanton A. Glantz, 5th edition (2001), McGraw-Hill Co.
3. Fundamentals of Biostatistics, Bernard Rosner, 5th edition (2000), Thomson Learning.

Course Code: **IBB.453**

Course Title: **Plant and Animal Cell Biotechnology**

Course Rating: **3 Credits**

Course Objectives

This course is designed to provide students with a scientific and technical understanding of animal and plant biotechnology. This course will also introduce the development of disease and stress resistant organisms.

Course Contents

Plant breeding; cell and tissue culture; plant transformation; methods of transformation in plants including competence, electroporation, microinjection, particle gun; agrobacterium biology; methods for assessing transformation, transgenic crops for herbicide pest, fungal, bacterial and viral resistance; transgenic plants for nitrogen fixation and ice-minus bacteria.

Animal cell culture; protein production; requirements of small and large scale cell cultures; transient expression systems; stable expression systems, virus as expression vectors.

Course Code: IBB.455

Course Title: Lab. V: Biotechnology

Course Rating: 2 Credits

Course Objectives

The course aims at providing students first hand knowledge about different aspects of microbial fermentation. The course is designed to teach students about various types of microbial, animal and plant cell cultures.

Course Contents

Study of unit operations of chemical and biochemical engineering and related aspects: experiments including physical and nutritional aspects of microbial fermentations, aerobic and anaerobic, batch and continuous cultures, product recovery, etc.; experiments on plant and animal cell cultures; determination of biological and chemical oxygen demand.

Course Impacts

At the end of this course students will have learnt the working of unit operations of biochemical engineering. They will have gained hands on experience of working with various types of cell cultures.

Recommended Books

1. Biotechnology procedures and experiments Handbook, S.Harisha (2008), Laxmi Publications.
2. Lab manual in biochemistry: Immunology and biotechnology, Arti Nigam, Archana Ayyagari (2007), Tata Mc Graw- Hill.
3. Experiments in microbiology, plant pathology and biotechnology, K.R.Aneja, 4th edition (2003), NewAge Int. Ltd.

Course Code: IBB.456

Course Title: Lab. VI: Biotechnology

Course Rating: 2 Credits

Course Objectives

The course aims to provide the practical knowledge to the students for producing the biomolecules of industrial and diagnostic importance. The students will be able to handle the cell culture techniques, immunization, animal handling and failure of growth of cultured cells.

Course Contents

Mini project on polyclonal antibody production; culturing techniques for animal and plant cells, transformation of animal and plant cells.

Course Impacts

Students will be able to understand the specificity and importance of antibodies molecules in research and diagnostic problems. They will also learn the culturing techniques and transformation of foreign gene to explore the mode of action of transformants.

Recommended Books:

1. Trigiano R.N and D. J. Gray (2000) 2nd edition, Plant tissue culture techniques and laboratory exercises, (eds.) CRC press text book
2. Kyte, M. and J. Kleyn, (1996) Plant from test tube, Timber Press,
3. Auge R. et al (1995) In vitro culture and its applications, (1995) Science Publishers Inc,
4. Gamborg, O.L. and G. C. Phillips (1995) Plant cell, Tissue and organ culture, Springer Lab Manual.
5. R. Ian Freshney, Culture of animal cells, A manual of basic techniques,(2000), Wiley Press.

Course Code: **IBB.457**

Course Title: **Thesis/ Project Report/ Internship/ Special Paper**

Course Rating: **3 Credits**

Course Description

The students will undertake experimental work on the topic of research allotted and submit a thesis by the end of fourth semester which will be evaluated on the basis of experimental results obtained, quality of manuscript and a viva voce examination.

M. Sc. Biotechnology

SEMESTER-IV

Course Code: **IBB.458**

Course Title: **Microbial Biotechnology**

Course Rating: **2 Credits**

Course Objectives

This course is designed to provide concise yet comprehensive coverage of microbial component of biotechnology and it includes a review of number of key strategies involved in the production of biotechnological products on a commercial scale.

Course Contents

Biophysical and biochemical factors for growth; stoichiometry and bacterial energetics; microbial kinetics; biofilm kinetics; shake flask, solid sate, anaerobic, batch and continuous fermentations; bioreactors; industrially important microorganisms and biotechnological products (antibiotics, enzymes, alcohol, amino acids, organic acids and single cell protein) pilot scale and scaling up of fermentations; bioinstrumentation and computer control of fermentation. Microbial metal leaching.

