INTEGRAL UNIVERSITY
DEPARTMENT OF BIOSCIENCES

PROGRAMME: M.Sc. BIOCHEMISTRY

PROGRAM SPECIFIC OUTCOMES (PSO):

PSO1: An ability to acquire in-depth theoretical and practical knowledge of Biochemistry and the ability to apply the acquired knowledge to provide cost efficient solutions in Biochemistry.

PSO2: An ability to properly understand the technical aspects of existing technologies that help in addressing the biological and medical challenges faced by humankind.

PSO3: An ability to translate knowledge of Biochemistry to address environmental, intellectual, societal and ethical issues through case studies presented in the class.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PE01. An ability to apply fundamental knowledge related to pure sciences in an interdisciplinary manner for providing innovative solutions to need based problems for global impact.

PE02. An ability to critically analyze scientific data, draw objective conclusions and apply this knowledge for human welfare. Students should be able to demonstrate expertise and ethical perspective on areas related to Biochemistry.

PE03. An ability to gain domain knowledge and know-how for successful career in academia, industry and research. Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, inter personal and team skills.

PROGRAMME: M.Sc. BIOCHEMISTRY FIRST YEAR

COURSE: BIOMOLECULES: STRUCTURE & FUNCTION
COURSE CODE: BS401

COURSE OBJECTIVES:
This course is designed to introduce the organic structure of living systems mainly dealing with biomolecules like carbohydrates, proteins, lipids, and nucleic acids laying the foundation for other advanced courses like physiology, cell biology, molecular biology, and immunology.

Course Outcomes: ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The students will learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system.
CO2	The students will learn about structure and function of lipids, circulating lipids and inflammatory lipid mediators etc. They will also learn about primary, secondary, tertiary, quaternary structure of proteins.
CO3	The students will understand about the structure and function of nucleosides and nucleotides.
CO4	The course will aid the students in understanding other accessory molecules like vitamins, plant and animal harmones, plant secondary metabolite like terpenes.

COURSE: BIOINFORMATICS & APPLIED STATISTICS
COURSE CODE: BS421

COURSE OBJECTIVES:
The objective of the course is learning and understanding the detailed developments and applications of the field of Bioinformatics in varied area of biological research. The course generally focuses on genomics, proteomics and computational biology studies and their relevance on research platform. Moreover, this course will also be helpful in the learning and understanding the application of various biostatistical methods and tools in research.

Course Outcomes: ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO 1	The student will learn about the Computer basics like Operating systems, Programming in Visual Basic, Data Access, Internet and Nucleic acid Sequence and protein Data Banks
CO 2	The course will help to understand the Database Similarity Searches like BLAST, FASTA etc., Multiple sequence alignments, Primer Designing, Homology Modeling, Phylogenetic analysis & Drug Designing, and Determination of Secondary & Tertiary of proteins.
CO 3	The student will learn the basics of handling of data, measures of central tendency like mean, median and mode, Measures of dispersion like mean deviation and standard deviation and Coefficient of variation.
CO 4	The course will aid in learning Tests of significance like Null hypothesis and alternative hypothesis, t –test, F-test, Chi-square test, Correlation and Regression analysis

COURSE: ESSENTIALS OF MOLECULAR BIOLOGY
COURSE CODE: BS403

COURSE OBJECTIVES:
The objective of the course is learning and understanding the fundamentals of molecular biology like nucleic acid as genetic material, replication, gene organization and its regulation etc. The application of the course lays the foundation to understand the disease processes.

Course Outcomes: ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The students will learn about nucleic acid as genetic information carriers, Possible modes of replication, and roles of helicase, primase, gyrase, topoisomerase, DNA Polymerase, DNA ligase, and Regulation of replication
CO2	Understand the detailed mechanism and regulation of Eukaryotic DNA replication, along with Mitochondrial and Chloroplastic DNA Replication
CO3	The students will learn about mechanism and regulation of transcription in prokaryotes along with Reverse transcription.
CO4	Understanding the classes of DNA sequences, Genome-wide and Tandem repeats, Retroelements, Transposable elements, Centromeres, Telomeres, Satellite DNA, Minisatellites, Microsatellites; Applications of satellite DNA and Split genes

