Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BS211	**Title of the Course**	IMMUNOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines and Immunization						

Course Outcomes	
CO1	Know the history and scope of Immunology.
CO2	Understand the types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity and the cell and organs of immune responses and their functions, B & T cells.
CO3	Have basic knowledge of Antigens as haptens, epitopes and Factors influencing immunogenicity, and Antibodies structure, types, production and functions of immunoglobulins, Clonal selection theory and Antigen Antibody reactions as Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA.
CO4	Comprehend Histocompatibility, structure of MHC class I, II & III antigens and their mode of antigen presentation, MHC restriction Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity
CO5	Understand Passive and Active immunization, Types of Vaccines: Inactivated, Attenuated, Recombinant and Subunit Vaccines, Peptide and DNA Vaccines.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basics of Immunology	History and scope of Immunology, Types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity	8	CO-1
2	Immune Responses	Cell and organs of immune responses and their functions, B & T cells.	8	CO-2
3	Antigens and Antibodies	Antigens: haptens, epitopes and Factors influencing immunogenicity, Antibodies: Structure, types, production and functions of immunoglobulins Clonal selection theory. Antigen Antibody reaction: Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA.	8	CO-3
4	Histocompatibility:	structure of MHC class I, II & III antigens and their mode of antigen presentation, MHC restriction; Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity.	8	CO-4
5	Vaccines and Immunization	Passive and Active immunization, Types of Vaccines: Inactivated, Attenuated, Recombinant and Sub Unit Vaccines, Peptide and DNA Vaccines	8	CO-5

Reference Books:

1. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York
2. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
3. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
4. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell)..
5. Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					3	3			
CO2	3	1				1	3	3			
CO3	3	1			1		3	3			
CO4	3	1		3	1		3	3			
CO5	3	1		1	1	1	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: 2020-21							
Course Code	BS303	**Title of the Course**	GENETIC ENGEENIRING	**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 mutagenes is (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.
CO2	Gain knowledge about In vitro construction of recombinant DNA molecules, passenger and vector DNA, and 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 and DNA ligases, Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmids.	08	CO-1
2	rDNA	*In vitro* construction of recombinant DNA molecules (pBR332, pUC19), Isolation of passenger and vector DNA, creation of r-DNA, Transformation of r-DNA by different methods.	08	CO-2
3	Screening and selection of recombinant host cells	Immunological screening and colony hybridization, Gene Libraries: Genomic DNA and cDNA cloning techniques, Expression of cloned DNA in *E. coli*.	08	CO-3
4	Techniques	Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Sanger's method, Blotting techniques: Southern, Western and Northern blot.	08	CO-4
5	Applications	Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.	08	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	PO8	PO9	PO10	PO11	PO12	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		2						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: 2020-21							
Course Code	BS321	**Title of the Course**	PLANT ANATOMY AND EMBRYOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of the scope and importance of plant anatomy and embryology of angiospermic plant, Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information of various tissue systems, anomalous secondary growth in plants, know fertilization, endosperm and embryogeny.						

Course Outcomes	
CO1	Course component will provide an ample understanding on the evolution of concept of organization of shoot and root apex.
CO2	To understand the basic concepts with ability to identify and distinguish various features related to anatomy.
CO3	To understand structure and development in microsporangium and megasporangium, process of microsporogenesis and megasporogenesis
CO4	To evaluate the structural organization of flower and the process of pollination and fertilization.
CO5	To understand the structure and development of dicot and monocot embryos.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant Anatomy-I	Root and shoot apical meristems; Simple and complex tissues. Epidermis, cuticle, stomata; Structure of xylem and phloem.	8	CO1
2	Plant Anatomy-II	Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).	8	CO2
3	Plant Embryology-I	Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryosac	8	CO3
4	Pollination and seed dispersal	Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms	8	CO4
5	Plant Embryology-II	Endosperm types, structure and functions; Dicot and monocot embryo; Apomixis and polyembryony	8	CO5

