INTEGRAL UNIVERSITY
DEPARTMENT OF BIOSCIENCES
Program: M.Sc. Biotechnology

Program Specific Outcomes (PSOs)

PSO 1: Acquire knowledge on the fundamentals of biotechnology to enable the students to understand the emerging and advanced concepts pertaining to the field of biotechnology

PSO 2: Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

PSO 3: Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology

PSO 4: Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists.

Program Educational Objectives (PEOs):

PEO 1: To provide in-depth knowledge about core areas of biotechnology

PEO 2: To make students competent in the field of biosciences and allied areas by providing them hands on experience in basic tools and techniques.

PEO 3: To instill the ability for research and entrepreneurship in the students along with strong ethics and communication skills.

PEO 4: To inculcate, facilitate, motivate and promote knowledge and technical skills in core areas of biological sciences including advanced tools and techniques like genomics, proteomics and transcriptomics to young aspirants.

PEO 5: To equip and motivate the students to pursue higher education and research in reputed institutes at national and international level in the field of science.

PEO 6: To develop trained human resource in the field of advanced translational research.

PEO 7: To provide students with an understanding of the role of science in societal development.

PEO 8: To develop graduates with a strong professional ethics and moral duties that will positively affect their profession, community, society and Nation at large.

Program Outcomes (POs)

PO 1: The degree programs offered at the Department of Biosciences empowers research-based in-depth study of Biotechnology

PO 2: It equips the students to work independently in laboratory, analyze and apprehend the scientific articles, present scientific topics and research results in spoken and written forms, both.

PO 3: It allows having a thorough perceivence and competency in specific areas of biology in addition to a broad-based integrative standing of basic biological concepts.

PO 4: It endows the understanding of research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO 5: Apply ethical principles and commit to professional ethics, responsibilities, and norms of the biological sciences practice.

PO 6: Empower the students to acquire technological cross-examination by connecting disciplinary and interdisciplinary aspects.

PO 7: Develop ability to work independently as well as part of a team.

PO 8: It also inculcates the importance of Bioethics, IPR, entrepreneurship, communication and management skills to usher next generation of Indian industrialists and researchers.

Course :Biomolecules: Structure & Functions
Course Code :BS401

Course Objective:

The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles and functions and inter relations. Emphasis will be on the association between structure and function of various biomolecules at a chemical level with a biological perspective.

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

Course Outcome (CO)	Description
CO 1	Basic knowledge of structure and functions of major bio-molecules will make the students to understand and implement the acquired knowledge in future.
CO 2	Introduced to the structure, properties and roles of carbohydrates, lipids and nucleic acids.
CO 3	Aware of the importance of amino acids and vitamins in biological systems.

Course : Bioinformatics and IPR & Biosafety
Course Code :BS402

Course Objective: The objective of this course is to provide students with basic understanding and applications of bioinformatics. The course will provide the basic concepts behind the sequence and structural alignment, database searching, protein structure prediction and computer-based drug designing. The course will also introduce the basic concepts of ethics and safety that are essential for various branches of science involving technical procedures and protection of intellectual property and related rights.

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

Course Outcome (CO)	Description
CO 1	Apply key concepts of different bioinformatics tools and analyse sequence and structure of bio-macromolecule data
CO 2	Apply the knowledge of bioinformatics in the biotechnology research and industry
CO 3	Interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life
CO 4	Comprehend benefits of GM technology and related issues as well as recognize importance of protection of new knowledge and innovations and its role in business.

Course : Essentials of Molecular Biology
Course Code :BS403

Course Objective: To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.

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

Course Outcome (CO)	Description
CO 1	Explain the properties of genetic materials and storage and processing of genetic information.
CO 2	Acquire basic knowledge about the processes of DNA replication, transcription and translation in prokaryotes and eukaryotes
CO 3	develop understanding of the molecular basis of RNA processing and RNA splicing

Course : Biophysical and Biochemical Methods
Course Code :BS404

Course Objective: The objectives of this course are to provide the Students with the understanding of various analytical techniques used in biotechnology based research and industry. The course will acquaint the Students with the various instruments, their configuration and principle of working, operating procedures, data generation and its analysis.

