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.	**6**	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.	**8**	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	B100102T/BS104	**Title of the Course**	Biochemistry and Metabolism	**L**	**T**	**P**	**C**
Year	I year	**Semester**	I sem	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	**The objective of this course is to develop an understanding of basics of biomolecules, enzymes and their metabolism.**						

Course Outcomes	
CO1	To understand basic details of 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 Enzyme and its classification

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Carbohydrates**	Structure, classification and properties of Monosaccharides, Disaccharides, and Polysaccharides (starch, glycogen, peptidoglycan, cellulose).	6	**CO1**
2	**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.	6	**CO2**
3	**Lipids and its metabolism**	Structure, function, classification and properties of Fatty acids. degradation of fatty acids: oxidation; Ketone bodies, acidosis, ketosis, cholesterol synthesis	6	**CO3**
4	**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 acid structure.	6	**CO4**
5	**Enzymes**	Classification, properties and factors influencing enzyme activity, coenzymes, prosthetic group and co-factors, Lock & key hypothesis, induced fit hypothesis, Enzyme kinetics: Michaelis Menten equation, Lineweaver-Burk plot, Enzyme inhibition, Allosteric enzymes.	6	**CO5**
6	**Carbohydrate metabolism**	Glycolysis, TCA cycle, Electron Transport Chain and Oxidative phosphorylation, Gluconeogenesis and Glycogen metabolism.	6	**CO1**
7	**Protein metabolism**	Urea Cycle, transport of ammonia, deamination and transamination reactions. Inborn errors of protein metabolism.	6	**CO2**
8	**Nucleic acid metabolism**	Purine and Pyrimidine biosynthesis and degradation.	6	**CO4**

Reference Books:

Lehninger, AL "Principles of Biochemistry"

Lubert Stryer "Biochemistry"

Voet & Voet "Biochemistry"

Robert K., M Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Appleton & Lange, Robert K. Murray "Harper's Biochemistry"

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					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		3	2

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	B100104P/BS106	**Title of the Course**	Basic 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 pKa 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, Barfoed and Iodine tests)	6	**CO1**
2	Exp 2	Estimation of vitamin C and Determination of pKa 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:

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

	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**

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Effective from Session: 2023-24							
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 micronutrients and 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 Fiber	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	B100206V/BS108	Title of the Course	Animal and Plant Biotechnology	L	T	P	C
Year	1	Semester	I	2	0	2	3
Pre-Requisite	10+2 with Biology	Co-requisite					
Course Objectives	The course has been designed to make students aware of basic plant biotechnology techniques and their applications in plant growth and development, and large scale production of natural products from plant source. The course also imparts information on characteristics of primary & secondary cell culture, hybridoma technology & application of animal biotechnology.						

Course Outcomes	
CO1	Get proper knowledge about media preparation for In-vitro propagation of plants and aseptic techniques used.
CO2	The students will learn the role of techniques for haploid plant production and its significance.
CO3	Have basic knowledge of several technique of transformation: Agrobacterium-mediated and physical methods (Microprojectile bombardment and electroporation) and the biology growth promoting bacteria.
CO4	Understand the characteristics of Primary & Secondary cell cultures. Principle & application of Hybridoma technology
CO5	Have an understanding of various methods of gene delivery methods of Animals and the application of Animal biotechnology

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Aseptic Techniques	Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokininis and Gibberellins). Callus and suspension culture	8	CO-1
2	Haploid Plant Production	Microspore and ovule culture, Organ Culture and their applications, Somatic Embryogenesis: Techniques and applications. Protoplast Culture, somatic hybridization, methods of protoplast fusion: chemical and electro fusion, practical application of somatic hybridization	8	CO-2
3	Transgenic Plants & Transformation Techniques	Transgenic Plants & Technique of transformation: Agrobacterium-mediated and physical methods (Microprojectile bombardment and electroporation).	8	CO-3
4	Animal Tissue culture	Nutrient requirements of mammalian cells, Media for culturing cells, Growth supplements. Primary cultures & Secondary cultures	8	CO-4
5	Plant Growth Promoting Bacteria	Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of Pathogens and growth promotion by free- living bacteria.	8	CO-3
6	Hybridoma Technology	Principles and methods of hybridoma technology. Production and characterization of monoclonal antibodies and their application in animal health and production.	8	CO-4
7	Gene delivery methods for Animals	Viral vectors, Direct DNA transfer, Particle bombardment, Electroporation, Microinjection & Chemical methods.	8	CO-5
8	Application of Animal Biotechnology	Application of Animal biotechnology: Gene Therapy, Milk Production, Meat Production and Aquaculture Production.	8	CO-5
Reference Books:				
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		
CO2	3	1			2		3		3		
CO3	3	1			2	2	3		3		
CO4	3	1					3	2	3		1
CO5	3	1		2	2		3				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**	II	**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	
CO2	3	2	2	3	1	2	3	1	2	
CO3	1	2	2	2	2	3	2	3	3	
CO4	1	3	2	3	2	3	2	3	1	
CO5	2	3	1	2	2	3	1	3	2	