Reference Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

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					1	3			
CO3	3	1					1	3			
CO4	3	1					1	3			
CO5	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: 2020-21							
Course Code	BS322	**Title of the Course**	COMPARATIVE ANATOMY & DEVELOPMENTAL BIOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of Ontogenetic and phylogenetic developmental in vertebrates, understand structural comparisons of vertebrate systems in major groups of vertebrates, Gametogenesis, Fertilization and early development, cleavage and its types based upon egg organization, cell types and cell patterns, stem cells, cell potency, cell competence, embryonic induction and cell determination						

Course Outcomes	
CO1	The students will learn the comparative anatomy of Skeletal System and Digestive System of animal vertebrate types.
CO2	Learn the comparative anatomy of Respiratory System, circulatory and Urinogenital System of animal vertebrate types.
CO3	The students will learn the comparative anatomy of Nervous System and different types of receptors in animal vertebrate types.
CO4	The students will learn about the Gametogenesis, Fertilization, Egg, Cleavage, Stem Cell, Cell lineage, Genomic equivalence.
CO5	Learn Blastulation and Gastrulation, Development of Chick, Extra embryonic membranes of chick and Placentation.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Integumentary System	Derivatives of integument w.r.t. glands and digital tips, Skeletal System: Evolution of visceral arches, Digestive System: Brief account of alimentary canal and digestive glands.	8	CO-1
2	Respiratory System	Gills, lungs and air sacs; Circulatory System: Evolution of heart and aortic arches; Urinogenital System: Succession of kidney, Evolution of urinogenital ducts	8	CO-2
3	Nervous System	Comparative account of brain; Sense Organs: Types of receptors	8	CO-3
4	Gametogenesis	Gametogenesis, Fertilization, Egg: structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence	8	CO-4
5	Embryonic development	Process of Blastulation and Gastrulation. Fate Map, Development of Chick up to formation of Primitive streak and mammal (in outline) Extra embryonic membranes of chick. Placentation and types of Placenta.	8	CO-5

Reference Books:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, McGraw Hills John Wiley and Sons.
4. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House. B.
5. Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
6. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
7. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
8. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
9. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

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					1	3			
CO3	3	1					1	3			
CO4	3	1					1	3			
CO5	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: 2020-21							
Course Code	BS323	**Title of the Course**	INDUSTRIAL& ENVIRONMENTAL BIOTECHNOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of principle, methodology and application of Drug and target identification, target validation, Bioprospecting and conservation: importance of biodiversity, free radical and antioxidants, Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity						

Course Outcomes	
CO1	Get proper knowledge about Structural and Functional dynamics of microbes for fermentation.
CO2	Gain knowledge about Solid waste treatment and management, Effluent Treatment
CO3	Learn about Isolation, screening, maintenance and improvement of industrial strains
CO4	Learn about the basics of general design of fermenter; media and Downstream Processing
CO5	Have knowledge of products obtained by industrial microbiological fermentation.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Structural and Functional dynamics of microbes	Structural and Functional dynamics of microbes: diversity, activity and growth, community profiling, biosensors, bioreporters, Microchips. Methanogenesis: methonogenic, acetogenic and fermentive bacteria- technical processes and conditions	8	CO-1
2	Solid waste treatment and management, Effluent Treatment	Solid waste treatment and management, Effluent Treatment: Aerobic and anaerobic water treatment processes: activated sludge, trickling filter, fluidized expanded bed reactor, Upflow anaerobic sludge blanket reactor. Bioleaching, Bioremediation, Biodegradable plastics, Biofuels / Biodiesel, Biopesticides, Biofertilizers and Vermitechnology.	8	CO-2
3	General concept and processes in fermentation	General concept and processes in fermentation, Isolation, screening, maintenance and preservation of industrial strains. Concept of strain improvement. Sterilization	8	CO-3
4	Industrial Fermentation	Media for Industrial Fermentation. General design of fermenter; Scale up concept. Downstream Processing: Filtration, centrifugation, cell disruption, extraction and drying	8	CO-4
5	Products obtained by industrial fermentation	Brief account of the following products obtained by industrial microbiological fermentation: Alcoholic Beverage: Beer, Organic acid: Citric acid, Antibiotic: Penicillin, Amino acids: Glutamic acid, Vitamin: vitamin B12.	8	CO-5