COURSE: BIOPHYSICAL & BIOCHMEICAL METHODS
COURSE CODE: BS404

COURSE OBJECTIVES:
The course will help students to acquaint with basic instrumentation, principle and procedure of various sophisticated instruments like Fluorescence microscope, TEM, SEM, HPLC, FACS, GLC and NMR etc. This will enable the students to implement the use of these techniques in biological research and in discovering new products/compounds.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes.***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The course will help students to acquaint with basic instrumentation, principle and procedure of various sophisticated instruments like phase contrast, fluorescence, electron microscopy, confocal microscopy, fluorescent activated cell sorting, and Freeze drying.
CO2	The students will get the theoretical knowledge of various instruments and their practical applications like Geiger-Muller counter, Liquid scintillation counter, autoradiography, X-ray crystallography, and Biosensors
CO3	The students will learn about Centrifugation & Electrophoresis, and Protein Sequencing
CO4	The students will be able to implement the use of instruments like chromatography, UV-VIS spectroscopy, NMR, CD, ORD in biological research.

COURSE: ESSENTIALS OF MICROBIOLOGY
COURSE CODE: BS422

COURSE OBJECTIVES:
The objective of the course is learning and understanding the fundamentals of Microbiology like important characteristics and biology of bacteria, fungi, mycoplasma, viruses etc. Moreover, this course is designed to learn basic knowledge of fermentation process and industrial application of microbes for the production various useful products.
Course Outcomes: ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	Understand the basics of microbiology like Characterization and classification of microorganisms, cultivation, nutrition, physiology and growth of microbial cells, Genetic recombination in bacteria.
CO2	The student will learn and understand the basics of mycology and Production of mutants and their characterization.
CO3	The student will learn about Bacterial toxins, and mode of action of bacterial protein toxins. Host Microbe Interactions, Viruses of bacteria, plant and animal cells, Mycoplasma and viriods.
CO4	The student will learn about Media for Industrial Fermentation, Large scale production and commercial applications of enzymes, solvents and antibiotics

COURSE: BIOCHEMISTRY & MICROBIOLOGY LAB.
COURSE CODE: BS423

COURSE OBJECTIVES:
The lab is designed to train the students in basic and some advanced techniques of Biochemistry like isolation, purification, and estimation of biomolecules. It also deals with microbial techniques of isolation, purification and maintenance of microbial cultures.
Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will get practical knowledge of Preparation of buffers and measurement of pH,
CO2	Qualitative tests of carbohydrates, Qualitative tests of proteins & Amino Acids, Comparative evaluation of different methods of protein analysis: UV, Lowry, Biuret, Bradford.
CO3	The student will learn Methods of sterilization and preparation of various culture media, Purification techniques
CO4	Identification of isolated bacteria, and Growth curve of microorganisms

COURSE: GENE EXPRESSION & REGULATION
COURSE CODE: BS411

COURSE OBJECTIVES:
The objective of this course is to understand the fundamentals of gene expression and regulation in prokaryotes and eukaryotes which comprise of the knowledge of transcription and its regulation, post-transcriptional regulation, translation, post-translational regulation etc.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn and understand the bascis of transcription in eukaryotes, Transcription factors, Nucleosome modifiers, Mediator complexes, Chromatin remodellers, Elongation factors in transcription; Cleavage and polyadenylation.
CO2	Learn and understand Post - transcriptional / Co-transcriptional processing of RNA, End modifications, RNA splicing, RNAediting, Alternative splicing.
CO3	Understand the fundamentals of translation in prokaryotes and eukaryotes, properties of Genetic code, Ribosome binding site; Formation of initiation complex; Transpeptidation and Translocation; Ribosome cycle
CO4	Understand Post - translational processing, Basics of Protein folding, Intein splicing, Chemical modification, Proteolytic cleavage, Zymogen activation
CO5	Understand regulation of gene expression; Concept of operon, Significance of repressor, Attenuation; Inhibitors of transcription and translation.

