Effective from Session: 2024-25							
Course Code	B100101T/ BS103	**Title of the Course**	Introduction to Cell Biology and Genetics	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop an understanding of basics of cell, cell organelles structure and functions, and basics of Mendelian Genetics.						

Course Outcomes	
CO1	Develop an understanding of the discovery of Cell; Historical prospective, Structural and functional differences between Prokaryotic and Eukaryotic cells, difference between animal and plant cells.
CO2	Develop an understanding about structure and functions of different cell organelles, cytoskeleton and cell motility.
CO3	Develop an understanding of different types of cell divisions, cell membrane and transport across the cell membrane, cell-cell communication, signal transduction and cell death.
CO4	Develop an understanding about Chromosomes, there composition, structure and functions, Mendelian genetics, variations from mendelian genetics, Linkage and mechanism & importance of crossing over.
CO5	Develop an understanding of gene mutations in plant, animals and bacteria, its types and economic importance. Karyotyping, Chromosomal aberrations in human and associated diseases, various types of DNA damages and their repair mechanisms.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Cell as a Basic unit of Living Systems**	Discovery of cell, The Cell theory Ultrastructure of an eukaryotic cell – (both plant and animal cell).	**6**	CO.1
2	**Cell organelles and cytoskeleton**	Structure and functions of cell organelles, Cytoskeletal structures (Microtubules, Microfilaments); cell motility.	**8**	CO.2
3	**Cell Division and Membrane Transport**	Cell cycle, mitosis and meiosis, Membrane transport: active and passive transport.	**8**	CO.3
4	**Cell signaling & Cell Death**	Introduction to signal transduction and its molecular mechanism, cell senescence, Programmed Cell Death.	**6**	CO.3
5	**Chromosomes: Structural Organization**	Centromere, telomere, chromonema, euchromatin and heterochromatin, chemical composition and karyotype, nucleosome model, Special types of chromosomes: Salivary gland and Lampbrush chromosomes, Chromosomal Variations, Chromosome mapping, structural and numerical aberrations.	**8**	CO.4
6	**Mendelism**	Mendel's laws of heredity, Test cross, Incomplete dominance and simple problems, Interaction of Genes: Supplementary factors, Comb pattern in fowls, Complementary genes: Flower color in sweet peas, Multiple factors: Skin color in human beings, Epistasis: Plumage colour in poultry, Multiple allelism: Blood groups in human beings, Concepts of allosomes and autosomes, XX-XY, XX-XO, ZW-ZZ, ZO-ZZ type, Linkage and Crossing Over, Mechanism and importance.	**8**	CO.4
7	**Mutations**	Spontaneous and induced mutations, Physical and chemical mutagens, Mutation at the molecular level, Mutations in plants, animals, and microbes for economic benefit of man. Human Genetics: Karyotype in man, inherited disorders: Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du- Chat syndrome).	**8**	CO.5
8	**DNA Damage and Repair**	DNA Damage and Repair: Causes and Types of DNA damage, Major mechanisms of DNA repair: photoreactivation, nucleotide and base excision repairs, mismatch repair, SOS repair.	**8**	CO.5

Reference Books:

Molecular Biology of cell – Bruce Alberts et al, Garland publications

Animal Cytology & Evolution – MJD, White Cambridge University Publications

Molecular Cell Biology – Daniel , Scientific American Books.

Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.

Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Sons Publications

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	2	2	1	
CO2	3	1					1	3	2	2	
CO3	3	1					1	3	2	3	
CO4	3	1					1	3	2	3	
CO5	3	1					1	3	2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25						
Course Code	B110101T / BS142	**Title of the Course**	Fundamentals of Biochemistry	**L**	**T**	**P**
Year	I	**Semester**	I	**3**	**1**	**0**
Pre-Requisite	10+2	**Co-requisite**				
Course Objectives	**The objective of this course is to develop an understanding of basics of biomolecules.**					

Course Outcomes	
CO1	To understand basic details of Normality, Molarity, Molality, per cent solutions, mole fractions, w/v and v/v solutions.Concept of pH, water as well as carbohydrate molecules and its classification.
CO2	To understand basic details of amino acid; protein molecules and its classification.
CO3	To understand basic details of lipid molecules and its classification.
CO4	To understand basic details of nucleic acid molecules and its classification.
CO5	To understand basic details of vitamin, Plant and animal hormones and their classification.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basics of Biochemistry**	General idea about Normality, Molarity, Molality, per cent solutions, mole fractions, w/v and v/v solutions. Concept of pH, water : a universal solvent.	6	**CO1**
2	**Carbohydrates**	Carbohydrates: structure, classification and properties of Monosaccharides, Disaccharides, and Polysaccharides (starch, glycogen, peptidoglycan, cellulose).	8	**CO1**
3	**Amino acids and proteins**	Structure, classification and properties of amino acids, peptide bond, proteins: primary, secondary (α-Helix, beta-pleated sheet), tertiary and quaternary structures, Ramachandran plot, structure of hemoglobin and myoglobin.	8	**CO2**
4	**Lipids and fats**	Lipids: Structure, function, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, Phospholipids, Lipoproteins.	8	**CO3**
5	**Nucleic acids**	Purines and pyrimidines, nucleosides, nucleotides, polynucleotides, DNA types: A DNA, B DNA and Z DNA and their function, RNA types: mRNA, rRNA and tRNA and their function, Forces stabilizing nucleic acidstructure.	8	**CO4**
6	**Vitamins**	Structure, sources, dietary requirements, function and deficiency disorders of water (B, C) and fat soluble vitamins (A, D, E and K).	8	**CO5**
7	**Plant hormones**	Plant hormones classification and function. Auxin, gibberellins, cytokinins, ethylene and abscisic acid.	6	**CO5**
8	**Animal hormones**	Animal hormones secreted by endocrine glands Hypothalamus, pituitary, thyroid gland, adrenal gland, pancrease and gonads. Their classification and function	8	**CO5**

Reference Books:

Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors

Biochemistry – Lubertstryer Freeman International Edition.

Biochemistry – Keshav Trehan Wiley Eastern Publications

Fundamentals of Bochemistry-J.L.JainS.Chand and Company

The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, Chapman and Hall Publications

Textbook of Organic Chemistry (A Modern Approach)

e-Learning Source:

https://www.khanacademy.org/

www.coursera.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3		1	2
CO2	3	1					1	3		2	2
CO3	3	1					1	3		3	2
CO4	3	1					1	3		3	2
CO5	3	1					1	3			

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B100103P/BS105	**Title of the Course**	Introduction to Cell Biology & Genetics Lab	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of use of Micrometer and calibration, measurement of onion epidermal cells and yeast, Cell division processes: Mitotic and meiotic studies, Chromosomes: polytene chromosomes, Karyotype analysis – with the help of slides and how to make Blood smear – differential staining and Buccal smear – Barr bodies.						

Course Outcomes	
CO1	Comprehend the use of Micrometer and calibration, measurement of cells
CO2	Have knowledge and can evaluate Cell division: Mitosis and meiosis
CO3	Analyze Chromosomes.
CO4	Have knowledge of types of chromosomes as polytene chromosomes
CO5	Make and analyze Blood smear – differential staining, Buccal smear – Barr bodies

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Exp 1	Use of Micrometer and calibration, measurement of onion epidermal cells and yeast cells.	4	**CO1**
2	Exp 2	Cell division: Mitotic studies in onion root tips	4	**CO2**
3	Exp 3	Cell division: Meiotic studies in grasshopper testes or flower bud	4	**CO2**
4	Exp 4	Chromosomes: Mounting of polytene chromosomes	4	**CO3**
5	Exp 5	Buccal smear – Barr bodies	4	**CO5**
6	Exp 6	Karyotype analysis – with the help of slides	4	**CO4**
7	Exp 7	Study of polytene chromosomes by slides	2	**CO4**
8	Exp 8	Blood smear – differential staining	4	**CO5**

Reference Books:

RF. (2012) Biochemistry laboratory: modern theory and techniques (2nd Edition). Pearson Education, Inc

e-Learning Source:

https://vlab.amrita.edu/index.php?brch=188&cnt=1&sim=1102&sub=3

https://vlab.amrita.edu/?sub=3&brch=188&sim=1102&cnt=2106

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3		3	1	3	2	3	
CO2	3	1		3		3	1	1		3	
CO3	3	1		3		3	1				3
CO4	3	1		3	3	3	1				3
CO5	3	1									

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B110102P /BS143	**Title of the Course**	Analytical Biochemistry Lab	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to familiarize the students with basic instruments used in Biochemistry and practical learning of Biomolecules.						

Course Outcomes	
CO1	Qualitative test for carbohydrates (Molisch test, Benedict test, Fehling test, Bradford and Iodine tests).
CO2	Estimation of vitamin C and Determination of pK A of glycine.
CO3	Perform spot test for amino acids in a given sample.
CO4	Estimate cholesterol in a given sample.
CO5	Perform DNA and RNA estimation in a given sample.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Exp 1	Qualitative test for carbohydrates (Molisch test, Benedict test, Fehling test,Bradford and Iodine tests).	6	**CO1**
2	Exp 2	Estimation of vitamin C and Determination of pK A of glycine.	6	**CO2**
3	Exp 3	Perform spot test for amino acids in a given sample.	6	**CO3**
4	Exp 4	Estimate cholesterol in a given sample.	6	**CO4**
5	Exp 5	Perform DNA and RNA estimation in a given sample.	6	**CO5**

Reference Books:

Books recommended: Boyer RF. (2012) Biochemistry laboratory: modern theory and techniques (2nd Edition). PearsonEducation, Inc.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1						3		3	
CO2	3	1		3		3	1	3	2	3	
CO3	3	1		3		3	1	1		3	
CO4	3	1		3		3	1				
CO5	3	1		3	3	3	1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B110205V/BS146	**Title of the Course**	Basic Microbiology and Biosafety Measures	**L**	**T**	**P**	**C**
Year	1	**Semester**	I	**2**	**0**	**1**	**3**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	On completion of this course, students will be able to develop an understanding of basics of microbiology, general classification of microbes, control of microorganisms, basics of recombination in prokaryotes, microbial interaction with environment.						

Course Outcomes	
CO1	Know the basics of microbiology, bacteriophage, stains and staining techniques, general classification of microbes.
CO2	Understand basics of structure of bacterial cell.
CO3	Study control measures for microorganisms.
CO4	Know the economic and pathogenic importance of microorganisms.
CO5	Discuss bio-safety measures.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Microorganisms, Traditional Indian Knowledge**	Theory: Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. Fermentation in Ayurvedic medicine. Practical: Demonstration of fermentation process.	8	**CO1**
2	**Structure of bacterial cell**	Theory: Ultrastructure of bacterial cell, Composition and detailed structure of gram positive and gram-negative cell walls, Archaebacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS). Effect of antibiotics and enzymes on the cell wall. Structure, function and chemical composition of bacterial cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: Structure, formation, stages of sporulation. Practical: Bacterial media preparation, culture, and growth curve determination.	8	**CO2**
3	**Control of microorganisms**	Theory: Sterilization-physical agents (autoclave, hot air oven, laminar air flow and membrane filter), chemical agents (Alcohol, Halogens and Gaseous agents, antibiotics), radiation methods (UV rays). Practical: Sterilization of media.	8	**CO3**
4	**Economic & pathogenic importance of microorganisms**	Theory: Common pathogenic microorganisms- bacterial gall, viral (TMV), fungal (red rot disease of sugar cane), multidrug resistance, *Mtb*. Fermentation: ethanol & antibiotics production. Practical: Demonstration of bioreactor working.	8	**CO4**
5	**Bio-safety measures**	Theory: Historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; biosafety guidelines - Government of India; definition of GMOs; roles of Institutional Biosafety Committee, RCGM, GEAC etc. Practical: Demonstration of different Biosafety cabinets.	8	**CO5**

Reference Books:

Srilakshmi B (2018): Food Science, 7th Colour Ed. New Age International (P) Ltd.

Mann J and TruswellS (2017): Essentials of Human Nutrition, 5th Ed. Oxford University Press.