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			

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	B100203T/BS110	**Title of the Course**	Plant Structure and Physiology	**L**	**T**	**P**	**C**
Year	1	**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 morphology and anatomy of plants, structure and functioning of plant tissues and physiology and growth in plants						

Course Outcomes	
CO1	Students will be able to learn the structural organization of lower plants (Algae-Gymnosperms).
CO2	Students will be able to learn the morphology and anatomy of angiospermic plants.
CO3	Students will be able to understand plant water relations, uptake, transport and role of micro and macronutrients
CO4	Students will be able to understand the process of photosynthesis, carbon and nitrogen metabolism
CO5	Students will be able to understand the role of pant hormones, photoperiodism and vernalization in plant growth and development.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Structural organization of lower plants**	General characters and structural organization of Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms	8	**CO1**
2	**Structural organization of higher plants**	Plant parts, Modifications of stems, leaves and roots, Flower: Parts, Functions, Floral whorls, Flower as a modified shoot, Fruits: Formation, Types, Parthenocarpy, Seed: Structure, Formation	8	**CO2**
3	**Plant Anatomy**	Structure of plant cell, Types of plant cells: parenchyma, collenchyma and sclerenchyma, Plant tissues: xylem and phloem. Anatomy of dicot and monocot stems, leaves and roots, Secondary growth and annual rings	8	**CO2**
4	**Plant water relations**	Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, Ascent of sap transpiration, stomata & their mechanism of opening & closing, guttation	8	**CO3**
5	**Micro & macro nutrients**	Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport	6	**CO3**
6	**Photosynthesis**	Photosynthesis- Photosynthesis pigments, concept of two photosystems, photphosphorylation, Calvin cycle, CAM plants, photorespiration, compensation point	8	**CO4**
7	**Nitrogen metabolism**	Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants	6	**CO4**
8	**Growth and development**	Growth and development: Definition, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene), physiological role and mode of action. Seed dormancy and seed germination, concept of photoperiodism and vernalization, plant movements.	8	**CO5**

Reference Books:

1. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
2. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
3. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
4. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
5. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
6. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4 edition, Sinauer Associates Inc .MA, USA
7. Biology PH Raven & G.B Johnson
8. A textbook of Botany S.N Pandey, Vikas Publishing, India

e-Learning Source:

https://www.classcentral.com/course/swayam-plant-groups-plant-diversity-95321 https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/213

	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			1
CO2	**3**					**1**	**1**	3			1
CO3	**3**					**1**	**1**	3			1
CO4	**3**	**1**				**1**	**1**	3			1
CO5	**3**	**1**				**1**	**1**	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	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 learn analysis of 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
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:2024-2025							
Course Code	B100204P/ BS119	**Title of the Course**	Plant structure and 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 enable the students to develop the understanding of the basic morphology and anatomy of plants, structure and functioning of plant tissues and physiology and growth in plants						

Course Outcomes	
CO1	Get basic knowledge of the structure of algae, fungi, bryophyte, pteridophyte, gymnosperm
CO2	Gain knowledge about the structure of a flower and various types of inflorescence, seeds and fruit
CO3	Have basic knowledge of anatomy of dicots and monocots
CO4	To study the effect of two environmental factors (light and wind) on transpiration and effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
CO5	Determination of osmotic potential of plant cell sap by plasmolytic method.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp -01**	Study of one example each of algae and fungi	4	**CO1**
2	**Exp -02**	Study of one example each of bryophyte, pteridophyte, and gymnosperm	4	**CO1**
3	**Exp -03**	Study of the morphology study of flower parts, inflorescence	6	**CO2**
4	**Exp -04**	Study of the morphology study of seed, fruit types	2	**CO2**
5	**Exp -05**	Transverse section of dicot and monocot roots, stem and leaves	8	**CO3**
6	**Exp -06**	To study the effect of two environmental factors (light and wind) on transpiration.	2	**CO4**
7	**Exp -07**	To study the effect of light intensity and bicarbonate concentration on O2 evolutionin photosynthesis.	2	**CO4**
8	**Exp -08**	Determination of osmotic potential of plant cell sap by plasmolytic method.	2	**CO5**

Reference Books:

1.Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.