COURSE: ENZYMOLOGY & ENZYME KINETICS
COURSE CODE: BS412

COURSE OBJECTIVES:
The objective of this course is to understand the importance of enzymes, their classification, and properties, to understand the mechanism of enzyme action, their kinetics and types of enzyme inhibitions, and to know about the advantages of immobilization of enzymes, methods of immobilization.

COURSE OUTCOMES (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	Acquire the knowledge of enzymes their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of K_m and V_{max}.
CO2	Learn about enzyme kinetics, effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and Multisubstrate enzyme kinetics.
CO3	Learn different immobilization techniques and Industrial and clinical scope of enzymes.

COURSE: METABOLISM & BIOENERGETICS
COURSE CODE: BS413

COURSE OBJECTIVES:
The objectives of the course are to learn and understand the fundamentals of cellular metabolism of carbohydrates, lipids, aminoacids, and nucleic acids and their association with various metabolic diseases.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will be able to learn Carbohydrate catabolism, and its association with cellular energy production, and carbohydrate anabolism in plants and animal cells.
CO2	The student will be able to learn Lipid biosynthesis, Degradation of fatty acids and cholesterol, ketone bodies, acidosis, ketosis
CO3	The student will learn and understand about the Biosynthesis of purines and pyrimidine nucleotides, degradation of nucleotides, salvage pathways, biosynthesis and biodegradation of amino acids. Inborn errors of metabolism.

COURSE: CYTOLOGY & CELL SIGNALING
COURSE CODE: BS431

COURSE OBJECTIVES:
The objectives of the course are to learn and understand the fundamentals of cell biology like cell orgenelles, cytoskeleton, cellular transport, cell-extracellular matrix interaction, cell division, and protein trafficking and signal transduction etc.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn about structural organization of prokaryotic and eukaryotic cells, ultra structure and functions of cell orgenelles and cell wall, the cytoskeleton,cell membrane, transport across cell membrane, exocytosis, receptor mediated endocytosis
CO2	The student will learn about cell division: mitosis and meiosis; Cell cycle: check points, role of cyclin and cyclin dependent kinases in cell cycle regulation,
CO3	Cell- Extracellular matrix interactions, Basics of signal transduction
CO4	The course will aid to understand about protein trafficking in cells, Protein sorting, vesicular Transport and protein targeting.

COURSE: MOLECULAR GENETICS
COURSE CODE: BS415

COURSE OBJECTIVES:
The objectives of the course are to learn and understand the fundamentals of Molecular genetics like genome organization, genetic control of development, Mendelian Inheritance, Population genetics, Mutation and DNA repair mechanisms, and Human genetics.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn and understand the Genome organization, Cytogenetics, Genetic Control of Development.
CO2	The student will learn and understand the Principles of Mendelian inheritance, Linkage and genetic mapping; Extrachromosomal inheritance, Sexlinked inheritance and genetic disorders, Somatic cell genetics, Population genetics.
CO3	The course will aid to learn about Physical and Chemical Mutagens, Drug metabolism and detoxification; DNA damage, DNA repair mechanisms, Oncogenes, proto-oncogenes, and tumour suppressor genes from humans.
CO4	The student will learn and understand the Human Genome Project, Gene therapy, Genetic Testing, and Genetic Counseling.

COURSE: ENVIRONMENTAL BIOLOGY
COURSE CODE: BS416

COURSE OBJECTIVES:
The objectives of the course are to develop the ability to solve the problems related to the environment, to make them aware of various eco-friendly techniques and modern techniques to solve various environment-related problems.

Course outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***.

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	Understand Microbiology of air and aquatic environments, Biological Oxygen Demand and pollution problems.
CO2	Graduates will be familiar with environmental pollution, Xenobiotic toxicity/genotoxicity, Mode of action of pesticides, fungicides and insecticides; Bioaccumulation and bioremediation, Biosensors, and Toxicogenomics.
CO3	Graduates will become aware of recycling of organic waste, composting and vermicomposting, and Municipal solid waste treatment and management.
CO4	Graduates will get familiarized with Microbial biotransformation/ degradation of organic pollutants, xenobiotics, pesticides, herbicides, heavy metals and radio isotopic materials, and biodeterioration.