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

Course Outcome (CO)	Description
CO 1	Apply basic principles of different analytical techniques in analytical work.
CO 2	Use spectroscopy, microscopy, centrifugation, electrophoretic techniques and radioactivity in biotechnological applications
CO 3	Demonstrate principle and working of various instruments.
CO 4	Use various techniques for solving industrial and research problems

Course :Biostatistics&Biomathematics
Course Code :MT403

Available from Department of Mathematics

Course : Gene Expression & Regulation
Course Code :BS411

Course Objective: The objective of the course is to introduce to the students the basic knowledge about how genes are transcribed and how translation takes place in prokaryotes and eukaryotes and how these processes are regulated, so that students can apply this knowledge in enhancing their analytical and problem solving skills.

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

Course Outcome (CO)	Description
CO 1	To understand the gene expression and regulation in Prokaryotes & Eukaryotes.
CO 2	To gain better knowledge in both Prokaryotes & Eukaryotes about the genetic code and Post-translational processing
CO 3	Learn about the various ways in which these biological processes are regulated and the significance of regulation in maintaining life forms

Course : Enzymology & Enzyme Kinetics
Course Code :BS412

Course Objective: This course has been designed to teach the student majoring in science all the major aspects of the study of enzymes. The course focuses on the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and immobilization of enzyme

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

Course Outcome (CO)	Description
CO 1	To understand the general properties of enzymes and their nomenclature
CO 2	To understand the theories of enzyme kinetics and the mechanisms of enzyme catalysis and enzyme inhibition
CO 3	To understand the Multisubstrate enzyme kinetics and enzyme Immobilization

Course : Metabolism & Bioenergetics
Course Code :BS413

Course Objective:

This course enables the students to provide basic knowledge about catabolism, anabolism, regulation of metabolism and pathway analysis. It also gives understanding of how enzymes and metabolites in living system work to produce energy and synthesizing different biomolecules. The course also extend comprehensive knowledge about biochemical pathways involved in intermediary metabolism of carbohydrate, protein, lipid and nucleic acid.

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

Course Outcome (CO)	Description
CO 1	Demonstrate an understanding of carbohydrate, protein, lipid, amino acids and nucleic acid metabolism.
CO 2	Distinguish between different metabolic processes and their impact in metabolism of biomolecules.
CO 3	Select particular metabolic pathway involved in carbohydrate, protein and fat related metabolic issues
CO4	Apply and analyze the knowledge related to bioenergetics in living system.

Course : Microbiology
Course Code :BS414

Course Objective: The objectives of this course are to introduce the students to the field of microbiology with emphasis on microbial growth, reproduction, microbial diversity, morphology and nutrition; basic techniques implied in microbiology including concept of aseptic work, isolation, identification, and cultivation of microbes from different habitats/sources.

Course Outcome: After completion of the course, a student will be able to:

Course Outcome (CO)	Description
CO 1	Identify/classify the microbial diversity i.e. bacteria, fungi, virus etc. on the basis of their structural characteristics; classify the nutritional types of microorganisms and measure microbial growth
CO 2	Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
CO 3	Understand the interactions between microbes, hosts and environment.
CO 4	Students would be able to isolate, maintain and preserve microorganisms for various applications
CO5	Gain insights on mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis).
CO6	Classify the medically important micro-organisms i.e. Non-pathogenic and Pathogenic Microbes, and understand their mode of survival and antibiotics resistant mechanism

Course : Molecular Genetics
Course Code :BS415

Course Objective:

The aim of the course is to provide students with an understanding of both classical and modern concepts in genetics with special emphasis on the areas of chromosome structure and function, molecular and developmental genetics, DNA damage and repair and chromosomal aberrations. The course will also providein-depth knowledge of cancer etiology, Human Genome projectand genetic diversity including Legal and Ethical Issues in Genetics.

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

Course Outcome (CO)	Description
CO 1	Understand the Genome organization and DNA packaging including Chromosome structure and function in both prokaryotes and eukaryotes.
CO 2	Understanding the principles of Mendelian genetics, extensions and applications.
CO 3	Able to understand the DNA damage and repair mechanism and the role of various onogenes in cancer etiology
CO 4	Able to understand The Human Genome project and genetic diversity including Legal and Ethical Issues in Genetics.