2.Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4 edition, Sinauer Associates Inc .MA, USA

3. Biology PH Raven & G.B Johnson

4.Biological science DJ Taylor NPO Green GW Stout

5.A textbook of Botany S.N Pandey, Vikas Publishing, India

e-Learning Source:

https://www1.biologie.uni-hamburg.de/b-online/virtualplants/ipivp.html

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	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

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	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 ofUnit	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, quartiledeviation 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 applicationsof 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), conditionalprobability, 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	
CO2	3	1	-	-	-	-	3	2	-	-	2	
CO3	3	3	-	-	-	-	3	2	-	-	1	
CO4	3	1	-	-	-	-	-3	2	-	-	2	
CO5	3	3	-	-	-	-	3	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	**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: 2024-2025							
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)

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	Z020201/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	
CO2	1	3	-	-	-	-	-	2	-	-	3	
CO3	2	3	-	-	-	-	-	3	-	-	2	
CO4	3	2	-	-	-	-	-	1	-	-	3	
CO5	3	3	-	-	-	-	-	3	-	-	2	

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

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	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
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 DNA repair systems.

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	B100303T/ BS208	**Title of the Course**	Basics of Microbiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	**The objective of this course is to develop an understanding of basics of microbiology and sterilization techniques**						

Course Outcomes	
CO1	To understand basic details of basics and history of microbiology and general classification of microbes and extremophiles
CO2	To understand basic details of microbes in extreme environments and microbial interactions
CO3	To understand basic details of control of Microorganisms and staining techniques
CO4	To understand basic details of growth of microbes and recombination in Prokaryotes
CO5	To understand basic details of bacteriophages

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	History of microbiology	Definition and scope of microbiology, Importance of microbiology in various fields, History of microbiology: Spontaneous generation and its controversy, Louis Pasteur and the refutation of spontaneous generation, Germ theory of disease, Robert Koch and the postulates of bacterial pathogenesis	8	**CO1**
2	Classification of microbes	Introduction to Microbial Classification, Prokaryotic, and eukaryotic microbes, Classification Methods and Techniques: Phenotypic, genotypic and serological methods, Microbial Taxonomy and Nomenclature; Nature of the microbial cell surface, gram positive and gram negative bacteria	8	**CO1**
3	Microbes in extreme environments and microbial interactions	Microbes in extreme environments and microbial interactions: The thermophiles: alkalophiles, acidophiles and symbiosis and antibiosis among microbial population, N_2 fixing microbes in agriculture and forestry.	8	**CO2**
4	Control of Microorganisms	Control of Microorganisms: Physical agents (Autoclave, Hot air oven, Laminar airflow and membrane filter.), chemical agents (Alcohol, Halogens and Gaseous agents, antibiotics), Radiation Methods (UV rays).	8	**CO3**
5	Stains and staining techniques	Introduction to Stains and Staining Techniques, Principles of staining, Types of stains – simple stains, structural stains, and Differential stains, Application of Staining Techniques in Microbial Diagnostics	6	**CO3**
6	Recombination in Prokaryotes	Recombination in Prokaryotes: Transformation, Conjugation and Transduction	8	**CO4**
7	Growth of microbes	Introduction to Microbial Growth, Microbial Growth Curve, Factors Influencing Microbial Growth	6	**CO4**
8	Viruses/Bacteriophage	Introduction to Bacteriophages, Bacteriophage Structure and genetics, Bacteriophage Life Cycle: Lytic and lysogenic cycle, General characteristics of plant and animal viruses	8	**CO5**

Reference Books:

1. Introduction to Microbiology, Ingraham, 2ed.
2. Brock Biology of Microorganisms, Madigan et al, 9th ed.
3. General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
4. Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
5. Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
6. The Microbial World, Roger Y. Stanier, Prentice Hall
7. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press, USA
8. Lewin, B., Gene VI New York, Oxford University Press.

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					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		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	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	B100304P/ BS210	**Title of the Course**	Microbiology Lab	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basic microbiology, Instruments used to study and work on microbes, Staining Techniques, Enzyme assay and Biochemical tests–starch hydrolysis, gelatin liquefaction, Cleaning and sterilization of glassware, Media preparation and Isolation of bacteria and fungi from various sources, Growth curve of bacteria, Isolation and purification and estimation of DNA and RNA						

Course Outcomes	
CO1	Develop an understanding of Instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.
CO2	Develop an understanding staining techniques
CO3	Understand processes involved in culturing of microbes as cleaning and sterilization of glassware, media preparation.
CO4	Understand the process of isolation of bacteria and fungi from soil/ air/water/ other sources
CO5	Understand the growth pattern of bacteria.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp 1	Study of instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge	8	**CO1**
2	Exp 2	Cleaning and sterilization of glassware	4	**CO3**
3	Exp 3	Media preparation: Nutrients agar, Nutrient broth and LB.	4	**CO3**
4	Exp 4	Isolation of bacteria and fungi from soil/ air/water – dilution and pour plate methods	8	**CO4**
5	Exp 5	Staining Techniques: Gram staining for gram positive and gram negative bacteria	8	**CO2**
6	Exp 6	Growth curve of bacteria	8	**CO5**