COURSE: PHARMACEUTICAL BIOLOGY
COURSE CODE: BS417

COURSE OBJECTIVES:
The course is designed to make the students understand the concept and basic steps of pharmaceutical biology which covers production of recombinant monoclonal antibodies, different formulations of proteins and peptides, injectable lipid emulsions for oral protein and peptide delivery, pulmonary drug delivery systems and polymers for controlled drug delivery system etc.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The students will learn about monoclonal antibodies and generation, recombinant antibodies.
CO2	The students will learn about formulation of proteins and peptides, and multi-phase drug delivery system
CO3	The students will learn about injectable lipid emulsions, liposomes, polymeric systems for oral protein and peptide delivery.
CO4	The students will learn about the pulmonary drug delivery systems for biomacromolecules; Lipid based pulmonary delivery.
CO5	The students will learn about polymers used for controlled drug delivery like Hydrophobic polymers poly(esters), Hydrophobic polymers poly (alkyl methacrylates), poly (methacrylates), poly (acrylates), alginates, chitosan, polyethylene glycol.

COURSE: ANALYTICAL BIOCHEMISTRY & ENZYMOLOGY LAB
COURSE CODE: BS432

COURSE OBJECTIVES:
The lab is designed to train the students in basic techniques of Analytical Biochemistry like detection and estimation of biomolecules, determination of isoelectric point of protein, and protein separation. It also deals with the assay of clinically important enzymes and determination of factor affecting enzyme activity.

Course outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***.

COURSE OUTCOME (CO)	DESCRIPTION
CO1	The students will learn about amino acid detections, estimation of starch in wheat flour and glucose and fructose estimation in biological sample.
CO2	The students will learn to find out isoelectric point of protein and Separation of protein by Poly Acrylamide Gel Electrophoresis.
CO3	The students will learn to perform assay of clinically important enzyme: serum alkaline phosphatase, serum creatine phosphokinase and serum acid phosphatase, and the factors affecting enzyme activity and determination of Km.

COURSE: EDUCATIONAL/INDUSTRIAL TOUR
COURSE CODE: BS419

COURSE OBJECTIVES: The main objective of this course is to provide the students an exposure to various research activities in the country and acquaint the student with state of the art technique/instruments used in various research institutions and industries of national repute.

Course outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***.

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Develop understanding of state of the art technique/instruments used in various reputed research institutions.
CO2	Develop understanding of state of the art technique/instruments used in various reputed research institutions. and industries
CO3	Prepare the tour report.

COURSE: GENETIC ENGINEERING
COURSE CODE: BS521

COURSE OBJECTIVES:
The course is designed to make the students understand the concept and basic steps in gene cloning, to acquaint them with various vectors and enzymes used in recombinant DNA technology, transformation and screening techniques. They will also be acquainted with modern techniques such as PCR technology, Real-Time PCR, DNA fingerprinting etc.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The students will be introduced to Rapid DNA and RNA sequencing techniques, High throughput Sequencing, and Microarray.
CO2	The students will learn about the Principle & applications of PCR, Real time PCR, Blotting and hybridization (Southern, western, northern).
CO3	The students will be introduced DNA fingerprinting, Molecular Markers, Recombinant DNA methods, Features of commonly used vectors, strategies for cloning in various vectors and restriction enzymes.
CO4	Learn about Genetic engineering and prospects of improving crop productivity, resistance, resistance to disease and environmental stresses, methods for production of transgenic animals.

COURSE: PLANT BIOCHEMISTRY
COURSE CODE: BS522

COURSE OBJECTIVES:
The main objective of this course is to impart students an understanding of plant biochemistry. The course includes biochemistry of plant hormones, cell wall, secondary metabolites, carbon and nitrogen fixation and assimilation in plants

Course outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***.

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The students will be introduced to the structure, biosynthesis and mechanism of action of major plant hormones, plant growth regulators, and photoreceptors in higher plants
CO2	The students will be able to understand the chemical and physical composition and biosynthesis of cellulose and lignin.
CO3	The students will learn about the secondary plant metabolism, biosynthesis and function of major secondary plant product classes like terpenoids, alkaloids and flavonoids etc.
CO4	The students will learn about nitrogen metabolism, mechanism of nitrate and nitrite reduction, and fixation of nitrogen.
CO5	This course will help the students to gain knowledge electron transport in higher plants and its relation with the carbon fixation pathways, Light regulation of photosynthetic enzymes, Calvin cycle, CAM, C4 pathways, and photorespiration.