Course Impacts

After studying this course, students would be able to outline how biotechnological innovations involving microorganisms have resulted in the diverse applications of biotechnology in different industries.

Recommended Books

1. Understanding Biotechnology, Aluizio Borem, Fabricio R. Santos, David E. Bowen, (2003), Prentice Hall PTR.
2. Basic Biotechnology, Colin Ratledge, William Bains, 2nd edition (2001), Cambridge University Press.

Course Code: **IBB.459**

Course Title: **Environmental Biotechnology**

Course Rating: **2 Credits**

Course Objectives

This course provides the student with an appreciation and understanding of the fundamental concepts and theoretical background of environmental science. It involves the study of environmental problems and their application to current, local and global issues.

Course Contents

Environmental biotechnology and society; environmental assessment of biotechnological processes, marine environment, interaction of microbes with plant and animal ecosystems; Interactions among microbial populations; development of microbial communities. Biofilms formation. Aquatic microbiology. Biogeochemistry; role of microbes in the biogeochemical cycles of elements like carbon, nitrogen and sulfur. Biodegradation and bioremediation; microbiology of water, waste water treatment. Microbiology of extreme environments; microbial mining; biofuels, microbial deodorisation, coal and oil desulphurization.

Course Impacts

At the end of this course the student will be able to explore the use of biotechnology as it relates to various environmental technologies. The student will also learn about environmental pollution caused by different human activities, and treatment of waste products produced by biotechnological process.

Recommended Books

1. Environmental Biotechnology: Principles and Applications, Bruce Rittman, Perry L. McCarty, (1998), Oxford University Press.
2. Brock Biology of Microorganisms, 12th edition (2012) Michael T. Madigan, John M. Martinko, Paul V. Dunlap, David P. Clark. Benjamin Cummings
3. Microbiology. 7th edition. (2008) Prescott, L.M., Harley, J.P., and Klein, D.A. McGraw-Hill Publ. 1088 p.
4. Microbiology, Principles and Exploration. Black, J. G., 6th edition (2005) John Wiley and Sons.
5. Polymicrobial Diseases. Brogden, K. A. and Guthmiller. J. M. (2002) Washington (DC), ASM Press.
6. Bioresources and human environment. Mohanka, R. and Singh, M.P. (2009) APH Publishing Corporation. New Delhi
7. Environmental Microbiology, 2nd edition. (2009) Raina M. Maier, Lan Pepper and Charles P. Gerba. Academic press and Elsevier.

Course Code: **IBB.460**

Course Title: **Current Research Trends in Biotechnology**

Course Rating: **2 Credits**

Course Objectives

This course aims at offering insights into front-line research being carried out in biotechnology throughout the world. Students shall also be introduced to topics like biosensors, bioreactors and their importance etc. so as to extend their knowledge of biotechnology.

Course Contents

Topics included in the course would be those which although considered important but could not be covered in any other course.

Course contents will be based on reviews and research publications and the contents will be determined by the Faculty from time to time.

Course Impacts

At the end of this course, students will know the latest developments in the areas of biotechnology.

Recommended Books:

Current literature, Journals in the subject

Course Code:: **IBB.457**

Course Title: **Thesis/ Project Report/ Internship/ Special paper**

Course Rating: **3 Credits**

Course Description

The students will undertake experimental work on the topic of research allotted during the third semester and submit a thesis by the end of fourth semester which will be evaluated on the basis of experimental results obtained, quality of manuscript and a viva voce examination.

Elective Courses

Course Code: **IBB.412**

Course Title: **Advanced Immunology**

Course Rating: **2 Credits**

Course Objectives

The course covers central topics in immunology for students who already have a basic knowledge of immunology. The aim is to provide in depth knowledge of selected topics in immunology.

Course contents

Lymphocyte development and expression of antigen receptors (BCR/TCR). Antigen recognition in adaptive and innate immunity. Cell adhesion; role in lymphocyte recirculation, trafficking, and microenvironment specific homing. NK recognition receptors. Antigen processing and presentation. Advances in understanding inflammatory disease. Tumor immunology. New and emerging immune therapies. Principles of vaccinology and application. Immune Response to pathogens; new concepts in the pathogenesis of asthma, immunotherapeutic, cytokines and cytokines based therapies, autoimmunity and hypersensitivities. Signaling pathways in the immune response; MAP kinase pathway, Akt cell signaling, inflammatory response pathway, integrin cell signaling, interferon (IFN) cell signaling, JAK-STAT cell signaling, Toll-like receptor (TLR) cell signaling.