Srilakshmi B (2017): Nutrition Science,6th Multicolour Ed. New Age International (P) Ltd.

e-Learning Source:

https://www.khanacademy.org/

www.coursera.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1					1	2	2	1	
CO2	3	1					1	3	2	2	
CO3	3	1					1	3	2	3	
CO4	3	1					1	3	2	3	
CO5	3	1					1	3	2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	Z010101T/ BE105	**Title of the Course**	Food, Nutrition, and Hygiene	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	I	**2**	**0**	**0**	**2**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	**To learn the basic concept of food, nutrition, hygiene, and common diseases prevalent in society along with 1000 days nutrition concept**						

Course Outcomes	
CO1	To learn the basic concept of the Food and Nutrition, and meal planning
CO2	To learn about macro and micronutrientsand theirs RDA, sources, functions, deficiency, and excess.
CO3	To learn 1000 days Nutrition Concept and study the nutritive requirement during special conditions like pregnancy and lactation.
CO4	To study common health issues in the society and to learn the special requirement of food during common illness.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Concept of Food and Nutrition	(a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food	8	CO1
2	Nutrients: Macro andMicro RDA, Sources, Functions, Deficiency and excess of	(a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fibre	7	CO2
3	1000 days Nutrition	(a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)	8	CO3
4	Community Health Concept	(a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity Constipation Diarrhea Typhoid	7	CO4
5	Community Health Concept	(b) National and International Program and Policies for improving Dietary Nutrition (c) Immunity Boosting Food	4	CO5

Reference Books:

Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.

SheelSharma,Nutrition and Diet Therapy,Peepee Publishers Delhi,2014,First Edition.

1000Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf

https://pediatrics.aappublications.org/content/141/2/e20173716

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/

e-Learning Source:

https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutritionDiploma in Human Nutrition-Revised Offered by Alison

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	-	-	-	2	2	3	2	3	3	2	2		
CO2	-	-	-	3	2	3	2	3	3	2	2		
CO3	-	-	-	3	3	2	3	3	-	-	2		
CO4	-	-	3	3	3	3	3	3	3	2	3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	A050101T/ HM101	**Title of the Course**	RASHTRA GAURAV	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	**2**	**0**	**0**	**2**
Pre-Requisite	10+2	**Co-requisite**	None				
Course Objectives	The objective of the course on "Rashtra Gaurav" is to explore and critically analyze the multifaceted dimensions of national pride and glory, as depicted in the paper. Participants will delve into the historical, cultural, social, and political aspects that contribute to the concept of "Rashtra Gaurav" (National Pride) in the context of the specific themes and perspectives presented in the paper. Through in-depth discussions, readings, and interactive sessions, participants will gain a comprehensive understanding of the factors that shape and define a nation's sense of pride, and how these factors influence individual and collective identities. The course aims to foster a nuanced appreciation for the significance of "Rashtra Gaurav" in contemporary society, encouraging participants to critically evaluate its implications and applications within diverse global contexts.						

Course Outcomes	
CO1	To understand the basics of Indian Society and culture.
CO2	To analyze the fundamental issues in India.
CO3	To understand Indian Heritage.
CO4	To examine the philosophical and spiritual developments in India.
CO5	To evaluate the contributions of Major National Characters and Personalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INDIAN SOCIETY & CULTURE	• Unity in Diversity • Art forms, Literature, Culture from Ancient to Modern time. • National and International Awards & Awardees	05	01
2	ISSUES IN INDIA	• Issues of Gender Equality and role of Women Organisations • Issues of Poverty and Development • Social Empowerment through Social Movements in India	05	02
3	INDIAN HERITAGE	• Cultural Heritage in India: Buddhist Monuments at Sanchi, Ajanta & Ellora Caves, Khajuraho, Taj Mahal • Tourist Places in India: Red Fort, Ambar Palace, Kaziranga National Park, Ram Mandir (Ayodhya)	04	03
4	PHILOSOPHICAL AND SPIRITUAL DEVELOPMENTS	• Sufism & Bhakti Movement: Bulleh Shah, Data Ganj Baksh, Khwaja Moinuddin Chishti, and Nizamuddin Auliya.Tulsidas, Surdas, Meera, Nank & Kabir • Jainism: Mahavir's biography and education • Buddhism: The life of Buddha, Contributions of Buddhism to India's Culture	05	04
5	MAJOR NATIONAL CHARACTERS AND PERSONALITIES	• Ashoka the Great and His Dhamma • Raja Ram Mohan Roy & Brahmo Samaj • Savitribai Phule: A Social Reformer and contribution in Women Education • Swami Vivekanand and his philosophies • Mahatma Gandhi: Role of Gandhi in Indian National Movement • Dr. Bhimrao Ambedkar: A Chief architect of the Indian Constitution	06	05

Reference Books:

Jawaharlal Nehru - "The Discovery of India"
B.R. Ambedkar - "Annihilation of Caste"
Ramachandra Guha - "India After Gandhi: The History of the World's Largest Democracy"
Mahatma Gandhi – "My Experiment with Truth"
S C Dubey- "Indian Society"
Nadeem Hasnain – "Indian Society and Culture" G Shah- "Social Movements in India"

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)									
PO-PSO CO	PO1	PO2	PO3	PO4	P05	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	3	2	2	3	2	1	2
CO2	3	2	2	3	1	2	3	1	2	1
CO3	1	2	2	2	2	3	2	3	3	2
CO4	1	3	2	3	2	3	2	3	1	3
CO5	2	3	1	2	2	3	1	3	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign and seal of HoD**

Effective from Session: 2024-25							
Course Code	B100201T/BS115	**Title of the Course**	Human Physiology	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	This course is designed to enable the students to develop the understanding of the basic of organs and organ system and their physiological importance.						

Course Outcomes	
CO1	Summarize the digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice
CO2	Will understand about respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift, composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.
CO3	Summarize excretion: modes of excretion, Ornithine cycle, Mechanism of urine form
CO4	Discuss mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat, and ECG, Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction, mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters
CO5	Discuss mechanism of action of hormones (insulin and steroids), Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Digestion: structure of digestive system and mechanism	Digestion: structure of digestive system, Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice	8	CO1
2	Respiration	Respiration: structure of lungs, Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.	7	CO2
3	Blood composition and coagulation	Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood.	8	CO2
4	Mechanism of working of heart	Mechanism of working of heart: structure of heart, Cardiac output, cardiac cycle, Origin & conduction of heart beat and ECG, double and single circulation	7	CO4
5	Structure of muscles	Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.	7	CO4
6	structure of kidney	Excretion: structure of kidney and nephron, modes of excretion, Ornithine cycle, Mechanism of urine formation.	8	CO3
7	Mechanism of nerve impulse	Mechanism of generation & propagation of nerve impulse, action potential, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters	5	CO4
8	Mechanism of action of hormones	Mechanism of action of hormones (insulin and steroids), Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.	10	CO5

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2.FoxSI – HumanPhysiology,(1998): (McGrawHill,,ISBN:0071157069)

3. Tortora ,G.J.&Grabowski,S.(2006).Principal of Anatomy &Physiolohy.XIEdition.Johnwiley&sons,Inc.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**					**1**	**2**	3		1			
CO2	**3**					**1**	**1**	3		1			
CO3	**3**					**1**	**1**	3		1			
CO4	**3**			**1**		**1**	**1**		2	1			
CO5	**3**			**1**		**1**	**1**		2	1			

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B110203T /BS154	**Title of the Course**	Clinical Biochemistry	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	**This course is designed to enable the students to develop the understanding of the basic of various clinical test for different biomolecules along with metabolisms.**						

Course Outcomes	
CO1	Discuss what standard solution, specimen collection and processing (Blood, urine, faeces) and how to transport of specimens.
CO2	Explain the composition and their functions, erythrocyte indices. Clotting time, Bleeding time, Prothrombin time, and Complete blood count, determination of Hb, PCV and ESR. Anticoagulant preservatives for blood and urine, Blood coagulation system, Anemia:- classifications, Hemoglobinopathies, Thalassemias.
CO3	Discuss the dorder in carbohydrate metabolism: Regulation of blood sugar, Glycosuria-types of glycosuria. Oral glucose tolerance test in normal and diabetic condition. Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis. Disorder in lipid metabolism: Lipid and lipoproteins: Classifications, composition, mode of action. Cholesterol: Factors affecting blood cholesterol level. Dyslipoproteinemias, atherosclerosis, risk factor and fatty liver.
CO4	Explain the Liver function test: Metabolism of bilirubin, jaundice - types, differential diagnosis. Liver function test –Icteric index, Vandenberg test, plasma protein changes. Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and troponin. Clinical significance of SGOT, SGPT,ALP, ACP, CPK and LDH
CO5	Describe the Renal function test: Clearance test–Urea, Creatinine, Inulin, para-aminohippuric acid (PAH) test,Concentration and dilution test.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basics of clinical biochemistry**	A brief review of units and abbreviations used in expressing concentrations and standard solutions. Specimen collection and processing (Blood, urine, faeces). Transport of specimens.	6	**CO1**
2	**Blood composition andcounts**	Composition and their functions, erythrocyte indices. Clotting time, Bleeding time, Prothrombin time, and Complete blood count, determination of Hb, PCV and ESR.	8	**CO1**
3	**Blood preservatives and relateddiseases**	Anticoagulant preservatives for blood and urine, Blood coagulation system, Anemia:- classifications, Hemoglobinopathies, Thalassemias.	8	**CO2**
4	**Disorder in carbohydrate metabolism**	Regulation of blood sugar, Glycosuria-types of glycosuria. Oral glucose tolerance test in normal and diabetic condition. Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis.	8	**CO3**
5	**Disorder in lipid metabolism**	Lipid and lipoproteins: Classifications, composition, mode of action. Cholesterol: Factors affecting blood cholesterol level. Dyslipoproteinemias, atheroscelorosis, risk factor and fatty liver.	8	**CO4**
6	**Liver function test**	Metabolism of bilirubin, jaundice - types, differential diagnosis. Liver function test- Icteric index, Vandenberg test, plasma protein changes. Involvement of enzymes in diagnostics of heart disease including aspartatetransaminase, isoenzymes of creatine kinase and troponin.	8	**CO5**
7	**Renal functiontest**	Clearance test–Urea, Creatinine, Inulin, para-aminohippuric acid (PAH) test, Concentration and dilution test.	8	**CO5**
8	**Enzymology**	Clinical significance of SGOT, SGPT, ALP, ACP, CPK and LDH	6	**CO4**

Reference Books:

Medical Biochemistry by MN Chatterjee, Rana Shinde, 8 edition, 2013, Jaypee publications.

Textbook of Medical Laboratory Technology by Praful B. Godkar and Darshan P. Godkar th

Medical Laboratory Technology by Ramnik sood, 5 Edition, 1999, Jaypee publishers.

e-Learning Source:

https://www.khanacademy.org/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3					1	2	3		2	
CO2	3					1	1	3		2	
CO3	3					2	1	3	1	2	
CO4	3				2	1	1		1	1	
CO5	3				1	1	1			1	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B100202P/BS152	**Title of the Course**	Human Physiology Lab	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**0**	**0**	**6**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	This course is designed to develop the understanding of the basic knowledge of Blood grouping, blood coagulation, haemoglobin, TLC, DLC and enzyme action.						

Course Outcomes	
CO1	Analyze Blood Grouping
CO2	Perform and analyze counting of RBCs,TLC and DLC
CO3	Perform and analyze coagulation of blood
CO4	Have knowledge of enzyme action
CO5	Perform and analyze Haemoglobin

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp -01**	Finding the coagulation time of blood	10	**CO1**
2	**Exp -02**	Determination of blood glucose level with the help of glucometer.	10	**CO2**
3	**Exp -03**	Counting of mammalian RBCs	10	**CO3**
4	**Exp -04**	Determination of TLC and DLC	10	**CO4**
5	**Exp -05**	Estimation of haemoglobin by haemocytometer.	10	**CO5**
6	**Exp -06**	Demonstration of action of salivary amylase enzyme from saliva.	10	**CO4**

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2.FoxSI – HumanPhysiology,(1998): (McGrawHill,,ISBN:0071157069)

3.Tortora ,G.J.&Grabowski,S.(2006).Principal of Anatomy &Physiolohy.XIEdition.Johnwiley&sons,Inc.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO6	PSO7
CO1	3	3	1				3	3	3	3	1		
CO2	3	3	1				3	3	3	3	1		
CO3	3	3	1				3	3	3	3	1		
CO4	3	3	1				3	3	3	3	1		
CO5	3	3	1				3	3	3	3	1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2023-24							
Course Code	B110204P/ BS155	**Title of the Course**	Clinical Biochemistry Lab	**L**	**T**	**P**	**C**
Year	1st year	**Semester**	II	**0**	**0**	**6**	**2**
Pre-Requisite	**10+2**	**Co-requisite**					
Course Objectives	This course is designed to develop the understanding of the basic knowledge of haemoglobin, diabetes, cholesterol, urea, creatinine, ALP, SGOT and SGPT						

Course Outcomes	
CO1	Understand the basics of haemoglobin analysis
CO2	Learn basics of diabetes determination
CO3	Have knowledge about serum cholesterol and urea estimation
CO4	Learn basics of creatinine, alkaline phosphatase, SGOT and SGPT
CO5	Understand specific gravity of urine