Reference Books:

Keith Wilson John Walker John M. Walker “Principles and Techniques of Practical Biochemistry”

William M., Ph.D. O’Leary Robert Dony Wu “Practical Handbook of Microbiology”

Joseph Sambrook David W. Russel Joe Sambrook “Molecular Cloning: A Laboratory Manual”

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	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		2		2	1				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	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	B100401T/ BS218	**Title of the Course**	Industrial Biotech and Bioprocess Technology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	After completion of the course, a student will be able to develop the understanding of industrial aspects of biotechnology, IPR and bioethics						

Course Outcomes: After this course students will be able to	
CO1	To understand the problems in isolation, strain improvement in industrial processes.
CO2	To understand the growth of microorganisms in industrial processes.
CO3	To understand design and types of fermenters and operation of fermenters.
CO4	To understand the production process of alcohols, antibiotic and enzymes and other biologically active compounds by industrial microbiological fermentation
CO5	To understand the regulation of bioethics and policies of IPR and entrepreneurship.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Introduction of Industrial microbiology and Bioprocess technology. History-Introduction, scope and relation with other sciences. Screening for new metabolites: primary and secondary products. Maintenance of strains. Strain development through selection, mutations and recombination, and other recent methods	**8**	CO1
2	Fermentation technology	Fermentation media, Natural and synthetic media, Sterilization techniques: Heat, Radiation and Filtration method. Types of fermentation: solid state, submerged fermentation and continuous fermentation, Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.	**8**	CO2
3	Bioprocess technology	Design and working of a typical bioreactor, Process of Aeration, Agitation, and Temperature regulation, Immobilized enzymes and cell bioreactors. Downstream processing (DSP), Disintegration of cells, Separation, Extraction, Concentration and purification of products.	**8**	CO3
4	Production of alcohols, antibiotic and enzymes:	Brief account of the following products obtained by industrial microbiological fermentation: alcohols (Ethanol) and Alcoholic Beverage: (Beer), Organic acid: (citric and acetic). Amino acids: (Glutamic acid), Vitamin: (vitamin B12).	**8**	CO3
5	Production of biologically active compounds:	Production of antibiotics (penicillin) and enzymes (amylase, protease). Production of microbial food and single cell proteins	**8**	CO4
6	IPR	Introduction to Intellectual Property Rights (IPR)-World Intellectual properties, Indian Intellectual Properties. Patents, Copyrights, Designs, Trademarks, Geographical Indication. Infringement of IPR, Its protection and Remedies. Licensing and its types.	**7**	CO5
7	Issues related to IPR	Issues related to IPR protection of software and database; IPR protection of life forms; patenting biological products and biodiversity; Major changes in Indian patent system as post TRIPS effects	**6**	CO5
8	Bioethics and GMP	Introduction, necessity and limitation; Different paradigms of bioethics: National and International; Ethical conflicts in Biotechnology; Bioethics of genes, Legal implications in bioethics. Introduction to GMP	**7**	CO5

Reference Books:

1. Glazier AN and Nikaido H (2007).Microbial Biotechnology – Fundamental & Applied Microbiology – Second Edition. Cambridge University Press.
2. Casida LE (2019) Industrial Microbiology. Second Edition, New Age International Publisher.
3. Stanbury P F and Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press
4. Shuler M L and Kargi F. (2002). Bioprocess Engineering: Basic Concepts. Upper Saddle River, NJ: Prentice Hall.
5. Crueger W and Crueger A (2002) Cruegers Biotechnology: A Textbook of Industrial Microbiology. Third Edition, Panima Publishing Corp., New Delhi.
6. Blanch H W and Clark D S. (1997). Biochemical Engineering. New York: M.Dekker.
7. Bailey J E and Ollis D F. (1986). Biochemical Engineering Fundamentals. New York: McGraw-Hill.

e-Learning Source:

https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-34-waste-containmentand-remediation-technology-spring-2004/lecture-notes/
https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-018j-ecology-i-theearth-system-fall-2009/
https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-018j-ecology-i-theearth-system-fall-2009/lecture-notes/MIT1_018JF09_Lec07.pdf
https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmentalmicrobiology-fall-2004/

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	2	3	
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	B100402P/ BS219	**Title of the Course**	Industrial Biotechnology 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 industrial biotechnology and fermentation						