Course Impacts

At the end of this course, students will be able to describe and explain the advanced topics of immunology.

Recommended Books

1. Cellular and Molecular Immunology, Abbas, Abul K., and Andrew Lichtman.. 6th edition. Philadelphia, PA: Saunders, 2005.
2. Immunobiology: The Immune System in Health and Disease, Janeway, Charles A., et al.. New York, NY: Garland Science, 2004.
3. Case Studies in Immunology: A Clinical Companion, Rosen, Fred, and Raif Geha.. 4th edition. New York, NY: Garland Pub., 2004
4. Immunology, J. Kuby, 6th edition (2006), W. H. Freeman and Co.

Course Code: **IBB.416**

Course Title: **Advanced Microbiology**

Course Rating: **2 Credits**

Course Objectives

This course is designed to give an extensive knowledge of use of microbes in improving quality of human life, interaction of microbes with other forms of life, microbiology and public health. The course will focus on impact of microbes on economy as well.

Course Contents

Continuous culture technologies for strain improvement; useful microorganisms for industry; role of microorganisms in soil and water; use of microbes in waste treatment, food and dairy industry; fermentation for the production of pharmaceutical products including antibiotics, hormones, vaccines etc.; microbial metal leaching; xenobiotic metabolism by microbes, biogeochemical cycling of C, N, S & P; microbial degradation of toxic and poorly degradable compounds; newly emerging pathogens; major microbial plant diseases.

Course Impacts

At the end of this course the student will be well familiarized with the use of microorganisms in daily life, their role in environment. The course will provide an understanding to get benefit from microbes by utilizing them in food, pharmaceutical industries. The student will be able to explain the major bacteria and viruses destroying crops in Pakistan and different types of new emerging microbes.

Recommended Books

1. Microbiology, Principles and Exploration. Black, J. G., 6th edition (2005) John Wiley and Sons.
2. Renewable Bioresources. Scope and Modification for Non-Food Applications. Stevens, C., Verhe, R., Verhé , R., (2004) John Wiley & Sons.
3. Industrial Pharmaceutical Biotechnology. Klefenz, H., (2002) Wiley-VCH Verlag GmbH.

4. Applied Dairy Microbiology. Steele Sr., J. L., Marth, E. H. (2001) Marcel Dekker
5. Modern Food Microbiology. J. M. Jay, M. J. Loessner, D. A. Golden, 7th edition (2006) Springer Science, Inc., USA.
6. Modern Soil Microbiology. Elsas, J. D. V., Jansson, J. K. and Trevors, J. T. (2006) 2nd Edition. CRC Press
7. Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products. 3rd edition. Robinson, R. K. (2005) John Wiley & Sons.
8. Environmental Microbiology of Aquatic and Waste Systems. Okafor, Nduka. (2011) 1st Edition. Springer.
9. Pharmaceutical Biotechnology. Concepts and Applications. Walsh., G. (2007) John Wiley & Sons.
10. Bioresources and human environment. Mohanka, R. and Singh, M.P. (2009) APH Publishing Corporation. New Delhi
11. Fungal Plant Pathogens. Principles and Protocols Series. Lane, C. R., Beales, P. and Hughes, K. J. D. (2012) CABL publishers.

Course Code: **IBB.421**

Course Title: **Protein Structure Function and Engineering**

Course Rating: **2 Credits**

Course Objectives

This course aims to deal with the various factors which determine protein structure, folding, targeting, modification and functions. The structure-function relationship on the basis of model proteins including myoglobin, haemoglobin and others shall be investigated.

Course Contents

Protein translation, codon usage and structure function, folding, functional design of proteins, membrane proteins, phosphorylation, dephosphorylation of proteins and regulatory mechanism, Protein sorting: synthesis and targeting of mitochondrial, chloroplast and peroxisomal proteins, overview of secretory pathway, Translocation of secretory proteins and insertion of membrane proteins, posttranslational modification, protein glycosylation, protein sorting and proteolytic processing, receptor mediated endocytosis and sorting of internalized proteins, molecular mechanism of vesicular traffic. Cell communication: general principles, signaling through G protein and enzyme linked cell surface receptors signaling pathways regulated by proteolysis. Motor proteins. DNA binding proteins including zinc fingers and leucine zipper. Mutagenesis its objectives and site directed mutagenesis, protein engineering, fusion protein and significance, assessment of mutant protein, alpha helix and turn helix proteins, cytokines protein for immune regulation, protein structural analysis and assessment.