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp -01**	Estimation of haemoglobin by cyanmethemoglobin method	4	**CO1**
2	**Exp -02**	Determination of serum albumin-globlin (A-G) ratio in blood	4	**CO1**
3	**Exp -03**	Quantitative analysis of blood sugar by glucometer and GOD-POD method	4	**CO2**
4	**Exp -04**	Determination of serum total cholesterol	4	**CO3**
5	**Exp -05**	Analysis of blood urea in serum	4	**CO3**
6	**Exp -06**	Estimation of serum creatinine and alkaline phosphatase activity	4	**CO4**
7	**Exp -07**	Quantitative analysis of SGOT and SGPT	4	**CO4**
8	**Exp -08**	Determination of specific gravity of urine	4	**CO5**

Reference Books:

1. Text book of Biochemistry with clinical correlation, Thomas M. Devlin, 3rd edition, A. JohnWiley-Liss Inc. Publication.
2. Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi.
3. A Manual of Lab Techniques, NIN, Hyderabad

e-Learning Source:

https://vlab.amrita.edu/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO6	PSO7
CO1	3						3	3		3			
CO2	3						3	3		3			
CO3	3						3	3		3			
CO4	3						3	3		3			
CO5	3						3	3		3			

Name & Sign of Program Coordinator	Sign & Seal of HoD

Effective from Session: 2024-25							
Course Code	B030202T/MT148	**Title of the Course**	Basic Mathematics & Statistic	**L**	**T**	**P**	**C**
Year	1	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of elementary mathematics. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able to explore subject into their respective dimensions						

Course Outcomes	
CO1	Students will be able to interpret limits and continuity of functions. Also they can find differential coefficient, differentiation of functions including function of a function, differentiation of parametric form, simple and successive differentiation.
CO2	Students will evaluate and interpret integration as an inverse of differentiation; They will be able to find indefinite integrals of standard form, integration by parts, by substitution and by partial fraction method. They can evaluate definite integrals.
CO3	Students can describe the basic concepts of simple random sampling and stratified random sampling. They can understand and find measures of central tendency (mean, median and mode), measures of variation (mean deviation and standard deviation), measure of coefficient if variation. Student will be able to understand and evaluate covariance and correlations, Karl Pearson's Coefficient of correlation and Spearman's coefficient of rank correlation. They can also be able to find regression by method of least squares.
CO4	Students can interpret the fundamental principle of counting. They will also be able to find permutations, permutations under certain conditions, combinations, combinatorial identities. They can also apply Binomial theorem (without proof)
CO5	Students will be able to understand the random experiment and associated sample space, events. They can also find probability and can use addition and multiplication theorems for finding probability (without proof). They will be able to understand probability distributions, and will be able to find Binomial, Poisson and Normal distributions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Limit and continuity**	Set and functions, left hand limit and right hand limit, limits of function, continuity of function	7	**1**
2	**Differentiability**	Definition of differential coefficient, differentiation of function including function of a function, differentiation of parametric form, simple and successive differentiation, Leibnitz rule	8	**1**
3	**Integrations**	Integration as inverse of differentiation, indefinite integrals of standard form, integration by parts, substitution method and partial fraction method. evaluation of definite integrals.	8	**2**
4	**UnivariateStatistics**	Basic concepts of simple random sampling and stratified random sampling, measures of central tendency (mean, median and mode), measures of variation (mean deviation, quartile deviation and standard deviation), coefficient of variation	7	**3**
5	**BivariateStatistics**	Covariance, correlations, scatter diagram, Karl Pearson's coefficient of correlation, Spearman'scoefficient of rank correlation, regression and its coefficient, estimation of regression lines by the method of least square	7	**3**
6	**Permutations and Combinations**	Fundamental principle of counting, permutations, permutations under certain conditions, combinations, combinatorial identities, Binomial theorem (without proof), some applications of Binomial theorem	7	**4**
7	**Probabilitytheory**	Random experiment and associated sample space, events, definition of probability, algebra ofevents, addition and multiplication theorems on probability (without proof), conditional probability, Baye's theorem	8	**5**
8	**Probability Distributions**	Probability distribution, probability mass function, probability distribution function, expectations, Binomial, Poisson, normal distributions and their mean and variance, fitting the expected frequency of Binomial and Poisson distributions.	8	**5**

Reference Books:

1. Murray R. Spiegel, 1980, Probability and Statistics, Schaum's (Outline Series) McGraw-Hill Book Co.
2. Q. S. Ahmad, V. Ismail and S. A. Khan: Biostatistics, Laxmi Publications Pvt. Ltd.
3. E. Kreyszig, "Advanced Engineering Mathematics", 5th Edition, Wiley Eastern, 1985.

e-Learning Source:

1. NPTEL, MOOC

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	`	1	-	-	-	-	3	2	-	-	2	2
CO2	3	1	-	-	-	-	3	2	-	-	2	1
CO3	3	3	-	-	-	-	3	2	-	-	1	2
CO4	3	1	-	-	-	-	-3	2	-	-	2	3
CO5	3	3	-	-	-	-	3	2	-	-	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	**LN110/A040203T**	**Title of the Course**	Aspects & Approaches to Communication	**L**	**T**	**P**	**C**
Year	**1st**	**Semester**	**1st and 2nd**	**5**	**1**	**0**	**6**
Pre-Requisite	**10+2**	**Co-requisite**	**None**				
Category	**Minor**						

Course Outcomes: After completing the course students shall be able to.	
CO1	Students will develop a basic understanding of Communication and professional communication
CO2	Students will be able to understand the importance of communicative English and its role in academic and non-academic environments
CO3	They will develop an understanding of English as a Language and its linguistic approaches.
CO4	They will develop an insight into Listening Skills to face the challenges of the professional world.
CO5	They will analyze and understand the concept of speaking skills in various situations

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Title of the unit: Professional Communication**	Professional Communication: Its Meaning and Importance, Essentials of Effective Communication, Barriers toEffective Communication. Communication Techniques	18	CO1
2	**Communication in English:**	Age of Globalization and the need to communicate in English, English as the first or Second Language. Uses of English in academic and non-academic situations in India	18	CO2
3	**Language Acquisition and Language Learning**	Language: Definition, characteristics, and importance of Language Linguistics: Definition, nature, scope, branches, levels, and types of Linguistics, Organs of Speech	18	CO3
4	**Communication Skills: Listening Skills**	Active listening Benefits of Effective Listening Barriers to Listening **Communication Skills: Speaking Skills** International Phonetic Alphabet (IPA Symbol)	18	CO4
5	**Communication Skills: Reading Skills**	Purpose, Process, Methodologies Skimming and Scanning **Communication Skills: Writing Skills** Elements of Effective Writing Precis Writing Note-taking	18	CO5

Reference Books:

1-Kumar, Sanjay and Pushp Lata., Communication Skills. Oxford University Press, Oxford 2011

2-Raman, Meenakshi, and Sangeeta Sharma. Technical Communication: Principals and Practice. Second Edition, Oxford University Press, 2012

3-Raina, Roshan Lal, Iftikhar Alam, and Faizia Siddiqui, Professional Communication. Himalaya Publication House 2012.

4-Agarwal, Malti. Professional Communication. Krishna's Educational Publishers. 2016.

5-http://www.uptunotes.com/notes-professional-communication-unit-i-nas-104..

6- https://www.docsity.com/en/subjects/professional-communication/

7- https://www.docsity.com/en/subjects/professional-communication/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		3	3	2	1		2		2		2	
CO2		3	3	2	1		2		2		2	
CO3		3	3	2	1		2		2		2	
CO4		3	3	2	1		2		2		2	
CO5		3	3	2	1		2		2		2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correla

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B100205V/ BS381	**Title of the Course**	Food Adulteration	**L**	**T**	**P**	**C**
Year	1	**Semester**	II	**2**	**0**	**1**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	**To learn the basic concept of food adulteration and its prevalence in society along with consumer rights**						

Course Outcomes	
CO1	Describe adulteration and its effect on health
CO2	Describe adulteration of different food items and methods of detection
CO3	To Understand laws related to food adulteration
CO4	To understand consumer rights and responsibilities related to food adulteration
CO5	To understand commonly used food additives and their harmful effects

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Common Foods and Adulteration**	Theory: Adulteration- Definition, Types- Poisonous substances, Foreign matter, Cheap substitutes, Spoiled parts. Common Foods subjected to adulteration. International and incidental. General Impact on Human Health. Practical: Methods for detecting adulterants in milk.	8	**CO1**
2	**Adulteration of Common Foods and Methods of Detection**	Theory: Means of Adulteration, Methods of Detection Adulteration in the following: Foods,Oil, and Grains. Sugar Additives and Sweetening agents. Practical: Methods of detecting adulterants present in common food items including processed food.	8	**CO2**
3	**Present Laws and Procedures on Adulteration**	Theory: Highlights of Food Safety and Standards Act 2006 (FSSA), Food Safety and Standards Authority of India, Rules and Procedures of Local Authorities. Role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies, Private testing laboratories, Quality control laboratories of consumer co- operatives. Practical: Case studies involving food safety issues.	8	**CO3**
4	**Consumer rights**	Theory: Consumer rights and responsibilities related to food adulteration • Consumer education, Consumer's problems rights and responsibilities, • COPRA 2019 • Offenses and penalties Procedures to Complain- Compensation to Victims. Practical: Case studies on food safety and consumer rights.	8	**CO4**
5	**Food Additives**	Theory: Adulteration through FoodAdditives- Food colors, flavor enhancers, antimicrobial agents, curing and pickling agents, enzymes, neutralizing agents, stabilizing agents. Concept of sanitation and hygienic production of food. Practical: Adulteration through food additives.	8	**CO5**

Reference Books:

1. A first cource in food analysis- A. Y. Sathe, New Age International (P) Ltd., 1999
2. FoodSafety, casestudies- Ramesh. V. Bhat, NIN. 1992
3. Http://old.fssai.gov.in/portals/o/pdf/Draft Manuals/Beverages and confectionary.pdf
4. Http://cbseportal.com/project/Download- CBSE=XII-Chemistry-project-food-

e-Learning Source:

https://indianlegalsolution.com/laws-on-food-adulteration/ https://fssai.gov.in/dart/
https://byjus.com/biology/food-adulteration/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	-	-	-	2	2	3	2	3	3	2	2		
CO2	-	-	-	3	2	3	2	3	3	2	2		
CO3	-	-	-	3	3	2	3	3	-	-	2		
CO4	-	-	3	3	3	3	3	3	3	2	3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Effective from Session: 2024-25							
Course Code	Z020201T/NS110	**Title of the Course**	First Aid and Health	**L**	**T**	**P**	**C**
Year	First	**Semester**	Second	2	0	0	2
Pre-Requisite	10+2	**Co-requisite**	-				
Course Objectives	This course aims to educate fundamental and essential understanding of first aid and sex education.						