Reference Books:

1. Environmental Studies by Benny Joseph, Tata McGraw Hill, 2005.
2. Environmental Studies by Dr. D.L. Manjunath, Pearson Education, 2006.
3. Principles of Environmental Science and Engineering by P. Venugopal Rao, Prentice Hall of India.
4. Environmental Science and Engineering by Meenakshi, Prentice Hall of India
5. Microbial Biotechnogy (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
6. Molecular biotechnogy: Principles a nd Applications of Recombinant DNA –Bernaral R. Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
7. Fungal Ecology and Biotechnogy (1993) Rastogi Publicaions, Meerut.
8. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers. Books (P) Ltd.
9. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS306	**Title of the Course**	APPLIED BIOTECHNOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students familiar with principle, methodology and application of Drug and target identification, target validation, Bioprospecting and conservation: importance of biodiversity, General theory of free radical and antioxidants, Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity						

Course Outcomes	
CO1	Get proper knowledge about Genomics and Proteomics and gene expression.
CO2	Gain knowledge about Drug Discovery and Designing: Drug and target identification, target validation.
CO3	Learn about Bioprospecting and conservation: importance of biodiversity.
CO4	Learn about the basics of Free Radical Biology: General theory of free radical and antioxidants.
CO5	Have knowledge of Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Genomics and Proteomics	Introduction to genomics, Genome annotation, Human genome project and its application, Introduction to Proteomics: Protein expression and its analysis	8	CO1
2	Drug Discovery and Designing	Drug and target identification, target validation, Molecular docking studies and its Insilco tools e.g. Autodock, GOLD.	8	CO2
3	Bioprospecting and conservation	Importance of biodiversity. biodiversity informatics, databases in biological materials. International efforts and issues of sustainability.	8	CO3
4	Free Radical Biology	General theory of free radical and antioxidants. Free radical mediated damage to lipids, proteins and DNA; Natural antioxidants and their applications.	8	CO4
5	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	CO5

Reference Books:

1. Environmental Studies by Benny Joseph, Tata McGraw Hill, 2005.
2. Environmental Studies by Dr. D.L. Manjunath, Pearson Education, 2006.
3. Principles of Environmental Science and Engineering by P. Venugopal Rao, Prentice Hall of India.
4. Environmental Science and Engineering by Meenakshi, Prentice Hall of India.

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

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

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

Integral University, Lucknow

Effective from Session:							
Course Code	BS216	**Title of the Course**	IMMUNOLOGY LAB	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	This course aims to develop the understanding of 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.	**Experiment**	**Content**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Blood grouping	3	CO1
2	Exp-02	Differential Count of WBC, Detergent lysis of RBC	3	CO2
3	Exp-03	Dot Elisa, ELISA – Demonstration	3	CO3
4	Exp-04	Ouchterlony Double diffusion (ODD)	3	CO4
5	Exp-05	Separation of serum from blood & precipitation of Immunoglobulins	3	CO5
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		2	3	
CO2	3	3	1				3		2	3	
CO3	3	3	1				3		2	3	
CO4	3	3	1				3		2	3	
CO5	3	3	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: 2020-21							
Course Code	BS308	**Title of the Course**	GENETIC ENGEENIRING LAB	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basics of genetic engineering and PCR.						

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

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

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 edn. 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	3	1				3	3	3	1	3
CO2	3	3	1				3	3	3	1	3
CO3	3	3	1				3	3	3	1	3
CO4	3	3	1				3	3	3	1	3
CO5	3	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: 2020-21							
Course Code	BS331	**Title of the Course**	COMPUTATIONAL SCIENCE AND BIOINFORMATICS	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop basic knowledge of computer networking and internet devices, Fundamental concepts of Internet and web technologies, Study biological databases, algorithms and flowchart design, Sequence Alignment, drug designing and understanding the advance applications of Bioinformatics.						