Course Impacts

The students would have learnt the various factors which determine protein structure and thus its functions. Skills of computer modeling on the basis of given sequences shall have been learnt.

Recommended Books

1. Protein Engineering and design, Sheldon J. Park, Jennifer R. Cochran (2010), CRC Press.
2. Proteomics: From protein sequence to function, Pennington, S. and Dunn, M.J., (2001), Spring Verlag.
3. Subcellular Biochemistry: proteins, Structure function and engineering, Roy, S. and Biswas, B. B., (1995), Plenum Pub Corp.

Course Code: **IBB.461**

Course Tiles: **Agriculture Biotechnology**

Course Rating: **2 Credits**

Course Objectives

The objectives of this course is to help the students understand various key concepts in the traditional plant breeding, the current impact of biotechnology on crop production, environmental, societal, and market issues specific to transgenic crops.

Course Contents

Orientation and introduction of agricultural biotechnology, Agriculture and society, Plant domestication, Traditional methods of crop improvement, Exploration of the use of trees in subtropical and tropical agriculture systems, application of geographic information systems to crop production, tropical soil management, advanced analytical methods, microclimatology, crop modeling; Chemical, biological control and ecology of plant pathogens, host resistance, pesticide resistance, disease forecasting and other decision aids, integrated disease management, and economic aspects of disease management; Scientific study of the interactions of organisms in an agricultural ecosystem and sustainability. Biological, chemical, and physical properties of soils; fundamentals of soil ecology, soil-water-plant relations, soil fertility, and soil genesis; Microorganisms in soil and their effect on nutrient recycling, environmental quality and crop production, Regulatory, intellectual property and market issues specific to transgenic crops.

Course Impacts

It is anticipated that after studying this course, students should achieve an understanding of traditional and non-traditional methods of crop improvement, the techniques required for the development of improved cultivars through biotechnology.

Recommended Books

1. Plants, Genes and Agriculture, Crispeel, M. J. and Sadava, D. E. (2003), Jones and Bartlett Publishers.
2. Understanding Biotechnology, Aluizio Boren, Fabricio R. and David E. Bowen, (2003), Prentice Hall PTR
3. Basic Biotechnology, Colin Ratedge, William Bains 2nd edition (2001), Cambridge University Press

Course Code: **IBB.462**

Course Title: **Food Biotechnology**

Course Rating: **3 Credits**

Course Objectives

This course aims to gain a basic knowledge of the food composition and other analysis methods. Food preservation and processing of foods shall be dealt with. Principles of microbiology, enzymology and other factors involved in food spoilage and processing shall be dealt with. Also marketing of food shall be covered.

Course Contents

Food composition; food analysis, Probiotics, Food enzymes; food additives; food microbiology. Microbial biotechnology of food flavor production, oil and fats. Industrial process of dairy products, meat and cereal foods. Food spoilage and food born diseases. Food preservation methods; food engineering principles. Modified atmospheric packaging; food marketing principles; food safety and quality control. Patenting invention in Food biotechnology.

Course Impacts

After completing this course the student will be able to have a knowledge and extensive background of role of microorganisms in food, food spoilage and preservation of food by different biotechnological process, also packing, storage and marketing principles will be understood.

Recommended Books

1. Food Biochemistry and food processing, Benjamin K. Simpson, (2012), 2nd edition, Wiley Blackwell.
2. Food Biotechnology, Kalidas Shetty, (2006), 2nd edition, CRC press, Taylor and Francis
3. Introduction to food biotechnology, Perry Johson-Green, (2002), CRC Press.
4. Dnnis D. Miller, Food Chemistry: (1998), A laboratory Manual

Course Code: **IBB.463**

Course Title: **Mixed Microbial Processes**

Course Rating: **2 Credits**

Course Objectives

This course provides students with an awareness of the benefits of mixed cultures in various food, industrial ecological and waste management processes. They will also get knowledge of different processes available involving mixed cultures to achieve desirable results and products.