Course Outcomes	
CO1	Learn the skill needed to assess the ill or injured person and learn the skills to provide CPR to infants, children and adults.
CO2	Learn the skills to handle emergency child birth and learn the Basic sex education help young people navigate thorny questions responsibly andwith confidence.
CO3	Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.
CO4	Help to understand natural changes of adolescence
CO5	Learn the skill to identify Mental Health status and Psychological First Aid

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Fundamentals of First Aid-I	A. Basic First Aid • Aims of first aid & First aid and the law. • Dealing with an emergency, Resuscitation (basic CPR). • Recovery position, Initial top to toe assessment. • Hand washing and Hygiene • Types and Content of a First aid Kit B. First AID Technique • Dressings and Bandages. • Fast evacuation techniques (single rescuer). • Transport techniques. C. First aid related with respiratory system • Basics of Respiration • No breathing or difficult breathing, Drowning, Choking, Strangulation andhanging, • Swelling within the throat, Suffocation by smoke or gases and Asthma. D. First aid related with Heart, Blood and Circulation • Basics of The heart and the blood circulation. • Chest discomfort, bleeding. E. First aid related with Wounds and Injuries • Type of wounds, Small cuts and abrasions • Head, Chest, Abdominal injuries • Amputation, Crush injuries, Shock F. First aid related with Bones, Joints Muscle related injuries • Basics of The skeleton, Joints and Muscles. • Fractures (injuries to bones).	8	1,2
2	Fundamentals of First Aid-II	G. First aid related with Nervous system and Unconsciousness • Basics of the nervous system. • Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. H. First aid related with Gastrointestinal Tract • Basics of The gastrointestinal system. • Diarrhea, Food poisoning. I. First aid related with Skin, Burns • Basics of The skin. • Burn wounds, Dry burns and scalds (burns from fire, heat and steam). • Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke. • Frost bites (cold burns), Prevention of burns, Fever and Hypothermia. J. First aid related with Poisoning • Poisoning by swallowing, Gases, Injection, Skin K. First aid related with Bites and Stings • Animal bites, Snake bites, Insect stings and bites L. First aid related with Sense organs • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. • Swallowed foreign objects. M. Specific emergency satiation and disaster management • Emergencies at educational institutes and work • Road and traffic accidents. • Emergencies in rural areas. • Disasters and multiple casualty accidents. • Triage. • Emergency Child birth	8	2.3

	Fundamentals of Sex Education-I	Basic Sex Education • Overview, ground rules, and a pre-test • Basics of Urinary system and Reproductive system. • Male puberty — physical and emotional changes • Female puberty — physical and emotional changes • Male-female similarities and differences • Sexual intercourse, pregnancy, and childbirth • Facts, attitudes, and myths about LGBTQ+ issues and identities • Birth control and abortion • Sex without love — harassment, sexual abuse, and rape • Prevention of sexually transmitted diseases	7	4
4	Fundamentals of Sex Education-II	• Mental Health and Psychological First Aid • What is Mental Health First Aid? • Mental Health Problems in the India • The Mental Health First Aid Action Plan • Understanding Depression and Anxiety Disorders • Crisis First Aid for Suicidal Behavior & Depressive symptoms • What is Non-Suicidal Self-Injury? • Non-crisis First Aid for Depression and Anxiety • Crisis First Aid for Panic Attacks, Traumatic events • Understanding Disorders in Which Psychosis may Occur • Crisis First Aid for Acute Psychosis	7	5

Reference Books:
Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf
Red Cross First Aid/CPR/AED Instructor Manual
https://mhfa.com.au/courses/public/types/youthedition4
Finkelhor, D. (2009). The prevention of childhood sexual abuse. Durham, NH: Crimes Against Children Research Center.
Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.
e-Learning Source:
https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online
www.unh.edu/ccrc/pdf/CV192. pdf
https://www.firstaidforfree.com/
https://www.coursera.org/learn/psychological-first-aid
https://www.coursera.org/learn/mental-health

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	-	-	-	-	-	2	-	-	2	1
CO2	1	3	-	-	-	-	-	2	-	-	3	3
CO3	2	3	-	-	-	-	-	3	-	-	2	2
CO4	3	2	-	-	-	-	-	1	-	-	3	3
CO5	3	3	-	-	-	-	-	3	-	-	2	3

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B100208T/ BS116	**Title of the Course**	Artificial Intelligence in Biological Sciences	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**0**	**0**	**0**	**0**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The curriculum aims to equip biological sciences students with the essential knowledge and skills to leverage artificial intelligence for innovative research and applications in their field.						

Course Outcomes	
CO1	The students will be able to explain components, scope and ethical consideration in AI.
CO2	The students will be able to explain basics of machine learning.
CO3	The students will be able to collect, clean, analyze sequences, predict protein structure, and network analysis in system biology.
CO4	The students will be able to carry out biodiversity modelling and text mining for literature review.
CO5	The students will be able to explain use of AI in drug discovery

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
UNIT 1	**Introduction to artificial intelligence**	History and evolution of AI, comparison of human and computer skills, Components of AI, scope and significance, applications, limitations and implications in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. **Problem-solving through AI:** Defining the problem as a state space search, analysing the problem, solving the problem by searching, informed search, and uninformed Search	**8**	**CO1**
UNIT 2	**Machine Learning Basics**	Neural networks and deep learning, Supervised and unsupervised learning, feature selection and engineering, learning from observation, and knowledge in learning. **Natural Language Processing:** Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system.	**8**	**CO2**
UNIT 3	**AI Techniques in Systems Biology**	Computational Biology and Bioinformatics: Introduction to bioinformatics tools and databases, Sequence analysis and protein structure prediction, Predictive modelling for gene expression, Network analysis in systems biology. Data collection and cleaning for biological datasets, Exploratory data analysis, Statistical tools for data interpretation.	**8**	**CO3**
UNIT 4	**Data Science for Biologists**	AI for Ecological Modelling: Environmental data analysis and modeling, Biodiversity monitoring using AI, Conservation strategies with machine learning. Text mining for literature review in life sciences, and Automated annotation of biological texts. Personalized medicine and genetic diagnostics, AI in Drug Discovery: Virtual screening using machine learning, Predictive modeling for drug interactions, Optimization algorithms in drug design.	**8**	**CO4,5**

Reference Books:

1. Ghosh, Z. and Mallick, B. (2008). Bioinformatics: Principles and Applications. Oxford University Press.
2. Lesk M. Arthur (2014). Introduction to Bioinformatics. Oxford University Press
3. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition, Wiley Blackwell.
4. Artificial Intelligence and Molecular Biology (Lawrence E. Hunter)

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	3	2	1
CO2	3	1					2	3	3	2	1
CO3	3	1					1	3	3	2	1
CO4	3	1					1	3	3	2	1
CO5	3	1					1	3	3	2	1

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B100301T/ BS207	**Title of the Course**	Molecular Biology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the concept of different types of genes, DNA replication, Transcription, Translation, regulation of Gene expression in prokaryotes and eukaryotes.						

Course Outcomes	
CO1	The students will be able to explain the basic concept of genome organization.
CO2	The students will be able to explain the process of DNA replication and its regulation in prokaryotes and eukaryotes and DNA repair systems.
CO3	The students will be able to explain the process of transcription in prokaryotes and eukaryotes and post transcriptional modifications.
CO4	The students will be able to describe the basics of translation in prokaryotes and eukaryotes and post translational modification.
CO5	The students will be able to discuss regulation in gene expression and significance of different classes of DNA.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basic Concepts of genome and its organization**	Importance of Molecular Biology, Nucleic acid as the genetic material, Central Dogma of Molecular Biology, Model organisms for studying Molecular Biology, Genome and its organization in prokaryotes and Eukaryotes: Gene, Genome, Exon, Intron, regulatory sequence, Nucleosome structure and packaging of DNA into higher order structures.	**8**	CO1
2	**DNA Replication**	Semiconservative mode of replication. Mechanism of Replication in prokaryotes and eukaryotes. Enzymes and proteins involved in replication, Theta model and Rolling circle model, Inhibitors of Replication.	**8**	CO2
3	**DNA Damage, Repair and Mutation**	Causes and types of DNA damage, Mechanism of DNA repair, Molecular basis and types of mutation. Ames test.	**6**	CO3
4	**Transcription**	Transcription process in prokaryotes and eukaryotes. Enzymes, promoter, and transcription factors. Inhibitors of transcription Actinomycin D and α- Amanitin.	**8**	CO4
5	**Translation**	Components of Protein synthesis machinery: Messenger RNA, tRNA structure and function, Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly, Mechanism of protein synthesis in prokaryotes and Eukaryotes.	**8**	CO4
6	**Post-Transcription and Post-Translation Modifications**	Post-transcriptional modifications of eukaryotic mRNA (capping, polyadenylation and splicing, post-translational modifications of proteins.	**8**	CO5
7	**Gene expression**	Principles of gene regulation, negative and positive regulation, concept of operons, Regulation of gene expression in prokaryotes and eukaryotes; Lac operon and Trp operon concept	**8**	CO5
8	**Classes of DNA sequences**	Satellite DNA, Split genes, Pseudogenes, Transposable elements, Retroelements, LINEs, SINEs.	**6**	CO5

Reference Books:

1. Lewin B. (2000). Genes VII. Oxford University press.
2. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1987). Molecular biology of the gene.
3. Lodish H, Baltimore D, Berk A, Zipursky SL, Darnell J. (1995). Molecular cell biology.
4. Brown, TA Genomes (2020).
1. Lewin B. (2000). Genes VII. Oxford University press.

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	2	2	1	
CO2	3	1					1	3	2	2	
CO3	3	1					1	3	2	3	
CO4	3	1					1	3	2	3	
CO5	3	1					1	3	2	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B110301T/BS245	**Title of the Course**	Tools and Techniques in Biochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basic principles, working and application of commonly used biophysical techniques like Chromatography, Centrifugation, Electrophoresis, Microscopy, Spectroscopy and Radioactivity including GM counters and Scintillation counting.						

Course Outcomes	
CO1	Understand the chemical bonding.
CO2	Understand the basics and types of Chromatography and Centrifugation.
CO3	Study the principles and applications of Electrophoresis and Microscopy.
CO4	Understand the principles and applications of Spectroscopy techniques.
CO5	Understand the importance of Radioactivity in biological studies, GM counters and Scintillation counting.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Basics of Biophysics**	Chemical bonding – Ionic bond, Covalent bond, Hydrogen bond and Vander-Waals force	**6**	**CO1**
2	**Chromatography**	Introduction & principle of Chromatography, Paper, Thin-layer, HPLC, GLC, Molecular sieving, Ion exchange chromatography, Affinity chromatography	**8**	**CO2**
3	**Centrifugation**	Principle of centrifugation, Basic rules of sedimentation, Sedimentation coefficient, Various types of centrifuges, Low speed centrifuge, High speed centrifuge and Ultracentrifuge, Types of rotors, Application of centrifugation, Differential centrifugation, Density gradient centrifugation- Zonal and Isopycnic.	**8**	**CO2**
4	**Electrophoresis**	Basic principle, Instrumentation and types of Electrophoresis, Agarose gel electrophoresis, PAGE, SDS-PAGE	**6**	**CO3**
5	**Microscopy**	Principle of Light microscopy, Phase contrast microscopy, Fluorescence microscopy, Electron microscopy, TEM and SEM, Permanent and temporary slide preparation	**8**	**CO3**
6	**Spectroscopic techniques I**	Colorimetry, UV-Visible spectrophotometry and Beer-Lambert law, Fluorescence spectroscopy, Infra-Red spectroscopy.	**8**	**CO4**
7	**Spectroscopic techniques II**	Circular Dichroism, Nuclear Magnetic Resonance spectrometry, Atomic absorption, Emission spectrometry, X Ray diffraction, Mass spectrometry	**8**	**CO4**
8	**Radioactivity**	Radioactivity, Types, their importance in biological studies, Measure of radioactivity, GM counters, Scintillation counting.	**8**	**CO5**

Reference Books:

1. Narayanan, P: Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Keith Wilson & John Walker: Principles and Techniques of Biochemistry and Molecular Biology.
3. Upadhyay, Upadhyay and Nath: Biophysical Chemistry: Principle and Techniques.
4. David Sheehan: Physical Biochemistry Principle and Applications.
5. Sabari Ghosal & A. K. Srivastava: Fundamentals of Bioanalytical techniques and Instrumentation.

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3			3
CO2	3	1					2	3			3
CO3	3	1					2	3			3
CO4	3	1					2	3			3
CO5	3	1					2	3			3

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B190302P/BS209	**Title of the Course**	Molecular Biology Lab	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to train the students in basic and some advanced techniques of Molecular biology.						

Course Outcomes	
CO1	The students will be able to isolate genomic DNA from bacteria.
CO2	The students will be able to isolate genomic DNA from plant or animal tissues.
CO3	The students will be able to isolate plasmid DNA (*E. coli*).
CO4	The students will be able to perform restriction digestion of DNA.
CO5	The students will be able to perform Agarose Gel Electrophoresis.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Isolation of genomic DNA from bacteria (*E. coli)*	4	**CO1**
2	Exp-02	Isolation of genomic DNA from plant tissue	6	**CO2**
3	Exp-03	Isolation of genomic DNA from animal tissue	6	**CO2**
4	Exp-04	Isolation of plasmid DNA (*E. coli*)	4	**CO3**
5	Exp-05	Restriction digestion of DNA	2	**CO4**
6	Exp-06	Agarose Gel Electrophoresis	2	**CO5**

Reference Books:

1. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown

2. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd Ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1						3		3	
CO2	3	1		3		3	1	3	2	3	
CO3	3	1		3		3	1	1		3	
CO4	3	1		3		3	1				3
CO5	3	1		3	3	3	1				3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B100303V /BS247	**Title of the Course**	Molecular Diagnostics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**0**	**3**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop an understanding of the basic principle and application of molecular techniques employed in diagnosis of diseases.						