Course Outcomes	
CO1	Understand method of isolation of industrially important microorganisms.
CO2	Perform Algal or fungal culture
CO3	Perform estimation of citric acid from *Aspergillus* culture.
CO4	Perform estimation of lactic acid.
CO5	Understand the working of small scale fermenter

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp. 1**	Isolation of industrially important microorganisms from soil.	**8**	**CO1**
2	**Exp. 2**	Algal or fungal culture (Yeast and *Aspergillus*)	**8**	**CO2**
3	**Exp. 3**	Estimation of citric acid from Aspergillus culture.	**8**	**CO3**
4	**Exp. 4**	Estimation of lactic acid.	**8**	**CO4**
5	**Exp. 5**	Demo of working of small scale fermenter	**8**	**CO5**

Reference Books:

1. Glazier AN and Nikaido H (2007).Microbial Biotechnology – Fundamental & Applied Microbiology – Second Edition. Cambridge University Press.
2. Casida LE (2019) Industrial Microbiology. Second Edition, New Age International Publisher.
3. Stanbury P F and Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press
4. Crueger W and Crueger A (2002) Crueger's Biotechnology: A Textbook of Industrial Microbiology. Third Edition, Panima Publishing Corp., New Delhi.
5. Blanch H W and Clark D S. (1997). Biochemical Engineering. New York: M. Dekker.

e-Learning Source:

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3			3	3	2		3
CO2	3	1		3			3	3	2		3
CO3	3	1		3			3	3	2		3
CO4	3	1					3	3	2		3
CO5	3	1					3	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	B100403T/BS256	**Title of the Course**	Infection and immunity	**L**	**T**	**P**	**C**
Year	II year	**Semester**	IV sem	**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 Vaccin ation

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. Monoclonial 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	B100404P/ BS258	**Title of the Course**	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, 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:

	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	B100501 T / BS309	**Title of the Course**	Biostatistics and Bioinformatics	**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 develop the understanding of biostatistical and bioinformatical techniques.						

Course Outcomes	
CO1	Learn the need of statistical approach, identify the different axiomatic approach and study the variability of observation
CO2	Know effective use of Office package –word, excel, ppt and publisher etc
CO3	Understand simple calculation using excel
CO4	Understand the basic theories and practical of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts
CO5	Critically analyse and interpret results of their studies with the help of bioinformatical and biostatistical tools.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**History and introduction to Bioinformatics**	Introduction and applications of bioinformatics. Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics	**6**	**CO1**
2	**Databases, Data generation, Data storage and retrieval**	General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL), Protein databases (Primary, Composite, and Secondary); Specialized Genome databases: (SGD, TIGR, and ACeDB); Structure databases (CATH, SCOP, and PDBsum)	**8**	**CO2**
3	**Sequence and Phylogeny analysis**	Introduction to Sequences, Alignments and Dynamic Programming; Local alignment and Global alignment (algorithm), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm)	**8**	**CO2**
4	**Searching Databases**	SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission; Gene identification tools	**6**	**CO3**
5	**Types and Collection of data**	Primary and Secondary data, Classification and Graphical representation of Statistical data; Measures of central tendency and Dispersion; Measures of Skewness and Kurtosis.	**8**	**CO3**
6	**Probability**	Definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.	**8**	**CO4**
7	**Sampling**	Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test; Problems on test of significance, t-test, chi-square test; for goodness of fit and analysis of variance (ANOVA)	**8**	**CO4**
8	**Correlation and Regression**	Types, Karl-Pearson's correlation, Spearman's Rank correlation, Regression equation and fitting; Main features of regression analysis-simple and multiple regression analysis; Differences between correlation and regression analysis	**8**	**CO5**

Reference Books:

1. Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.
2. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press
3. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
4. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell
5. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
6. Sharma V. Munjal A. Shanker A.(2018). A Textbook of Bioinformatics (2nd Edition). Rastogi Publication.
7. Choudhuri S. (2014) Bioinformatics for beginners. (1st edition) Elsevier
8. Rastogi SC. Mendiratta N. Rastogi P. (2013). Bioinformatics Methods and Applications Genomics Proteomics and Drug Discovery. (4th edition). Prentice Hall India Learning Private Limited
9. Rastogi VB. (2015). Biostatistics (3rd Edition). MedTec

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**

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	B100502P / BS390	**Title of the Course**	Bioinformatics and Biostatistics 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 bioinformatical and biostatistical tools						

Course Outcomes	
CO1	Understand about information resources.
CO2	To understand the use of data search tools
CO3	Understand use of gene prediction methods and primer designing
CO4	Understand the use of biostatistical methods.
CO5	Learn the designing of diagram, chart and plots