COURSE: IMMUNOLOGY
COURSE CODE: BS503

COURSE OBJECTIVES:

The objective of the course is to apprise the students about components associated with immune system and molecular mechanism of their working. The course also deals with implications of deregulation of basic regulatory networks that lead to immune system related disorders. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.

Course outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***.

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.
CO2	The course will aid in understanding various aspects of immunological response and how its triggered and regulated.
CO3	The student will learn and understand the rationale behind various assays used in immunodiagnosis of diseases and will be able to transfer knowledge of immunology in clinical perspective.
CO4	The course will aid in understanding the principles of Graft rejection, Auto immunity and Antibody based therapy.
CO5	Develop the capacity for problem-solving about immune responsiveness, knowledge of pathogenesis of diseases and designing of immunology based interventions for effective treatment.

COURSE: PHYSIOLOGY & CLINICAL BIOCHEMISTRY
COURSE CODE: BS523

COURSE OBJECTIVES:
The main objective of this course is to learn and understand the fundamentals of physiology and its association with clinical biochemistry. This course is designed to impart knowledge of functioning of circulatory, respiratory, digestive and excretory system and associated clinical conditions/diseases.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn and understand the basics of circulatory system including haematopoiesis, homeostasis, and diseases of blood.
CO2	The student will learn and understand the fundamentals of digestive system.
CO3	The student will learn and understand the fundamentals of Respiratory system and Neural & chemical regulation of respiration.
CO4	The course will aid to understand the basics of excretory system like structure of nephron, glomerular filtration, reabsorption and tubular secretion, homeostatic regulation of water and electrolyte.
CO5	The course will also aid to learn about kidney diseases like uremia & glomerulonephritis; liver diseases like Jaundice, Hepatitis, Neurological diseases like Epilepsy, Parkinson & Alzheimer's disease.

COURSE: APPLIED BIOTECHNOLOGY, IPR & BIOSAFETY
COURSE CODE: BS524

COURSE OBJECTIVES:
The main objective of this course is to impart students an understanding of Plant biotechnology and its application in agriculture; Medical biotechnology and its application in gene therapy, stem cell therapy and antibody therapy; Industrial biotechnology and its application in food, dairy, leather, cosmetic and pharmaceutical industries; Animal biotechnology and its application in cell cultures, organ and animal cloning etc. Moreover, the course also includes the basic concept of IPR and its significance in biological research along with a detailed understanding of Biosafety, biohazards, and biosafety guidelines in biological research.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn about the basic concept of Plant Biotechnology and applications in agriculture like micro-propagation, haploid plants, embryo culture, hybrids, cybrids etc.
CO2	The student will also learn about the fundamentals of Medical Biotechnology and its application in stem cell therapy, gene therapy, antibody therapy etc.
CO3	Understanding application of biotechnology in food, beverage, dairy, paper and pulp, leather, detergent, cosmetic, and pharmaceutical industries etc. along with application in animal cell culture, organ and animal cloning.
CO4	The student will learn basic concept of IPR; laws; forms of IPR like patent, design copyright and trademark, Issues related to IPR protection, and detailed information on patenting biological products and biodiversity.
CO5	The course will also aid in understanding the Biohazard and Biosafety, Biosafety guidelines of Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs and Bioethics.

COURSE: IMMUNOLOGY & MOLECULAR BIOLOGY LAB
COURSE CODE: BS525

COURSE OBJECTIVES:
The lab is designed to train the students in basic and some advanced techniques of Immunology like qualitative and quantitative analyses of antigen-antibody interaction. It also deals with Molecular biology techniques of isolation and purification of bacterial plasmid and chromosomal DNA and their application in cloning.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will practically learn and understand the antigen-antibody interaction by Double Immunodiffusion method, Ouchterlony's Method, Immunoelectrophoresis, Western Blotting and ELISA.
CO2	The student will practically learn to isolate plasmid DNA and genomic DNA from *E. coli* and will learn to perform Agarose gel electrophoresis of DNA
CO3	The course will aid to learn Restriction digestion of DNA and its application in cloning and to perform PCR.