Course Outcomes	
CO1	To gain the basic knowledge about mechanism and pathogenesis of common diseases.
CO2	To understand basic details of pathogenesis and diagnosis of infectious diseases caused by bacteria, fungi, virus, and protozoa.
CO3	To understand basic details of basic principle & application of classical genotyping techniques.
CO4	To understand basic details of types of cancers, genetics and types of cancer and applications of Molecular Diagnostics for Human Cancers.
CO5	To understand basic details of principle and application of Molecular diagnostics techniques such as PCR, Real- Time PCR, DNA Sequencing, Microarray etc.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Human Genome & common diseases	Introduction and mechanism related to the human genome, such as gene expression, replication and genome maintenance. Consequences of mutations and polymorphisms, and impacts of genes and environment on major common diseases, such as cancer, diabetes, vascular and coronary disease	10	CO1
2	Infectious Diseases and History of Diagnostics	Types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Infection mode of transmission in infections, factors predisposing to microbial pathogenicity. Diagnosis of infectious diseases caused by bacteria, fungi, viruses, protozoa and Helminthes.	10	CO2
3	Major Genetic disorders, its causes & Diagnosis.	Genetic disorders; Sickle cell anaemia, Duchene muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex – linked inherited disorders	10	CO3
4	Cancer Biology and Diagnostics	Different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes, Applications of Molecular Diagnostics for Human Cancers.	8	CO4
5	Molecular Diagnostics Tools	RT- PCR, Animal cell culture, DNA Sequencing, Microarray, Techniques of Nucleic acid Extraction, Real time PCR, Fluorescence In Situ Hybridization.	7	CO5

Reference Books:

"Murray's Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller

"Medical Microbiology" by David Greenwood, Richard C. B. Slack, Michael R. Barer, Will L. Irving

"Kuby Immunology" by Judy Owen, Jenni Punt, Sharon Stranford

"Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. Lichtman

e-Learning Source:

vlab.amrita.edu

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1				1	3		1	3
CO2	3	1					1	2		2	3
CO3	3	1		3			1	3		3	2
CO4	3	1					1	2		3	2
CO5	3	1					1	3		3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B110302P/ BS246	**Title of the Course**	Biochemical Tools and Techniques	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	This course is designed to enable the students to develop the understanding of Beer's law, methods of protein estimation, chromatography and electrophoresis techniques.						

Course Outcomes	
CO1	Have knowledge of Beer's Law and Estimation of proteins.
CO2	Know how to detect Amino acids by TLC/ Paper chromatography.
CO3	Know how to perform Agarose Gel Electrophoresis and SDS PAGE.
CO4	Know how to isolate mitochondria.
CO5	Learn about the staining Visualization of cells by methylene blue

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp. 1**	Verification of Beer's Law	**6**	**CO1**
2	**Exp. 2**	Estimation of proteins by Biuret/Lowry method	**6**	**CO1**
3	**Exp. 3**	Separation of amino acid acids by TLC/paper chromatography	**6**	**CO2**
4	**Exp. 4**	To perform agarose gel electrophoresis	**6**	**CO3**
5	**Exp. 5**	To perform agarose SDS PAGE	**6**	**CO3**
6	**Exp. 6**	To isolate mitochondria by differential centrifugation	**6**	**CO4**
7	**Exp. 7**	Visualization of cells by methylene blue	**6**	**CO5**

Reference Books:

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.
3. Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 1998,
4. Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010.

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3			2	3	2		
CO2	3	1		3			2	3	2		
CO3	3	1		3			2	3	2		
CO4	3	1					2	3	2		
CO5	3	1					2	3	2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B100403T/ BS256	**Title of the Course**	Infection and immunity	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	**The objective of this course is to develop an understanding of the basics of infection and immunity**						

Course Outcomes	
CO1	To understand basic details of infectious diseases and its transmission
CO2	To understand basic details of Laboratory Diagnosis of Infectious Agents
CO3	To understand basic details of antigens, immune system organization and types of immunity
CO4	To understand basic details of Structure and functions of MHC molecules and complement activation
CO5	To understand basic details of Immunological techniques, Immune response and Vaccination

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	History and transmission of infectious diseases	Definition and Historical perspectives of infectious diseases, Modes of Transmission and Pathogenesis of Infectious Diseases: Adherence and invasion mechanisms, toxigenesis and virulence factors, Host-pathogen interactions	8	CO1
2	Laboratory Diagnosis of Infectious Agents	Laboratory Diagnosis of Infectious Agents: Sample collection and handling, Microscopic examination and staining techniques, Culture, biochemical tests, and serological assays; Infection Control Measures: Standard precautions and isolation techniques, Sterilization, disinfection, and decontamination, Surveillance and outbreak investigation	8	CO2
3	Immune system organization	History of Immune system, Types of immunity Humoral & Cell Mediated. The cells and organs of the immune system. Innate immunity. Anatomical barriers, cell types of innate immunity, connection between innate and adaptive immunity	8	CO3
4	Types of Immunity and antigenic determinants	Adaptive immunity: Antigens and haptens. Structure and distribution of classes and substances of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Generation of antibody diversity	8	CO3
5	Structure and functions of MHC molecules	Structure and functions of MHC molecules (MHC I and II), Endogenous and exogenous pathways of antigen processing and presentation	6	CO4
6	Complement and its activation	Complement and its activation by classical, alternate and lectin pathway; biological consequences of complement activation; regulation of complement activity	6	CO4
7	Immunological techniques	Immunological methods-Antigen-antibody interactions. Agglutination, hemagglutination. Precipitin reactions in solution and in gels; immunoassays. Selection, Antigen presentation, Activation of T and B cells. Cytokines	8	CO5
8	Immune response and Vaccination	Immunological tolerance-Primary and secondary. Hypersensitivity and its types. Immune response against major classes of pathogens. Vaccines: Live attenuated, Inactivated, Toxoid, subunit/conjugate vaccine. Monoclonal Antibody	8	CO5

Reference Books:

"Murray's Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller

"Medical Microbiology" by David Greenwood, Richard C. B. Slack, Michael R. Barer, Will L. Irving

"Kuby Immunology" by Judy Owen, Jenni Punt, Sharon Stranford

"Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. Lichtman

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1				1	3		1	3
CO2	3	1					1	2		2	3
CO3	3	1		3			1	3		3	2
CO4	3	1					1	2		3	2
CO5	3	1					1	3		3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B110401T/BS254	**Title of the Course**	Enzymes and hormones	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	UG in Biological Sciences	**Co-requisite**					
Course Objectives	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 Outcomes	
CO1	The students will understand the general properties of enzymes and their classification & nomenclature.
CO2	The students will understand the theories of enzyme kinetics.
CO3	The students will understand the mechanisms of enzyme catalysis and enzyme inhibition & activation.
CO4	The students will understand the multisubstrate enzyme kinetics and enzyme Immobilization and its clinical & industrial use.
CO5	The students will understand the functions of plant and animal hormones

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Classification and nomenclature of enzymes	General properties of enzymes. Mechanism of enzyme action: Chymotrypsin, ribonuclease, activation of transition metal cation, activation by alkaline earth metal cation, nicotinamide nucleotide, flavin nucleotide and adenosine phosphate.	8	CO1
2	Enzyme kinetics	Michaelis-Menten initial rate equation based on equilibrium assumption, Briggs Haldane steady state approach, integrated form of the Michaelis equation, methods for the determination of Km and Vmax normalized initial rate equation and normalized curves, Haldane relationship.	8	CO2
3	Effect of factors and inhibitors on enzyme kinetics	Effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions. Enzyme inhibition and activation: Types of reversible inhibitors, qualitative analysis of data, derivation of equations for different types of inhibitions, determination of inhibitor constant, determination of activator constant.	8	CO3
4	Multisubstrate enzyme kinetics	Multisubstrate enzyme kinetics: random bi-bi, and ping pong reactions. Intracellular localization of enzymes, purification of enzymes and tests for homogeneity.	6	CO4
5	Applied Enzymology	Immobilization; kinetics of immobilized systems. Isozymes. Allosteric enzymes. Industrial and clinical scope of enzymes.	6	CO4
6	Plant Hormones	Classification, structural features & functions in Plants: Auxins, gibberellins, Cytokinins, ethylene, and abscisic acid	8	CO5
7	Animal Hormones I	Classification, structural features &Functions of hormones secreted by endocrine glands: Hypothalamus, pituitary gland- anterior pituitary and posterior pituitary, thyroid gland	8	CO5
8	Animal Hormones II	Classification, structural features &Functions of hormones secreted by endocrine glands: adrenal gland, Pancreas, gonads	8	CO5

Reference Books:

1. Enzymes Biochemistry, Biotechnology, Clinical Chemistry Authors: T Palmer, P L Bonner; Woodhead Publishing
2. Biochemistry – Lubert Stryer Freeman International Edition.
3. Lehninger: Principles of Biochemistry (2017) by Nelson and Cox Seventh edition, WH Freman and Co.
4. Enzyme Structure and Mechanism; Publisher W H Freeman & Co, New York; Alan Fersht
5. Enzymes: Authors: Malcolm Dixon, Edwin C. Webb; Academic Press

e-Learning Source:

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				2	1	3			
CO2	3	1				2	1	3			
CO3	3	1				2	1	3			
CO4	3	1				2	1	3			
CO5	3	1				2	1	3			

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B110402P/BS257	Immunological Techniques Lab	Enzymes and hormones lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students learn about basics of enzymes and hormones						

Course Outcomes	
CO1	Know how to isolate enzyme
CO2	Know how to determine enzyme activity.
CO3	Know how to study the effect of varying substrate and inhibitor concentration on the enzyme activity
CO4	Know how to study the effect of pH and temperature on the enzyme activity.
CO5	Know the effect of plant growth hormone

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp. 1**	Isolation of enzyme crude extract and determination of enzyme activity	**6**	**CO1**
2	**Exp. 2**	Study of the effect of pH on the enzyme activity.	**6**	**CO2**
3	**Exp. 3**	Study of the effect of varying substrate concentration on the enzyme activity and determination of Km and Vmax.	**6**	**CO3**
4	**Exp. 4**	Study of the effect of temperature on the enzyme activity.	**6**	**CO4**
5	**Exp. 5**	Study of the effect of inhibitors on the enzyme activity.	**6**	**CO4**
6	**Exp. 6**	Study the effect of any plant growth hormone	**6**	**CO5**

Reference Books:

1. Asim Roy Kumar, IMMUNOLOGY THEORY & PRACTICAL, 5TH SEM. (KALYANI PUB.) 2. Talwar Gupta A Handbook of Practical & Clinical Immunology 3. A.K. Abbas and A.H. Lichtman, Saunders, Basic Immunology, W.B. Company

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3			2	3	2		
CO2	3	1		3			2	3	2		
CO3	3	1		3			2	3	2		
CO4	3	1					2	3	2		
CO5	3	1					2	3	2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B100404P/BS258	Immunological Techniques Lab	Immunological Techniques Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students learn about basics of immunology, types of Blood grouping, cell counts, ELISA, Ouchterlony Double diffusion (ODD) and Separation of serum from blood & precipitation of Immunoglobulins						

Course Outcomes	
CO1	Analyze Blood grouping
CO2	Perform and analyze differential counting of WBC and detergent lysis of RBC
CO3	Perform and analyze Dot Elisa, ELISA
CO4	Have knowledge of and can perform Ouchterlony Double diffusion assay
CO5	Perform and analyze separation of serum from blood & precipitation of Immunoglobulin

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp. 1**	Blood grouping	**6**	**CO1**
2	**Exp. 2**	Differential Count of WBC	**6**	**CO1**
3	**Exp. 3**	Detergent lysis of RBC	**6**	**CO2**
4	**Exp. 4**	Dot Elisa	**6**	**CO3**
5	**Exp. 5**	ELISA – Demonstration	**6**	**CO3**
6	**Exp. 6**	Ouchterlony Double diffusion (ODD)	**6**	**CO4**
7	**Exp. 7**	Separation of serum from blood & precipitation of Immunoglobulins	**6**	**CO5**

Reference Books:

1. Asim Roy Kumar, IMMUNOLOGY THEORY & PRACTICAL, 5TH SEM. (KALYANI PUB.) 2. Talwar Gupta A Handbook of Practical & Clinical Immunology 3. A.K. Abbas and A.H. Lichtman, Saunders, Basic Immunology, W.B. Company

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3			2	3	2		
CO2	3	1		3			2	3	2		
CO3	3	1		3			2	3	2		
CO4	3	1					2	3	2		
CO5	3	1					2	3	2		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B110405V/ BS259	**Title of the Course**	Molecular Medicine	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop an understanding of principle and application of the molecular medicine.						