Course:Environmental Biology
Course Code :BS416

Course Objective:

The course content aims to make the Students identify and explain the environmental factors responsible for the pollution. It also helps in understanding how biotechnology can provide solutions for environmental problems and understand legal aspects related with environmental issues and environmental protection.This course enables the students to select the appropriate method for the treatment of wastewater and solid waste management as well as can apply Suitable bioremediation methods for the treatment.

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

Course Outcome (CO)	Description
CO 1	Comprehend environmental issues and role of biotechnology in the cleanup of contaminated environments
CO 2	Comprehend fundamentals of biodegradation, biotransformation and bioremediation of organic contaminants and toxic metals
CO 3	Apply biotechnological processes in waste water and solid waste management.
CO 4	Demonstrate innovative biotechnological interventions to combat environmental challenges

Course :Pharmaceutical Biology
Course Code :BS417

Course Objective: This course enables the students to learn the various aspects of pharmaceutical sciences. In this course, students get exposed to the insights into various therapeutic strategies against infectious and non-infectious diseases i.e. via monoclonal antibodies (mABs), peptide based therapeutics, liposome/emulsion-based drug delivery systems, PEG-conjugates-based drug delivery and various factors affecting the drug delivery, its release, and absorption.

Course Outcome: After completion of the course, a student will be able to:

Course Outcome (CO)	Description
CO 1	Explain the principle of mABs generation, their mode of action, and their application in targeting various diseases.
CO 2	Formulate the therapeutic proteins and peptides, their encapsulation with other macromolecules and their implication in drug delivery.
CO 3	Prepare lipid-based drug delivery systems as well as PEG-conjugates for fast drug delivery and release inside the body.
CO 4	Develop the strategies of new drug discovery.
CO 5	Apply the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals.

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 :rDNA Technology
Course Code :BS501

Course Objective: The objective of this course is to give students a basic understanding of various components required for gene cloning.

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

Course Outcome (CO)	Description
CO 1	Know the role of the several molecular tool applied in gene cloning for construction of recombinant molecules (DNA and Vectors)
CO 2	Several techniques involved in production of CDNA and Genomic library and primer synthesis
CO 3	Classification and properties of an ideal plasmid , plasmid as cloning vector
CO 4	Different types of cloning vectors used in genetic engineering
CO 5	Different types of screening and selection procedure of identifying recombinants

Course :Bioprocess Engineering & Industrial Biotechnology
Course Code :BS502

Course Objective: This course was designed to acquire knowledge on basics of thermodynamics of reactors systems with special emphasis on bioreactor design, operation, flow patterns, and analysis of enzyme kinetics in biochemical engineering reactions along with downstream processing.

Course Outcome: After completion of the course, a student will be able to :

Course Outcome (CO)	Description
CO 1	Apply the concepts of thermodynamics and basic chemical engineering principles in a bioprocess/fermenters
CO 2	Produce bio-products and secondary metabolites on commercial level using fermenters
CO 3	Understand the techniques used for isolation and purification of desired products
CO 4	Operate and optimize the factors affecting fermentation for producing industrial products.
CO 5	Treat the solid waste and effluent treatment

Course :Immunology
Course Code :BS503

Course Objective: The objective of this course is to provide students with detailed understanding of historical aspects of immunology, different cells of the immune system and their role in immune protection and application of immunological techniques. The course will provide knowledge about autoimmunity, hyper sensitivity, compliment system, and vaccination etc. One of the major goals of this course is to provide basic understanding of immunology and immune responses in response to various infectious and non-infectious diseases i.e. cancer, diabetes, neurological disorders etc.

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

Course Outcome (CO)	Description
CO 1	Apply the knowledge of immune associated mechanisms in medical biotechnology research.
CO 2	Explain role of immune cells and their mechanism in preventing the body from foreign attack and infectious disease, cancer and other disease development.
CO 3	Perform in-vitro and in-vivo experiments to assess the immunomodulatory effects test drug candidates.
CO 4	Develop novel immunological techniques for diagnosis and industrial purposes.
CO 5	Students will gain knowledge about the importance of understanding the antigen-antibody interactions.