COURSE: NUTRITIONAL BIOCHEMISTRY
COURSE CODE: BS531

COURSE OBJECTIVES:
The objective of this course is to learn and understand the basic concepts of nutritional biochemistry which comprises nutritional values of foods, dietary requirements of carbohydrates, lipids and proteins, nutritional significance of minerals. Moreover, this course is also designed to understand the factors responsible for malnutrition and measures to overcome malnutrition in infants and adults.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn and understand the basic concepts of nutrition, and nutritional values of foods, and Basal metabolic rate and measurement of energy requirements.
CO2	The student will also learn and understand the dietary requirement of carbohydrates, lipids and proteins and their biological significance.
CO3	The course will also aid to learn the nutritional requirement and significance of dietary minerals like calcium, phosphorus, magnesium, iron, iodine, zinc and copper and vitamins like vitamin B complex, C and A, D, E & K
CO4	Uunderstand the condition of malnutrition, its prevention, and recommended dietary allowances.

COURSE: FREE RADICAL BIOLOGY
COURSE CODE: BS512

COURSE OBJECTIVES:
The main objective of this course is to impart students an understanding of free radicals, their properties, cause of generation of free radicals, damage caused by free radicals and free radical associated diseases. Moreover, role of antioxidants and antioxidant enzymes in neutralizing the free radicals have also been included for the development of better therapeutic intervention against free radical associated diseases.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will learn and understand the basics of free radicals, classification, properties, generation of free radicals, and associated factors and their biological significance.
CO2	The course will also aid in understanding of minerals and their role free radical generation.
CO3	The student will acquire the role of free radicals in the development of diseases, mechanisms of free radical induced protein oxidation, lipid peroxidation, DNA oxidation and defense mechanisms against free radicals such as role of antioxidants in the prevention of diseases.
CO4	The course will also aid in understanding of antioxidant enzymes as first line of defense like superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase and second line of defense like glutathione, vitamin C, vitamin E etc.

COURSE: FOOD BIOTECHNOLOGY
COURSE CODE: BS513

COURSE OBJECTIVES:
The objective of the course is to apprise the students about the fundamentals of food biotechnology which covers wide aspect of food spoilage and preservation. This course is designed to get knowledge of microbiology of food spoilage and safety measures for its control. Moreover, in this course, various safety standards have been introduced to learn the proper preservation of foods.

Course Outcomes (CO): ***After completion of the course, a student will be able to achieve these outcomes***

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	The student will get the basic knowledge of spoilage of foods and different methods of preservation of foods, microbial food poisoning and infection.
CO2	This course will help in understanding the microbiology and spoilage of meat and meat products, fish and poultry, fruits and vegetables, sugar and sugar products.
CO3	The student will understand the spoilage of milk and milk products, Milk borne diseases and Starter lactic cultures.
CO4	The student will also learn food adulteration and contamination of food with harmful microorganisms, food laws and standards; Indian and International food safety laws and standards, BIS Laboratory Services, BIS product certification and licensing quality systems; Certification by BIS.

COURSE: SEMINAR

COURSE CODE BS514

COURSE OBJECTIVES: The students will be able to summarise the existing data related to a specific topic in the form of a report.

Course Outcomes (CO): After completion of the course, a student will be able to achieve these outcomes

Course Outcome (CO)	Description
CO 1	The students will be able to summarize the recent research in the form of review.
CO 2	The students will be able to deliver power point presentations on an assigned topic.

COURSE: PROJECT WORK

COURSE CODE BS515

COURSE OBJECTIVES: The main objective of this course is to acquaint the student with various techniques used in contemporary research in microbiology/biotechnology that will be useful in successful completion of their project work in the fourth semester.

Course Outcomes (CO): After completion of the course, a student will be able to achieve these outcomes:

Course Outcome (CO)	Description
CO 1	To develop synopsis of a defined research problem.
CO 2	To conduct the bench work.
CO 3	To prepare the research report and its oral demonstrations.