Course Contents

Introduction of mixed microbial cultures. Flux balance analysis of mixed microbial cultures. Mixed culture entrapped microbial cell immobilization (EMCI), Granulated mixed microbial culture. Employment of Bioaugmentation. Exploring mixed microbial community functioning: recent advances in metaproteomics. Entrapped mixed microbial cell processes for removal of carbon and nitrogen. Secondary and tertiary wastewater treatment. Detoxification of metals and radionuclides. Bioenergy production. Polyhydroxyalkanoates production, mixed culture food fermentations. Mixed cultures versus Pure cultures— ecological considerations.

Course Impacts

After completing this course the student will be able to explain the different technological advancements in mixed culture processes which will be helpful for the production of various useful products.

Recommended Books

1. National research council: Microbial processes; promising technologies for developing countries, 2001.
2. B. Sikyta. Progress in industrial microbiology, volume 31, 2000.
3. Gabriel Bitton, Waste Water microbiology, 3rd edition, Wiley & sons, New Jersey 2005.
4. Junhua (alex) Tao, Romas Kazlauskas. Biocatalysis for Green Chemistry and Chemical Process development. Wiley & sons, New Jersey 2011.

Course Code: **IBB.464**

Course Title: **Marine Biotechnology**

Course Rating: **2 Credits**

Course Objectives

This course provides students with an awareness of the diversity of marine organisms and the adaptations that enable them to survive in their natural environment. Also an understanding of the latest advances for the biotechnological production of novel commercial products will be developed.

Course Contents

Introduction to marine environment. Marine Flora-phytoplankton, seaweeds, sea grasses. Marine organisms and their behavior, marine fauna–zooplankton. Major marine invertebrates; characteristics

nd identification. Role of microbes within marine environment; microbial nitrogen fixation, carbon, itrogen and phosphorus cycle. Decomposition of organic matter. Bioleaching and biodeteroriation of atural and synthetic materials. Primary and secondary metabolites (enzymes, antibiotics, organic id, toxins etc.). Seafood microbiology, normal genera associated with fish, food spoilage, fish and uman pathogens. Indicator of pollution - faecal coliforms; prevention and control. 'Omics' driven chnologies; metabolic engineering and systems biology; cultivating the uncultured. Technological dvances in bio-engineering; applications of marine biotechnology. Marine food industry; marine iotechnology for sustainable production of healthy products through fisheries and aquaculture. arine energy; marine biotechnology for energy supply. Bio discovery of novel marine-derived iomolecules. Protection and management of marine ecosystems.

ourse Impacts

fter completing this course the student will be able to explain the different technological dvancements in bio-engineering which will be helpful for the production of sustainable healthy arine products.

ecommended Books

1. Jeffrey S. Levinton, Marine Biology: Function, biodiversity, ecology, 2nd edition (2001).
2. M.T. Madigan and J.M. Martinko, Biology of Microorganisms, 13th edition(2011) Pearson Prentice Hall, USA.
3. M. Kelly Cowan, Kathleen Park Talaro, Microbiology : A Systems Approach, 10th edition (2008) Tata McGraw Hill.
4. Gareth M and Judith C. Furlong, Environmental Biotechnology, 2nd Edition (2011) Wiley Blackwell.
5. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton, Industrial Microbiology (2001) Wiley Blackwell.
6. Gareth G. Evans, Judy Furlong, Environmental Biotechnology: Theory and Application (2011) John Wiley and Sons.

Course Code: **IBB.465**

Course Title: **Safety Considerations for Biotechnological Processes**

Course Rating: **2 Credits**

Course Objectives

This course is designed to give an extensive knowledge about biosafety considerations regarding ransgenics. The course will also focus on the industrial and international regulatory aspects of iosafety in biotechnology.

Course Contents

Risk assessment for genetically modified herbicide-tolerant and virus resistant plants; biosafety for iological expression systems and expression vectors, biosafey considerations for transgenic animals,

plants and microorganisms; gene flow from transgenic plants; safety evaluation of biotherapeutics and agribiotechnology products; biosafety and animal biotechnology; safety assessment of genetically modified feed for animals.

Course Impacts

After studying this course student will be able to comprehend the significance of biosafety considerations regarding transgenics and industrial and international regulatory aspects of biosafety in biotechnology.