Course Outcomes	
CO1	To understand basic knowledge of working, design, and requirements a molecular medicine lab set up along with sample handling and preparation in lab.
CO2	To understand basic understanding of conformations of Biomolecules and diseases related to protein mis- folding.
CO3	To understand basic details the principle and methodology employed for the studying tissue and cell structure, and different preparative procedures for light and electron microscopic visualization
CO4	To understand basic details about the principle and technical aspects of animal cell culture.
CO5	To understand basic details about principle and application of several molecular techniques employed in diagnosis of diseases.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Molecular Medicine Lab	Molecular Laboratory Set up: Introduction, Design, Requirements, Laboratory, Good Clinical Laboratory Practice (GCLP), buffer preparation, micro-pipetting, Measurement of pH of solutions, molarity, normality and molality calculation and graph plot, sample collection, handling and storage etc. used in laboratory.	8	CO1
2	Biomolecule Conformations & related disorders	Conformation of Biomolecules: Nucleic acids: A-, B-, Z-DNA forms. Ramachandran plot, Secondary, Tertiary and Quaternary structure, Domains, Motif and Folds. Protein misfolding: diseases and diagnosis	8	CO2
3	Cell Imaging and Interpretation	Principles and constituents of compound, fluorescence, phase contrast, differential interference contrast and dark field microscopy, Preparation of cells and tissues for light and electron microscopy.	8	CO3
4	Animal Cell Culture	Description and maintenance of animal cell culture, aseptic technique, cloning and selection of specific cell types, contamination, methods for measuring viability and cytotoxicity, cell culture environment (substrate, gas phase, medium) and the culturing of specific cell types	8	CO4
5	Molecular Diagnostics Techniques	Role of PCR & its variants in diseases diagnosis, Nucleic acid Extraction Protocol (DNA & RNA), Polymorphism based disease diagnostics techniques such as RFLP and RAPD.	6	CO5

Reference Books:

" Berg, J.M., Tymoczko, J.L. and Stryer, L. (2010). Biochemistry. W.H. Freeman & Company. USA.

"Medical Microbiology" by David Greenwood, Richard C. B. Slack, Michael R. Barer, Will L. Irving

"Kuby Immunology" by Judy Owen, Jenni Punt, Sharon Stranford

"Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. Lichtman

e-Learning Source:

vlab.amrita.edu

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1				1	3		1	3
CO2	3	1					1	2		2	3
CO3	3	1		3			1	3		3	2
CO4	3	1					1	2		3	2
CO5	3	1					1	3		3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HOD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110501T / BS344	**Title of the Course**	Bioenergetics and Metabolism	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The course has been designed to: ● Understand the concepts of metabolism, characteristics of anabolic and catabolic pathways. ● Gain a detailed knowledge of various metabolic pathways and their regulations ● Gain knowledge about the diseases/in-born error caused by defects in metabolism						

Course Outcomes	
CO1	The students will understand the concept of thermodynamics and laws associated with it
CO2	The students will understand the metabolism of carbohydrate and electron transport chain along with the diseases associated with metabolic irregularities
CO3	The students will understand the metabolism of lipids and its type, its regulation, abnormal lipid metabolism and diseases associated
CO4	The students will understand the metabolism of protein and nucleic acids. The concept of deamination and transamination. *De-novo* and salvage pathways of nucleotide synthesis and disorders associated
CO5	The students will understand the concept of photosynthesis and nitrogen metabolisms in plants.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Principle of Bioenergetics	Bioenergetics and thermodynamics, Laws of Thermodynamics, Gibbs free energy, enthalpy, Entropy and their relationships, ATP as universal currency in biological system, Coenzymes and proteins as universal electron carriers	**6**	**CO1**
2	Carbohydrate Metabolism	Glycolysis, TCA cycle, Pentose phosphate pathway, Gluconeogenesis and Glycogen metabolism, Diseases associated with metabolic irregularities	**8**	**CO2**
3	Oxidative phosphorylation	The electron transport chain - its organization and function, Peter Mitchell's chemiosmotic hypothesis and Proton motive force, FoF1ATP synthase, structure and mechanism of ATP synthesis.	**6**	**CO2**
4	Lipid Metabolism	Oxidation of fatty acids, β oxidation, ω oxidation and α oxidation, Ketone-body metabolism, Cholesterol biosynthesis, Regulation of fatty acid metabolism, Diseases associated with abnormal lipid metabolism	**8**	**CO3**
5	Protein Metabolism	Urea Cycle, Transport of ammonia, Deamination and transamination reactions, Inborn errors of protein metabolism, Glucogenic and ketogenic amino acids, Overview of amino acid synthesis	**8**	**CO4**
6	Nucleic Acid Metabolism	*De novo* synthesis of purine and pyrimidine nucleotides, Salvage pathways, Degradation of purine and pyrimidine nucleotides, Disorders of purine and pyrimidine metabolism	**8**	**CO4**
7	Photosynthesis	Light harvesting and photosynthetic electron transport, Water splitting, formation of H+ gradient and photophosphorylation, Calvin cycle, and its regulation, Photo respiration, C4 and CAM pathways in plants	**8**	**CO5**
8	Nitrogen metabolism	Nitrogen cycle, biological nitrogen fixation by free living and in symbiotic association Structure and function of the enzyme nitrogenase, Nitrate assimilation: Nitrate and Nitrite reductase	**8**	**CO5**

Reference Books:

1. Lehninger,Albert, Cox,Michael M. Nelson, David.(2017) Lehninger Principles of biochemistry/NewYork:W.H.Freeman.
2. Voet,D.,&Voet, J.G.(2011). Biochemistry.NewYork:J.Wiley&Sons
3. Biochemistry – Lubert stryer Freeman International Edition.
4. Biochemistry – Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Bochemistry-J.L.Jain S.Chand and Company
6. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition
10. Hopkins, W.G., Huner, N.P.,. Introduction to Plant Physiology. John Wiley & Sons,

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4

CO1	3	1					2	3			3
CO2	3	1					2	3			3
CO3	3	1					2	3			3
CO4	3	1					2	3			3
CO5	3	1					2	3			3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100503 T / BS319	**Title of the Course**	Genetic Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 in Biology	**Co-requisite**					
Course Objectives	The course has been designed to make students aware of DNA manipulative enzymes and Gene cloning vectors, Screening and selection of recombinants, Techniques used as Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing and Application of r-DNA techniques						

Course Outcomes	
CO1	Get proper knowledge about the DNA manipulative enzymes: Restriction enzymes and DNA ligases, and Gene cloning vectors, In vitro construction of recombinant DNA molecules
CO2	Gain knowledge about isolation of genomic and plasmid DNA, creation of rDNA and methods of Transformation
CO3	Learn about screening and selection of recombinant host cells, Gene Libraries, cloning techniques, Expression of cloned DNA
CO4	Learn about the basics of Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Blotting techniques.
CO5	Gain knowledge of Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	DNA manipulative enzymes	Restriction enzymes, DNA ligases, Polymerases, Kinases, Alkaline phosphatases, Reverse Transcriptase	8	CO-1
2	Vectors	Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmids. *In vitro* construction of recombinant DNA molecules (pBR332, pUC19)	8	CO-1
3	Isolation of DNA	Isolation of genomic and plasmid DNA	8	CO-2
4	rDNA	Creation of r-DNA, Transformation of r-DNA by different methods.	8	CO-2
5	Screening and selection of recombinant host cells	Immunological screening, colony hybridization and blue-white screening.	6	CO-3
6	Gene Libraries	Preparation and comparison of Genomic DNA and cDNA library, Expression of cloned DNA in *E. coli*.	8	CO-3
7	Techniques	Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Sanger's method, Blotting techniques: Southern, Western and Northern blot.	8	CO-4
8	Applications	Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.	8	CO-5

Reference Books:

1. Glick, B.R & Pasternak J.J (1994) Molecular Biotechnology, Princi[ples and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (186) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Steitz J.A and Weiner A.M (1988). Molecular biology of society for Microbiology
6. Lewin b. (1994) Genes VI, New York, Oxford University Press

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3	3	3	
CO2	3	1					2	3	3	3	
CO3	3	1					2	3	3	3	
CO4	3	1		2	2		3	3	3	3	
CO5	3	1		1	1	1	3	3	3	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110503T/ BS345	**Title of the Course**	Plant Biochemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	• The course has been designed to: • Understand the plant cell, photosynthesis, transporters and important primary metabolites. • Illustrate plant growth regulators, plant's responses to various biotic and abiotic stresses • Explain about plant secondary metabolites and their functional importance.						
Course Outcomes							
CO1	The students will understand the concept of plant cell structure and membrane transport across plant membrane.						
CO2	The students will understand the biotic and abiotic stresses and plants response under these conditions.						
CO3	The students will understand various types of plant hormones and their mode of action.						
CO4	The students will understand the structure and importance of secondary metabolites.						
CO5	The students will understand the concept of photosynthesis and nitrogen metabolisms in plants.						

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant cell structure	Plant cell- structure and molecular components: Cytoskeleton, Chemical and physical composition of cell wall. Structure of cellulose, hemicellulose and pectin. Plant cell division.	8	CO1
2	Plant cell membrane transport	Plant cell membranes and membrane transport: Introduction to plant cell membranes and membrane constituents. Organization of transport systems across plant membranes; Different types of transporters in plant cell and organelle membranes; Ion channels- properties and significance; Aquaporins.	8	CO1
3	Biotic stress	Plant responses to biotic stresses: Introduction; plant pathogens and diseases; plant defense systems-hypersensitive response; systemic acquired resistance.	6	CO2
4	Abiotic stress	Plant responses to abiotic stress- Salt stress, drought and heavy metal stress responses.	8	CO2
5	Plant hormones	Plant growth regulators: Role of auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids, polyamines, jasmonic acid and salicylic acid.	8	CO3
6	Secondary metabolites	Plant Secondary Metabolites: An overview of primary metabolism contribution to secondary metabolites biosynthesis. Classification of plant secondary metabolites. Alkaloids, Phenolics and Terpenoids: General characteristics and classification with examples. Applications of secondary metabolites in plant defense. Physiologically active secondary metabolites in modern medicine and therapeutic compounds for human ailments.	8	CO4
7	Nitrogen metabolism	Nitrogen assimilation: Nitrate and nitrite reduction. Fixation of molecular nitrogen	6	CO5
8	Photosynthesis	Carbon assimilation: An overview of photosynthesis; electron transport in higher plants and its relation with the carbon fixation pathways. C3, C4 plants and crassulacean acid metabolism (CAM); photorespiration; Phytochromes.	8	CO5

Reference Books:

1. Lehninger,Albert, Cox,Michael M. Nelson, David.(2017) Lehninger Principles of biochemistry/NewYork:W.H.Freeman.
2. Voet,D.,&Voet, J.G.(2011). Biochemistry.NewYork:J.Wiley&Sons
3. Biochemistry – Lubert stryer Freeman International Edition.
4. Biochemistry – Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Bochemistry-J.L.Jain S.Chand and Company
6. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition
10. Hopkins, W.G., Huner, N.P.,. Introduction to Plant Physiology. John Wiley & Sons,

e-Learning Source:

PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**		**PSO4**

CO										PSO 3	
CO1	3	1				2		3			
CO2	3	1				2		3			
CO3	3	1				2		3			
CO4	3	1				2		3			
CO5	3	1				2		3			

1. Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110504T / BS346	**Title of the Course**	Industrial and environmental biotechnology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to get proper knowledge about Structural and Functional dynamics of microbes for fermentation; understand upstream processing and downstream processing for industrial production using fermenters, understanding of environmental biotechnology, bioremediation, waste management, bioleaching, biofuel						

Course Outcomes	
CO1	Get proper knowledge about Structural and Functional dynamics of microbes for fermentation.
CO2	Know about environmental pollutant and their impact
CO3	Learn about the basics of the general design of fermenter; Processing; and products obtained by industrial microbiological fermentation
CO4	Gain knowledge about bioremediation, Solid waste treatment and wastewater Treatment
CO5	Have knowledge about production of biofuel and GMOs.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Structural and Functional dynamics of microbes**	Structural and Functional dynamics of microbes; Microbial diversity; screening for new metabolites: primary and secondary products; strain improvement through selection, mutations and recombination	**7**	**CO1**
2	**Environment and pollution**	Characteristics of environment; Water, soil and air as a component of environment, Pollutants: Nature, origin, source, monitoring and their impacts; Air, Water and Noise pollution; conventional fuels and their environmental impact; bioreporters, biosensors and their applications	**8**	**CO2**
3	**Bioprocess technology**	Design and working of a typical fermenter; basic principle components of fermentation technology. Types of fermentation – Batch, Fedbatch and Continuous culture.	**8**	**CO3**
4	**Production of alcohols, antibiotic and enzymes**	Production of alcohols (Ethanol) and organic acids (citric and acetic); production of biologically active compounds: antibiotics (penicillin) and enzymes (amylase, protease); production of microbial food and single cell proteins; bioreactor for immobilized cells/enzyme system.	**8**	**CO3**
5	**Bioremediation**	Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents; degradation of lignin and cellulose using microbes, degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products; phytoremediation	**9**	**CO4**
6	**Waste Treatment**	SWM: Integrated Waste management, solid waste processing (Mechanical, thermal and biological), WWM: Primary, secondary and tertiary treatment	**7**	**CO4**
7	**Biofuel**	Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol.	**7**	**CO5**
8	**Use of genetically modified organisms**	Environmental significance of genetically modified microbes, plants and animals; Bioleaching, Biodegradable plastics, Biopesticides, Biofertilizer	**6**	**CO5**

Reference Books:

1. Ritmann R and McCarty P L (2000). Environmental Biotechnology: Principle & Applications. 2nd Ed., McGraw Hill Science.
2. Benny Joseph (2005) Environmental Studies, Tata McGraw Hill.
3. Bailey J E and Ollis D F. (1986). Biochemical Engineering Fundamentals. New York: McGraw-Hill.
4. Chapman JL . Ecology: Principal & Application. Cambridge Univ. Press.
5. Stanbury P F and Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press
6. Crueger W and Crueger A (2002) Cruegers Biotechnology: A Textbook of Industrial Microbiology. Third Edition, Panima Publishing Corp., New Delhi.
7. Odum E and Barret G. (2004) Fundamentals of Ecology. Nataraj Publication.