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Use of sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt.	4	CO-1
2	Exp-02	Use of similarity search tools FASTA and BLAST.	2	CO-2
3	Exp-03	Multiple sequence alignment using ClustalW and interpretation of results.	2	CO-2
4	Exp-04	Use of gene prediction methods (GRAIL, Genscan).	2	CO-3
6	Exp-05	Use of different protein structure databases (PDB, SCOP, CATH etc.).	4	CO-3
7	Exp-06	Computations analysis of biological data by Mean, Median, Mode, S.D., Correlation	2	CO-4
8	Exp-07	To perform Regression Analysis, Chi square test, Student test, ANOVA.	4	CO-4
9	Exp-08	Designing of bar diagram, pi chart, histogram, scatter plots	4	CO-5

Reference Books:

1. Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.
2. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press
3. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
4. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell
5. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
6. Sharma V. Munjal A. Shanker A.(2018). A Textbook of Bioinformatics (2nd Edition). Rastogi Publication.
7. Choudhuri S. (2014) Bioinformatics for beginners. (1st edition) Elsevier
8. Rastogi SC. Mendiratta N. Rastogi P. (2013). Bioinformatics Methods and Applications Genomics Proteomics and Drug Discovery. (4th edition). Prentice Hall India Learning Private Limited
9. 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	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	**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)	3	CO-1
2	Exp-02	Isolation of genomic DNA from plant and animal tissue	3	CO-1
3	Exp-03	Isolation of plasmid DNA (E. coli)	3	CO-1
4	Exp-04	Restriction digestion of DNA	3	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	B100505 T/BS300	**Title of the Course**	Bioanalytical Tools	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 introduce various techniques like Chromatography, Centrifugation, Electrophoresis, Microscopy, Spectroscopy and Radioactivity to the students used in biological research.						

Course Outcomes	
CO1	Understand the basic concept of 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, column chromatography, HPLC, GLC, 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

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	B100506T / BS391	**Title of the Course**	Medical Biotechnology	**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 make students aware of Zoonoses, Fungi and viruses, Pathology of diseases, Therapies and Medico-legal aspects						

Course Outcomes	
CO1	The student will understand Classifications of pathogenic microbes, Leptospira, Brucella, bacillus anthracis, Medical Parasitology: Amoebiasis, Cryptosporidium, Giardiasis, Malaria, Toxoplasmosis, Trichomoniasis, Medical Bacteriology: Staphylococcus, Streptococcusandenterococcus, Peneumococcus, Mycobacterium, Bacillus, Salmonella, Shigella, Pseudomonas, and Vibrio, , Pathology of Tuberculosis
CO2	The student will understand Adenoviruses, Pox viruses, Hepadnaviruses, Arboviruses, Retroviruses, ellow Fever, Japanese Encephalitis, Dengue, Acquired Immune Deficiency Syndrome (AIDS). Medical Mycology: Fungi, Yeast, Pathogenic fungi, superficial Mycoses, cutaneous Mycoses, subcutaneous Mycoses, Systemic Mycoses
CO3	The student will understand Blood formation, Anemia; Blood loss anemia, Magaloblastic anemia, Leukaemia, The Parts of Brain, BrainTumours, Stem cells: stem cell or Bone marrow transplant
CO4	The student will understand Introduction to chemotherapy and radiotherapy, Human Gene Therapy. Antibiotics: Classificationof Antibiotics,Combinations of Antibiotics, Doses of Antibiotics, Side Effects of Antibiotics, General Principles for use of Antibiotics
CO5	The student will understand Social: genetic discrimination: insurance and employment, human cloning, foeticide, sex determination, Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Definition of Zoonoses	Classifications of pathogenic microbes, different mode of transmissions, types of life cycles, types of hosts, medical definitions	**6**	**CO1**
2	Bacteriology	Leptospira, Brucella, bacillus anthracis, Staphylococcus, Streptococcusandenterococcus, Peneumococcus, Mycobacterium, Bacillus, Salmonella, Shigella, Pseudomonas, and Vibrio, Pathology of Tuberculosis	**8**	**CO2**
3	Parasitology	Amoebiasis, Cryptosporidium, Giardiasis, Malaria, Toxoplasmosis, Trichomoniasis	**6**	**CO2**
4	Medical Virology	Adenoviruses, Pox viruses, Hepadnaviruses, Arboviruses, Retroviruses, Yellow Fever, Japanese Encephalitis, Dengue, Acquired Immune Deficiency Syndrome (AIDS).	**8**	**CO3**
5	Medical mycology	Fungi, Yeast, Pathogenic fungi, superficial Mycoses, cutaneous Mycoses, subcutaneous Mycoses, Systemic Mycoses.	**8**	**CO3**
6	Pathology of diseases	Blood formation, Anemia; Blood loss anemia, Magaloblastic anemia, Leukaemia, The Parts of Brain, Brain Tumours, Stem cells: stem cell or Bone marrow transplant.	**8**	**CO4**
7	therapies	chemotherapy and radiotherapy, Human Gene Therapy. Antibiotics: Classificationof Antibiotics,Combinations of Antibiotics, Doses of Antibiotics, Side Effects of Antibiotics, General Principles for use of Antibiotics	**8**	**CO4**
8	Medico-legal aspects	Social: genetic discrimination: insurance and employment, human cloning, foeticide, sex determination, Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function	**8**	**CO5**

Reference Books:

1.Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.