Recommended Books

1. Biotechnology and safety assessment 3rd edition. (2002) John A. Thomas and Roy L. Fuchs. Academic press
2. Laboratory Biosafety Manual. 2nr edition. (Revised) (2003) World Health Organization.
3. Biotechnology, Biosafety and Biodiversity (1999) Sivramiah Shantharam and Jane F. Montgomery. Oxford & IBH publishers
4. Biosafety in Industrial Biotechnology. (1994) Hambleton, P.; Salusbury, T. (Eds.). Blackie academic and professional publishers.
5. Biotechnology and biosafety: a forum. (1999) Ismail Serageldin, Wanda Williams Collins. World Bank
6. Biosafety and Bioethics in Biotechnology. (2007) V. Shree Karishna. New age international publishers.

Course Code: **IBB.466**

Course Title: **Cost accounting, Marketing and Management**

Course Rating: **2 Credits**

Course Objectives

The course aims to provide an interdisciplinary education for biotechnology students equipping them with the necessary business and managerial skills. Moreover students will be introduced to foundations of marketing as they relate to the whole business enterprise and provide instructions on basic management philosophy and decision making; principles involved in planning, organizing, leading, and controlling a bioscience enterprise.

Course Contents

Cost accounting concepts and objectives, financial statements; the bases for planning and control, costs: concepts, uses and classification, job order costing, process costing: planning and control of factory overhead, joint and by product costing. Planning and control of materials, planning and control of labour, value cost and profit analysis, differential cost analysis

Introduction to marketing; marketing environments; marketing and strategy; marketing decisions; consumer behavior; products and services. Ppricing techniques and related strategies; distribution; promotion; advertisement and publicity. Introduction to management; the organizational culture and

the manager; foundations and basic elements of planning; decision making; basics of strategic management; human resource management; motivation; teamwork and group behavior; leadership and its characteristics.

Course Impacts

After studying this course student will be able to understand the importance of cost accounting as a first step in the manufacturing process, the steps involved in the accumulation of total cost in different departments and cost data for the decision making of the higher management. Understand the elements in marketing mix and their application in marketing decisions. Students will also understand managerial functions of planning, organizing, leading, and controlling.

Recommended Books

1. Cost Accounting: Planning and Control, Adolph Matz, Milton F. Usry, 10th edition (1991) South-Western.
2. Principles of Marketing. Philip Kotler, Gary Armstrong, 14th edition (2011), Prentice Hall.
3. Management, Stephen P. Robbins, Mary Coulter, 11th edition (2011) International ed.

central nervous system diseases; biochemistry of Alzheimer's and prion disease; neurochemistry of Schizophrenia, neurochemical bases of drug abuse.

Course Impact:

After studying this course, the students will be able to understand the cellular, molecular and biochemical aspects of nervous system as well as biochemical basis of different neurological diseases.

Recommended Books:

1. Basic Neurochemistry: Molecular, Cellular and Medical Aspects, George J. Seigel, Bernard W. Agranoff, R. Wayne Albers, Stephen K. Fisher and Michael D. Uhler., 7th edition (2005), Published by Academic press.
2. Handbook of Neurochemistry and Molecular Neurobiology, Armen Galoyan, Hugo Besedovsky, and Abel Lajtha. 3rd edition (2007). Springer Verlag Publishers.

Course Code: **IBB.419**

Course Title: **Advanced Endocrinology**

Course Rating: **2 Credits**

Course Objectives

The objective of this course is to provide students with the latest information about hormones, their action, regulation and role in various diseases. Students will also learn about various developments in the field of hormone assays and the use of recombinant DNA technology in making therapeutically administrable hormones.

Course Contents

Ultrastructure of endocrine glands and secretory mechanisms. General introduction to hormones including their classification, biosynthesis control of secretion, hormones assays. Mechanism of actin of steroids and peptides hormones. Role of nucleotides and hormone action. Regulatory functions of the hormones including metabolism, reproduction and gene expression. Hormones of the glucose regulatory system; role of hormone in water and mineral regulation. Hormone in male and female reproduction; sex hormone binding globulin; hormonal control in reproduction. Hormone interrelationship. Hormones in pregnancy. Maternal hormones. Hormone and lactation. Parturition. Menopause. Structure-function relationship among the polypeptide hormones. Naturally occurring variants. Synthetic analogue and their application. Recombinant DNA technology and genetic manipulation in the study of hormones.

Course Impacts

The students will be able to understand how hormones, neurotransmitters and other regulators work intracellularly, what is their mode of action to regulate the expression of specific genes and what are the biological bases of certain hormonal and neurological disorders.