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				3	1	3	3	3	1
CO2	3	1				2	1	3	3	3	1
CO3	3	1				3	3	3	3	3	1
CO4	3	1				3	3	3	3	3	1
CO5	3	1		1	2	3	1	3	3	3	1

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110502P / BS347	**Title of the Course**	Metabolism Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The course is designed to train the students in fundamentals of enzymology and metabolism.						

Course Outcomes	
CO1	The students will be able to isolate enzyme determine enzympe kinetics
CO2	The students will be able to perform biochemical tests related to starch hydrolysis, gelatin Liquefaction
CO3	The students will be able to perform amylase assay
CO4	The students will be able to perform cholesterol estimation
CO5	The students will be able to understand rhizobium from root nodules of legumes

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Isolation of enzyme and determination of enzyme activity	3	CO-1
2	Exp-02	Study of the effect of varying substrate concentration on the enzyme activity and determination of Km and Vmax.	3	CO-1
3	Exp-03	Biochemical tests–starch hydrolysis, gelatin Liquefaction	3	CO-2
4	Exp-04	Assay of salivary amylase	3	CO-3
5	Exp-05	Cholesterol estimation	6	CO-4
6	Exp-06	Study of Rhizobium from root nodules of legumes	6	CO-5

Reference Books:

1. Wilson, K and Walker, J (eds 2000 Principles and Techniques of Practical Biochemistry, 5th edn Cambridge University Press
2. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
3. Trevor Palmer and Philip Bonner 2008 Enzymes Biochemistry, Biotechnology, Clinical Chemistry, 2nd edn EWP

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1						3		3	
CO2	3	1		3		3	1	3	2	3	
CO3	3	1		3		3	1	1		3	
CO4	3	1		3		3	1				3
CO5	3	1		3	3	3	1				3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100504P / BS320	**Title of the Course**	Genetic Engineering Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basics of genetic engineering and PCR.						

Course Outcomes	
CO1	The students will be able to isolate genomic DNA from bacteria, plant, and animal tissues.
CO2	The students will be able to isolate plasmid DNA (*E. coli*).
CO3	The students will be able to perform restriction digestion of DNA.
CO4	The students will be able to perform Agarose Gel Electrophoresis.
CO5	The students will be able to explain Polymerase Chain Reaction.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Isolation of genomic DNA from bacteria (E. coli)	6	CO-1
2	Exp-02	Isolation of genomic DNA from plant and animal tissue	6	CO-1
3	Exp-03	Isolation of plasmid DNA (E. coli)	6	CO-1
4	Exp-04	Restriction digestion of DNA	6	CO-2
5	Exp-05	Agarose Gel Electrophoresis	6	CO-3
6	Exp-06	Demonstration of PCR	6	CO-4

Reference Books:

1. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown
2. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd Ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1						3		3	
CO2	3	1		3		3	1	3	2	3	
CO3	3	1		3		3	1	1		3	
CO4	3	1		3		3	1				3
CO5	3	1		3	3	3	1				3

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100507R / BS392	**Title of the Course**	Industrial visit and survey report	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**4**	**4**
Pre-Requisite	**10+2**	**Co-requisite**					
Course Objectives	The main objective of this course is to provide the students an exposure to various research activities and acquaint the student with state of the art technique/instruments used in various reputed research institutions and industries.						

Course Outcomes	
CO1	To develop understanding of state of the art techniques/instruments used in various reputed research institutions.
CO2	To develop understanding of state of the art techniques/instruments used in various reputed research institutions. and industries
CO3	To prepare the tour report.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				3	1	3	3	2	3
CO2	3	1				3	2	3	3	2	3
CO3	3	1				3	1	3	3	2	3
CO4	3	1				3	1	3	3	2	3
CO5	3	1				3	1	3	3	2	3

3- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110603 T/BS353	**Title of the Course**	Biostatistics, Bioinformatics and computer application in Biochemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basic principles, working and application of Biostatistics, Bioinformatics and computer application						

Course Outcomes	
CO1	Understand the principles of biological data collection, statistical analysis and presentation. Collect, analyze and interpret biological data using appropriate statistical tools. Learn and appreciate various factors that influence type of sample collected and sample size.
CO2	Formulate and justify appropriate choices in technology, strategy, and analysis for a range of projects involving DNA, RNA, or protein sequence data. Explain common methods and applications for analysis of gene or protein expression.
CO3	Improvise their computational, mathematical and computer skills, which would increase their eligibility to pursue research based higher education.
CO4	Acquire proficiency in sequence alignment methods, both global and local, and database similarity searching using heuristic algorithms, along with an overview of phylogenetic studies.
CO5	Use data visualization software to effectively communicate results.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Handling of data	Tabulation and diagrammatic representation of data, Bar diagram and pie diagram, Measures of central tendency: mean, median and mode. Measures of dispersion: range, quartile deviation, mean deviation and standard deviation, Coefficient of variation.	**4**	**CO1**
2	Tests of significance	Null hypothesis and alternative hypothesis, Z-test, Student's distribution, Paired t – test, F-test for equality of population variances. Contingency table, Chi-square test for goodness of fit and independence of attributes, Correlation analysis	**8**	**CO1**
3	Molecular Techniques	DNA sequencing, Polymerase Chain Reaction (PCR), Primer designing, DNA fingerprinting, site directed mutagenesis, RFLP, RAPD, Southern, Northern and Western Blotting	**4**	**CO2**
4	Basics of Computer and Bioinformatics	Operating systems, Hardware, Software, DOS, Data Access Using Data Control, Internet, LAN, WAN, Web servers. MS word office, excel ,powerpoint, Definition and need of Bioinformatics, Brief history of biological databases International nucleotide databases (e.g., Gen Bank, European Molecular Biology Laboratory (EMBL) Bio information and DNA Data Bank of Japan (DDBJ) Center), International Nucleotide Sequence Database Collaboration (INSDC).	**8**	**CO3**
5	Protein Databases	Classification of protein databases (e.g., primary, secondary, and composite databases), Brief overview of ExPASy (Expert Protein Analysis System) bioinformatics resource portal, Protein 3D structural databases (e.g., RCSB-PDB (Research Collaboratory for Structural Bioinformatics Protein Data Bank), and MMDB (Molecular Modeling Database) of NCBI)	**8**	**CO2**
6	Database Similarity Searches	BLAST, FASTA, PSI-BLAST, algorithms, Multiple sequence alignments - CLUSTAL, PRAS. Primer Designing, Homology Modeling, Phylogenetic analysis Drug Designing, Determination of Secondary & Tertiary of proteins	**8**	**CO4**
7	Biological File Formats and Literatures Databases	Brief overview of biological sequence and 3D structure file formats (e.g., GenBank/GenPept, EMBL, FASTA, PIR, and PDB), NCBI's literature databases (e.g., PubMed, PubMed Central, PubChem Project and OMIM database	**8**	**CO5**
8	Database Similarity Searching and Phylogenetics	Requirements of database searching, BLAST (Basic Local Alignment Search Tool) algorithm, Statistical significance and variants of BLAST FASTA algorithm and its statistical significance, Comparison of BLAST and FASTA, Brief Overview of phyogenetic analysis	**8**	**CO4**
Reference Books:				

D. W. Mount: Bioinformatics-sequence and genome analysis, Cold Spring Harbor Lab Press Goel, Deepa, and Shomini Parashar.
IPR, biosafety, and bioethics. Pearson Education India, 2013.
e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1											
CO2											
CO3											
CO4											
CO5											

4- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B110601T / BS355	**Title of the Course**	Food and Nutritional Biochemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 in Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of the basic concepts of nutritional biochemistry which comprises nutritional values of foods, dietary requirements of carbohydrates, lipids, proteins and the factors responsible for malnutrition and measures to overcome malnutrition in infants and adults.						

Course Outcomes	
CO1	Concept of nutrition, energy measurements, BMR, SDA, RNI and RDA
CO2	Classification, Functions, Bioavailability and deficiency of Minerals and vitamins
CO3	Distribution, composition and functions of fluid in human body
CO4	Classification, composition, food sources, functions of carbohydrates, proteins, fats and oils
CO5	Introduction to various clinical diagnostic tests

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Food and Nutrition	Food as a source of nutrients, Functions of food- Physiological, psychological and social, definition of nutrition, nutrients, adequate, optimum and good nutrition, malnutrition.	6	CO-1
2	Energy Metabolism	Unit of energy measurements of food stuffs by Bomb colorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.	8	CO-1
3	Minerals & Vitamins	Minerals Classification: Macronutrients and Micronutrients, Functions, sources, Bioavailability, and deficiency of minerals. Classification, Bioavailability, sources, functions and deficiency: Fat soluble vitamins- A, D, E and K, Water soluble vitamins- thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C	8	CO-2
4	Water metabolism	Distribution & composition of fluid in human body, ECF, ICF, Functions of water, fluid balance disorder of water metabolism, Homeostasis.	8	CO-3
5	Carbohydrates	Classification, composition, food sources, functions, storage in body.	8	CO-4
6	Fat and Oils	Classification, composition, saturated and unsaturated fatty acids, food sources, functions of fats.	8	CO-4
7	Proteins	Composition, , essential and non-essential amino acids, food sources, functions, protein deficiency.	8	CO-4
8	Biochemical test	Introduction to liver function test, Liver function test LFT profile, Glucose tolerance test, renal function test, Evaluation of filtration barrier, Total Protein Albumin/Globulin Ratio (A-G Ratio).	8	CO-5

Reference Books:

1. Tom Brody: Nutritional Biochemistry (Second Edition), Academic Press.
2. David A. Bender: Nutritional Biochemistry of the Vitamins, Second Edition, University College London, Cambridge University Press.
3. Harper's Illustrated Biochemistry, 29th edition, Mc Graw Hill Education, Lange
4. Denise R. Ferrier, Richard A. Harvey, Biochemistry (Lippincott Illustrated Reviews Series), 6th edition. Wolters Kluwer/Lipincott, Williams and Wilkins
5. Rekhi T and Yadav H (2014). Fundamentals of Food and Nutrition. Elite Publishing House Pvt Ltd., Delhi.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3			
CO2								3			
CO3	3	1					1	3			
CO4	3	1					1	3		1	
CO5	3	1					1			3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100607T/BS313	**Title of the Course**	**BIONANOTECHNOLOGY**	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of the Basics of nanotechnology and an overview of nanoscale materials, Nanomaterials: Biosensors: Biophotonics and Bioimaging and Principles of Toxicology;						