Course :Advanced Molecular Techniques
Course Code :BS504

Course Objective: To develop the understanding about advanced techniques used in molecular biology and biotechnology and their application

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

Course Outcome (CO)	Description
CO 1	Polymerase chain reaction (PCR) and its application. Modifications of PCR. Site directed mutagenesis and its types.
CO 2	Various methods of gene silencing in plants and animals: RNA interference, antisense technology and ribozymes.
CO 3	Genome sequencing, various types of sequencing technologies and sequencing approaches. Pros and cons of different sequencing technologies.
CO 4	Molecular markers and their types. Advantage, disadvantage and application of various types of molecular markers. Principle and application of Proteomics techniques like yeast two hybrid system, protein microarray etc.
CO 5	Principle, instrumentation and application of various methods used for introduction of DNA into living cells like chemical transformation etc.

Course :Cell Biology
Course Code:BS505

Course Objective: The objectives of this course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes becomes deeper and inclusive. This course will enable the students to learn the basics of cytology, as cell is the basic unit of life, and the mechanistic insights into the cell division, cell cycle, regulatory processes of the cells like various signaling pathways, protein trafficking and cell death. At the end, students will also learn the application of cell culture, transfection, cloning and gene knockout techniques for the betterment of living beings.

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

Course Outcome (CO)	Description
CO 1	Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
CO 2	Students will understand the cellular components underlying cell division
CO 3	Students will learn about cell communication and signaling through distinct signaling pathways that will help them to discover novel therapeutic targets/agents.
CO 4	They will be able to use the cell culture techniques for basic and pharmacological purposes.
CO 5	Explain the basic pathways of protein function , folding and targeting

Course :Applied Biotechnology
Course Code :BS511

Course Objective: This course has been designed to recollecting some basic but very important concepts in biotechnology as well as plant and animal cell culture with advanced knowledge of various recent developments taking it to the industrial level. This course also aimed to teach the students about the application of transgenic plants, cloning mechanisms, IVF, and commercial production of vaccines.

Course Outcome: After completion of the course, a student will be able to:

Course Outcome (CO)	Description
CO 1	Understand the techniques of microbial, plant and animal cell culture
CO 2	Understand the basic mechanisms of protoplast biology, in-vitro selection of mutants, the process of plant organ development and their application in agriculture and horticulture.
CO 3	Understand the development of transgenic plants with special acquired protective mechanisms against drought, salt stress, pathogens, herbs and development of edible vaccines.
CO 4	Understand the cloning strategies, antigen recognition and presentation by B and T lymphocytes and their application in vaccine development.
CO 5	Understand the techniques of *in-vitro* fertilization and embryo transfer technique, test tube babies

Course :Free Radical Biochemistry
Course Code :BS512

Course Objective: This course was specifically designed to teach the students about the oxidants, antioxidants, oxidative stress, and their role in the pathogenesis of different diseases. In addition, the students will be able to understand the role of anti-oxidants in targeting various free radical-induced human diseases like Alzheimer's, Parkinson's, Cancer, Diabetes, and Cardio Vascular Diseases.

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

Course Outcome (CO)	Description
CO 1	Introduction to free radicals, their classification, physical and chemical properties, sources, biological significance.
CO 2	To understand the mineral biochemistry
CO 3	Students will learn about enzymatic and non-enzymatic antioxidants, their sources, and their role in targeting various diseases.
CO 4	Students will learn the free radical-mediated oxidation of various macromolecules and their role in tissue injury.
CO 5	Reconstitution of damaged molecules and membranes and the role of de-novo enzymes in third line of defense.

Course :Food Biotechnology
Course Code :BS513

Course Objective: This course was designed to enable the students to understand various aspects of food biotechnology including food spoilage, food preservation techniques, food borne diseases, dairy products, their contamination, and associated milk-borne diseases, the importance of different flavors in food industry, food laws and standards, and BIS Certification of food products.

Course Outcome: After completion of the course, a student will be able to:

Course Outcome (CO)	Description
CO 1	Learn the basic concepts of food spoilage and preservation techniques.
CO 2	Learn about the chemical and microbiological examination milk constituents, milk grading, contamination and milk-borne diseases.
CO 3	Learn about the microbial flavors in food industry.
CO 4	Understand the food laws and standards, Quality and safety assurance in food and dairy industry, and BIS product certification andlicensing quality systems.
CO 5	Determine the microorganisms and their metabolites in different foods using distinct techniques.

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.