2. Collee, JG. Duguid JP., Fraser AG., Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.

3. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992) Medical Microbiology. 14th edition. ELBS with Churchill Livingstone.

4. Hugo WB and Russell AD. (1989) Pharmaceutical Microbiology IV edition. Blackwell Scientific Publication, Oxford

5. Sabari Ghosal & A. K. Srivastava: Fundamentals of Bioanalytical techniques and Instrumentation.

e-Learning Source:

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

CO											
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: 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		**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 technique/instruments used in various reputed research institutions.
CO2	To develop understanding of state of the art technique/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	B100601T/BS317	**Title of the Course**	Essentials of Environmental Biotechnology	**L**	**T**	**P**	**C**
Year	2	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of environmental biotechnology, bioremediation, waste management, bioleaching, conventional and modern fuels						

Course Outcomes	
CO1	Have knowledge of modern fuels and their environmental impact
CO2	Comprehend the Structural and Functional dynamics of microbes, their diversity, activity, and growth, and community profiling their uses as biosensors, bioreporters, and Microchips. Also know about Methanogenesis: methanogenic, acetogenic and fermentative bacteria- technical processes and conditions
CO3	Gain insight on Bioremediation and Phytoremediation of soil & water contaminated with oil spills, heavy metals, and detergents and the use of microbes in degradation of lignin and cellulose using and of pesticides and other toxic chemicals by microorganisms, Degradation of aromatic and chlorinated hydrocarbons and petroleum products.
CO4	Have knowledge of treatment of municipal waste and Industrial effluents, Biofertilizers: Role of symbiotic and asymbiotic nitrogen-fixing bacteria in the enrichment of soil, algal and fungal biofertilizers (VAM).
CO5	Have basic understanding of Enrichment of ores by microorganisms (gold, copper, and Uranium), Environmental significance of Genetically modified microbes, plants and animals.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Conventional and modern fuels**	Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol.	8	CO-1
2	**Structural and Functional dynamics of microbes**	Diversity, activity and growth, community profiling, biosensors, bioreporters, Microchips.	6	CO-2
3	**Methanogenesis**	Methanogenesis: methanogenic, acetogenic and fermentative bacteria- technical processes and conditions	8	CO-2
4	**Bioremediation**	Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents, Degradation of lignin and cellulose using microbes,.	8	CO-3
5	**Phytoremediation**	Phytoremediation, Degradation of pesticides and other toxic chemicals by microorganisms, Degradation of aromatic and chlorinated hydrocarbons and petroleum products	8	CO-3
6	**Waste Management**	Treatment of municipal waste and Industrial effluents,	6	CO-4
7	**Biofertilizers**	Biofertilizers: Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, algal and fungal biofertilizers (VAM).	8	CO-4
8	**Bioleaching**	Enrichment of ores by microorganisms (gold, copper, and Uranium), Environmental significance of Genetically modified microbes, plants and animals.	8	CO-5

Reference Books:

1. Microbial Biotechnology (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company

2. Molecular biotechnology: Principles and Applications of Recombinant DNA –Bernaral R. Glick and Jack J. Pastemak ASMPress. Washington, D.C (1994).
3. Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut.
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	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

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

4-

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

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100603T / BS318	**Title of the Course**	Food microbiology and Biotechnology	**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 food and types of microorganisms associated with foods and their origin and role, food preservation and fermentation techniques used in dairy industry, enzymes in food technology, dairy products and value addition products						

Course Outcomes	
CO1	The students will learn about the role of microorganism in food microbiology
CO2	Gain insight on spoilage of foods by microbes and the microbial examination of food
CO3	Learn about food preservation techniques and fermentation of foods
CO4	Learn about history and evolution of food technology, enzymes used in food industry
CO5	Learn about the microbial flavors in food industry