Course Outcomes	
CO1	Understand the basics of nanotechnology and overview of nanoscale materials.
CO2	Understand the basics of Nanomaterials.
CO3	Understand the basics of Biosensors.
CO4	Understand the basics of Biophotonics and Bioimaging.
CO5	Understand the Principles of toxicology.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction**	Introduction to nanotechnology and overview of nanoscale materials, the effect of length scale on properties,	6	CO.1
2	**Bionanotechnology**	Introduction to bionanotechnology, challenges and opportunities associated with biology on the Nanoscale, bionanotechnology systems, biological and medical applications of Bionanomaterials.	8	CO.1
3	**Nanomaterials**	Introduction to nanomaterials. DNA-based nanostructures. General surface and colloid chemistry, principles, experimental techniques, surface potential, DLVO theory; Characteristics of nanoparticles, chemical speciation of dissolved species, Environmental behavior of nanoparticles.	8	CO.2
4	**Characteristics of nanoparticles**	Characteristics of nanoparticles, chemical speciation of dissolved species, Environmental behavior of nanoparticles.	8	CO.2
5	**Biosensors**	Introduction to biosensors, the biological component, the sensor surface, Immobilization of the sensor molecule, Transduction of the sensor signal: Optical, Electrochemical and Mechanical sensors, Sensor stabilization	8	CO.3
6	**Biophotonics**	Overview of imaging biological systems, from the cellular level through to whole-body medical imaging, Introduction to biophysics,	6	CO.4
7	**Bioimaging**	Basic physical concepts in imaging, Major techniques using ionizing and non-ionizing radiation: fluorescence and multi-photon microscopy, spectroscopy, OCT, MRI, X-ray CT, PET and SPECT imaging.	8	CO.4
8	**Nanotoxicology**	Principles of toxicology; toxicology models, experimental toxicology studies; activation and detoxification mechanisms, importance of biological membrane in toxicology; Toxicology and bioaccumulation of particles. Biological activity of nanomaterials.	8	CO.5

Reference Books:

· Engines of Creation, K E Drexler, Oxford Paperbacks, New York
· .Engines of Creation, K E Drexler, Oxford Paperbacks, New York
· Nanosystems: Molecular Machinery, Manufacturing and Computation, K E Drexler, Wiley, ISBN 0471575186
· Our Molecular Future: How Nanotechnology, Robotics, Genetics and Artificial Intelligence Will Transform the World, Prometheus ISBN 1573929921
· Nanobiotechnology-Concepts, Applications and Perspectives edited by CM Niemeyer and CA Mirkin, Wiley-VCH ISBN 527-30658-7
· NanoBiotechnology Protocols in Methods in Molecular Biology Series Edited by SJ Rosenthal and DW Wright, Humana Press, ISBN: 1-58829-276-2
· Understanding Nanotechnology Scientific American, ISBN: 0446679569 Prey (a novel) by Michael Crichton, ISBN:

006621412

e-Learning Source:
www.nanotechweb.org; www.nano.gov; www.nanotec.org.uk

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	3	3	
CO2	3	1					1	3	3	3	
CO3	3	1				2	1	3	3	3	
CO4	3	1				1	1	3	3	3	
CO5	3	1			1	3	1	3	3	3	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

1-

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110602P/BS356	Title of the Course	Food and Nutritional Biochemistry Lab	L	T	P	C
Year	III	Semester	V	0	0	4	2
Pre-Requisite	10+2	Co-requisite					
Course Objectives	The course is designed to train the students in techniques of Food and Nutritional Biochemistry.						

Course Outcomes	
CO1	The students will be able to quantify total protein content of different food products.
CO2	The students will be able to quantify carbohydrate content of different food items.
CO3	The students will be able to estimate phenolic content.
CO4	The students will be able to estimate carotenes.
CO5	The students will be able to plan meals for individuals according to their requirement.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Exp-01	Estimation of total protein content of different food products by Lowry's method.	3	CO-1
2	Exp-02	Estimation of carbohydrate content of different edible items by Anthrone's method.	3	CO-1
3	Exp-03	Estimation of phenolic content.	3	CO-2
4	Exp-04	Estimation of carotenes	3	CO-3
5	Exp-05	Estimation of reducing sugar by dinitrosalicylic acid method.	6	CO-4
6	Exp-06	Meal planning for persons of different age groups to meet their nutritional requirements (Kids, Adolescents, Adults etc.)	6	CO-5
Reference Books:				
1. W.F. Harrigan, Laboratory methods in Microbiology, Publisher – Elsevier				
2. Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press				
e-Learning Source:				

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**						**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**		**1**	
CO5	**3**	**1**					**1**			**3**	**2**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

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Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B110604P/BS354	**Title of the Course**	Bioinformatics, Biostatistics and Computer application Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to train the students in bioinformatics and Biostatistical tools.						

Course Outcomes	
CO1	To understand the working of computer, MS-Word, MS-excel, MS-PowerPoint.
CO2	To understand data analyzing software and sequence databases.
CO3	Develop understanding of Bioinformatics as tools for Sequence Alignment.
CO4	To study gene/protein homologs, Protein Structure Visualization, as well as for Gene Finding
CO5	To learn the biostatistical methods and designing of diagram chart and plots.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	An introduction to Computers, MS-Word, MS Excel, MS Power Point.	2	CO1
2	Exp-02	Learning to analyze data using SPSS or R software	4	CO2
3	Exp-03	Introduction to types of sequence databases (Nucleotides & Protein)	2	CO2
4	Exp-04	Pair wise Sequence Alignment (NW and SW approach), FASTA & BLAST search	4	CO3
5	Exp-05	Multiple Sequence Alignment (ClustalX&Treeview)	2	CO3
6	Exp-06	Use of gene prediction methods (GRAIL, Genscan, Glimmer).	4	CO4
7	Exp-07	Use of different protein structure prediction databases (PDB, SCOP, CATH etc.).	4	CO4
8	Exp-08	Computations analysis of biological data by Mean, Median, Mode, S.D., Correlation, regression Analysis, Chi square test, Student test, ANOVA	4	CO5
9	Exp-09	Designing of bar diagram, pi chart, histogram, scatter plots, in EXCEL for presentation of data.	4	CO5

Reference Books:

Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.

Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. Baxevanis, A. D., & Ouellette, B. F. (2001).

Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience

Rosner, B. (2000). Fundamentals of Biostatistics. Boston, MA: Duxbury Press.

Rastogi VB.(2015). Biostatistics (3rd Edition). MedTec

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1				3	2		3	2
CO2	3	3	1				3	2		3	2
CO3	3	3	1				3	2		3	2
CO4											
CO5											

3- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session: 2024-25							
Course Code	B100604P / BS310	**Title of the Course**	Food microbiology and Biotechnology Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of food microbiology and biotechnology.						

Course Outcomes	
CO1	The students will be able to isolate and characterize yeast.
CO2	The students will be able to isolate and identify important microorganisms of food microbiology.
CO3	The students will be able to assess the quality of raw milk and preparation of sauerkraut.
CO4	The students will be able todetermine total proteins by Bradford method.
CO5	The students will be able to analyse moisture, ash, protein, fat, fiber and carbohydrate in food sample.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Exp-01	Isolation and characterization of Yeast used in Bakery/distillery/winery	6	CO-1
2	Exp-02	Isolation & identification of important microorganism of food microbiology	6	CO-1
3	Exp-03	Methylene Blue Dye Reduction Test for Assessing the quality of raw milk.	6	CO-1
4	Exp-04	Preparation of sauerkraut.	6	CO-2
5	Exp-05	Quantitative determination of Total proteins by Bradford method	6	CO-3
6	Exp-06	Proximate analysis of food sample: moisture, ash, protein, fat, fiber and carbohydrate	6	CO-4

Reference Books:

1. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., New Delhi.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3			
CO2	3	1						3			
CO3	3	1					1	3			
CO4	3	1					1	3		1	
CO5	3	1					1			3	2

4- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	B100605T/BS394	Title of the Course	Applied Biotechnology	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	10+2 Biology	Co-requisite					
Course Objectives	The objective of this course is to make students familiar with Genomics and proteomics, principle, methodology and application of Drug discovery, Bioprospecting and conservation: importance of biodiversity, General theory of free radical and antioxidants, Significance of IPR; Requirement of a patentable novelty, Biosafety and GMOs.						

Course Outcomes	
CO1	Get proper knowledge about Genomics, Proteomics and gene expression.
CO2	Gain knowledge about Drug Discovery and Designing: Drug and target identification, target validation.
CO3	Learn about Bioprospecting and conservation: importance of biodiversity.
CO4	Learn about the basics of Free Radical Biology: General theory of free radical and antioxidants.
CO5	Have knowledge of Significance of IPR and Biosafety.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Genomics and Genome annotation	Introduction to genomics, Genome annotation, Alignment, Whole genome sequencing methods, Human genome project and its application	8	CO1
2	Proteomics and its analysis	Introduction to Proteomics, Proteomics classification, Protein expression and its analysis, Bioinformatics in proteomics	8	CO1
3	Drug Discovery and designing	Drug and target identification, Drug and target validation, Molecular docking studies and its Insilco tools e.g. Autodock, GOLD.	8	CO2
4	Bioprospecting and conservation	Importance of biodiversity. biodiversity informatics, databases in biological materials. International efforts and issues of sustainability.	8	CO3
5	Free Radical Biology	General theory of free radicals and antioxidants. Free radical mediated damage to lipids, proteins and DNA; Natural antioxidants and their applications.	6	CO3
6	IPR and Patenting	Significance of IPR; Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms; International convention in IPR; Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity.	8	CO4
7	Biosafety	Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines Government of India; Roles of Institutional Biosafety Committee, RCGM, GEAC etc.	8	CO5
8	GMOs	Definition of GMOs; GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication	6	CO5

Reference Books:

3. 1.Genome, T.A. Brown, John Willey & Sons Inc.
4. 2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
5. 3. Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
6. 4. Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison- Wesley Publishing.
7. 5. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley and Sons Inc.

6. Biotechnology- B.D. Singh

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					3	3	1	1	3
CO2	3	1					3	3	1	1	3
CO3	3	1			1	3	3	3	1	1	3
CO4	3	1					3	3	1	1	3
CO5	3	1			3	2	3	3	1	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100606T/ BS395	**Title of the Course**	Genomics, Proteomics & Metabolomics	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of Genome sequencing, Genome databases, Genome analysis, Proteomics and Metabolomics.						

Course Outcomes	
CO1	The students will be able to explain Genome sequencing techniques and Sequencing technology.
CO2	The students will be able to discuss about major Genome databases, Genome analysis, Comparative genomics, Functional genomics techniques.
CO3	The students will be able to describe about basic Proteomics technologies.
CO4	The students will be able to describe the basics technologies used in Metabolomics.
CO5	The students will be able to discuss applications of Genomics and Proteomics in various fields of life.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Genome sequencing	Sequencing technology: Sanger sequencing, Maxam-Gilbert sequencing. Pros and cons of these sequencing technologies. Whole shotgun genome sequencing	**6**	**CO1**
2	Next generation Sequencing	Sequencing technology: Pyrosequencing, Illumina/Solexa, SOLiD System, Ion Torrent. Introduction to third generation sequencing technologies.	**8**	**CO1**
3	Genome databases and Structural genomics	Major Genome databases, Genome analysis and their applications-Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of Genomes; sequence assembly and annotation.	**8**	**CO2**
4	Functional genomics	Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics. Comparative genomics.	**8**	**CO2**
5	Proteomics	Introduction to basic proteomics technology: 1D-SDS-PAGE, 2D-SDS PAGE. Detection and quantitation of proteins in gels. Pros and cons of various staining methods. Yeast-two-hybrid system, cDNA microarrays.	**8**	**CO3**
6	Mass spectrometry	Basics of mass spectrometry. MALDI-TOF and ESI, and their application in proteomics, Tandem MS/MS spectrometry, Peptide sequencing by tandem mass spectrometry.	**8**	**CO3**
7	Metabolomics	Technologies in metabolomics, Role of Spectroscopy, Electrophoretic and Chromatographic techniques in metabolic profiling. Nutrigenomics.	**8**	**CO4**
8	Applications	Applications of genomics and proteomics in agriculture, human health, and industry.	**6**	**CO5**

Reference Books:

1. Griffiths JF, “An Introduction to Generic Analysis”.
2. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown
3. Genomics and Proteomics: Functional and Computational Aspects by Suhai and Sándors,
4. Genomics and Proteomics: Principles, Technologies, and Applications by Devarajan Thangadurai and Jeyabalan Sangeetha
5. The Handbook of Metabolomics and Metabolomics by John C. Lindon, Jeremy K. Nicholson and Elaine Holmes

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	3	2	1
CO2	3	1					2	3	3	2	1
CO3	3	1					1	3	3	2	1
CO4	3	1					1	3	3	2	1
CO5	3	1					1	3	3	2	1

5- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100608R/ BS396	**Title of the Course**	Research Project (minor) and seminar	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**0**	**0**	**6**	**6**
Pre-Requisite		**Co-requisite**					
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	
CO1	To develop synopsis of a defined research problem.
CO2	To conduct the bench work.
CO3	To prepare the research report and its oral demonstrations.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				3	1	3	3	2	3
CO2	3	1				3	2	3	3	2	3
CO3	3	1				3	1	3	3	2	3
CO4	3	1				3	1	3	3	2	3
CO5	3	1				3	1	3	3	2	3

6- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**