Course Outcomes	
CO1	Utilizing and configuring computer operating system and application software and understanding its application in life sciences.
CO2	Understanding the concept of Bioinformatics and biological databases.
CO3	Derive the basic knowledge of nucleic acid and protein databases.
CO4	Understanding biological sequence alignment and its methodologies.
CO5	Knowing the advance applications of bioinformatics in biological sciences

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Computers	Computers: Input and Output Devices; Internet- Web Browsers, URL; Types of network - LAN and WAN. Need of Computers in Biological Sciences, Benefits of computational sciences.	8	CO1
2	Bioinformatics	Introduction to Bioinformatics, Application of Bioinformatics in life sciences. Biological databases: primary and secondary databases; various types and categories of Biological databases.	8	CO2
3	Sequence databases	Nucleotide sequence databases: Genbank, EMBL, DDBJ; Protein sequence databases: SWISS PROT, TrEMBL; Structural databases: PDB and MMDB and its applications.	8	CO3
4	Molecular Visualization & Database similarity search	Molecular Visualization tools: PyMOL, Rasmol. Introduction to NCBI and its various components; Database similarity search tools: BLAST – algorithm and its versions. FASTA – algorithm and its version.	8	CO4
5	Advanced Bioinformatics	Advanced Bioinformatics: Protein Structure prediction studies – Homology Modeling, method and tools; Multiple sequence alignment – concept and implications – MSA in phylogenetics; Application of bioinformatics in Computer Aided drug Design	8	CO5

Reference Books:

1. Andrew Leach; Molecular Modelling: Principles and Applications (2nd Edition), Prentice Hall, 2001, ISBN 13: 9780582382107
2. David W. Mount Bioinformatics, Cold Spring Harbor Laboratory Press, ISBN 0-87969-608-7
3. D.E. Krane and M.L. Raymer Fundamental concepts of Bioinformatics, Pearson Education ISBN 81-297-0044-1
4. A.D. Baxevanis et al., Current Protocols in Bioinformatics, Wiley Publishers

e-Learning Source:

DNA sequence analysis methods-I Dr. Vikash Kumar Dubey http://nptel.ac.in/courses/102103017/pdf/lecture%2029.pdf

DNA Sequence Analysis Methods-II Dr. Vikash Kumar Dubey http://nptel.ac.in/courses/102103017/pdf/lecture%2030.pdf

Computational chemistry in drug discovery. European Bioinformatics Institute - EMBL-EBIhttps://www.youtube.com/watch?v=9DESulCWbRQ.

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BS332	**Title of the Course**	PLANT AND ANIMAL BIOTECHNOLOGY	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of basic plant and animal biotechnology techniques and their applications in plant growth and development and cell culture, and large scale production of natural products from plant source, Production of transgenics and expression of Cloned proteins and vaccines.						

Course Outcomes	
CO1	Get proper knowledge about the history and Scope of Animal Tissue Culture, Culture Media, Simulating natural conditions for growth of animal cells.
CO2	Gain knowledge about Primary Culture, cell lines and Secondary Culture, transformed animal cells and continuous cell lines. Monolayer formation, Synchronization
CO3	Learn about transfection of animal cell lines, Selectable makers and Transplantation of Cultural Cells. Microinjection, In vitro fertilization and Stem cell technology.
CO4	The students will get proper knowledge about the media preparation for In-vitro propagation of plants and different aseptic techniques used during preparation.
CO5	The students learn the role of techniques haploid plant production and its significance.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Aseptic Techniques for Callus and suspension culture	Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokininis and Gibberellins). Callus and suspension	8	CO-1
2	Haploid plant production	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	Role of tissue culture & Techniques of transformation	Role of tissue culture in agriculture, horticulture and forestry, Transgenic plants, Technique of transformation: Agrobacteriummediated and physical methods (Microprojectile bombardment and electroporation).	8	CO-3
4	Primary Culture	Primary Culture: Cell lines, and cloning, isolation and mechanical disaggregation of tissue, enzyme. Secondary Culture: transformed animal cells and continuous cell lines. Monolayer formation, Synchronization	8	CO-4
5	Expression of Cloned proteins in animal cell	Expression of Cloned proteins in animal cell: Expression vector, over production and downstream processing of the expressed proteins, Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies, HAT selection	8	CO-5