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to food & nutrition	History, Development and Scope of food microbiology; Concept of food and nutrients; Physiochemical properties of food; Importance and types of microorganisms in food (bacteria, mold and yeast); Food as a substrate for microorganism- Intrinsic and extrinsic factors that affect growth and survival of microbes in food, natural flora and source of contamination of foods in general.	8	CO-1
2	Microbial spoilage of various foods and Microbial examination of food	Principal; Spoilage of vegetables, fruits, meats, eggs, milk and butter, bread, canned foods, DMC, viable count, examination of faecal Streptococci. Food quality monitoring, Biosensors and Immunoassays	8	CO-1
3	Food Preservation	Basic Principles, Methods (heating, freezing, dehydration, chemical preservatives, radiation). Modern technologies in food preservation, Packaging material.	6	CO-2
4	Fermentation of foods	Types of fermentation, production and defects. Fermentation of pickles, butter, cheese, creams, yogurt and ice creams. Probiotics: health benefits, types of microorganisms used, probiotic foods available in market.	8	CO-2
5	Introduction to Food Biotechnology	Historical Background of Food technology. Importance, global trends, codex guidelines, nutritional labelling in India, FSSAI guidelines. Improvements through Biotechnology (e.g. Golden Rice, Potato, Flavr Savr Tomato etc.)	8	CO-3
6	Enzymes in Food Industry	Carbohydrases, Proteasase, Lipases, Modification of food using enzymes: Role of endogenous enzymes in food quality, Enzymes use as processing aid and ingredients	8	CO-4
7	Milk and Milk products	Milk and milk products: Clean milk production, collection, cooling and transportation of milk, Therapeutic value and nutritive value of fermented milk products; Spoilage of milk and milk products; Milkborne diseases; antimicrobial systems in milk; sources of contamination of milk; Chemical and microbiological examination of milk; grading of milk; Starter lactic cultures; management and preparation of starter cultures; starter defects	8	CO-4
8	Value addition products	Value addition products like High Fructose Syrup, Invert Sugars etc. SCPs (e.g. Spirulina, Yeast etc.) as food supplements, Edible fungus: Mushrooms. Potential of Probiotics. Flavour enhancers: Nucleosides, nucleotides and related compounds. Organic acids (Citric acid, Acetic acid) and their uses in foods/food products.	8	CO-4

Reference Books:

1. Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.
2. R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill
3. Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)
4. Food processing Biotechnological Applications, S.S. Marwaha and Arora, AsitechPub
5. Lopez GFG, Canaas G, Nathan EV. Food Sciences and Food biotechnology

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4

PSO / CO											
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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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

2-

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

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B100602P/BS393	Title of the Course	Fundamentals of Environmental Biotechnology Lab	L	T	P	C
Year	2	Semester	IV	0	0	4	2
Pre-Requisite	10+2 with Biology	Co-requisite					
Course Objectives	This course aims to develop the understanding of basics of Algal and fungal culture, estimation of Nitrogen, citric acid, lactic acid, heavy metals, BOD and COD, and examination of bacteria by MPN Count Method.						

Course Outcomes	
CO1	Culture algae and fungi
CO2	Perform and analyze estimation of citric acid and lactic acid.
CO3	Perform and analyze estimation of Total Nitrogen by Kjeldahl method.
CO4	Can perform Bacterial Examination of Water by MPN Count Method and estimate of BOD and COD
CO5	Estimate heavy metals (Iron, chromium and arsenic) in water sample

Exp. No.	**Title of Experiment**	**Contact Hrs.**	**Mapped CO**
Exp-01	Algal and fungal culture – Yeast and Aspergillus	10	CO-1
Exp-02	Estimation of citric acid from Aspergillus culture.	8	CO-1
Exp-03	Estimation of lactic acid.	8	CO-2
Exp-04	Estimation of Total Nitrogen by Kjeldahl method.	8	CO-3
Exp-05	Bacterial Examination of Water by MPN Count Method.	8	CO-3
Exp-06	Estimation of BOD and COD (2 Samples).	10	CO-4
Exp-07	Estimation of heavy metals (Iron, chromium and arsenic) in water sample.	8	CO-5

Reference Books:
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	3	3	3	3	2
CO2	3	3	1				3	3	3	3	1
CO3	3	3	1			2	3	3p	3	3	1
CO4	3	3	1			3	3	3	3	3	2
CO5	3	3	1			3	3	3	3	3	1

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

3-

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B100604P / BS310	**Title of the Course**	Food microbiology and Biotechnology Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	**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

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	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 and basics of Free Radical Biology.
CO4	Have knowledge of Significance of IPR.
CO5	Have knowledge of Significance of Biosafety and GMO.

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 radical 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:

1.Genome, T.A. Brown, John Willey & Sons Inc.

2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing

3. Molecular Cell Biology, H. Lodish, A.Berk, S. Zipursky, P Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.

4. Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison- Wesley Publishing.

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**