Reference Books:

1. Ravishankar G.A and Venkataraman L.V(1997) Biotechnology applications of Plant Tissue & cell culture. Oxford &IBH Publishing co., Pvt Ltd.
2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi
3. H. S. Chawla "Plant Biotechnology: A Practical Approach"
4. Chrispeel M.J. and Sdava D.E. (1994 Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
5. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropogation (3rd Edition) timber Press, Partland

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	2	1	1	3
CO2	3	1					1	2	1	1	
CO3	3	1					1	2	1	1	3
CO4	3	1				1	1	2	1	1	3
CO5	3	1				1	1	2	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: 2020-21							
Course Code	BS314	**Title of the Course**	BIOINFORMATICS LAB	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of sequence databases, Retrieving sequences, Simple sequence comparison using DOTPLOT, Pair wise Sequence Alignment, FASTA & BLAST search, Multiple Sequence Alignment (ClustalX & Treeview), Protein Structure Visualization (RASMOL, Swiss-PDB Viewer), Gene Finding tools (Grail or Genscan).						

Course Outcomes	
CO1	Learn about types of sequence databases (Nucleotide & Protein)
CO2	now about Retrieving sequences from the databases and simple sequence comparison using DOTPLOT
CO3	Have knowledge of Pair wise Sequence Alignment (NW and SW approach), FASTA & BLAST search and Multiple Sequence Alignment (ClustalX & Treeview)
CO4	Have basic knowledge of Protein Structure Visualization (RASMOL, Swiss-PDB Viewer)
CO5	Have basic knowledge about Gene Finding tools (Grail or Genscan)

Exp. No.	**Title of Experiment**	**Contact Hrs.**	**Mapped CO**
Exp-01	Introduction to types of sequence databases (Nucleotide & Protein)	3	CO1
Exp-02	Retrieving sequences from the databases	3	CO2
Exp-03	Simple sequence comparison using DOTPLOT	3	CO2
Exp-04	Pair wise Sequence Alignment (NW and SW approach)	3	CO3
Exp-05	FASTA & BLAST search	3	CO3
Exp-06	Multiple Sequence Alignment (ClustalX & Treeview)	3	CO3
Exp-07	Protein Structure Visualization (RASMOL, Swiss-PDB Viewer).	3	CO4
Exp-08	Gene Finding tools (Grail or Genscan)	3	CO5

Reference Books:

3. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown
4. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd edn. 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	3	1			1	3	3	1	1	1
CO2	3	3	1			1	3	3	2	1	3
CO3	3	3	1			1	3	3	2	1	3
CO4	3	3	1			1	3	3	2	1	3
CO5	3	3	1			1	3	3	2	1	3

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS315	**Title of the Course**	PROJECT & TRAINING	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	0	0	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The main objective of this course is to acquaint the student with various techniques used in contemporary research in biotechnology or allied areas.						

Course Outcomes	
CO1	To be able to define a research problem.
CO2	To conduct bench work.
CO3	To prepare the research report and its oral demonstrations.
CO4	To coorealate theoretical knowledge of techniques with practical application
CO5	To promote lifelong learning

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

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

- Students are allocated a dissertation topic individually under the supervision of faculty of the department.
- The dissertation must be similar to the thesis style and encompass:

(i) Introduction / Rationale and Review of Literature
(ii) Materials and Methods,
(iii) Results,
(iv) Discussion and (v) Bibliography.

The dissertation should be submitted in type-written, bound form to the department for record.

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS316	**Title of the Course**	EDUCATIONAL TOUR	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	0	0	0	2
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The main objective of this course is to provide the students an exposure to various research activities in the country and acquaint the student with state of the art technique/instruments used in various research institutions and industries of national repute. The student needs to submit a report after completion of the tour.						

Course Outcomes	
CO1	Develop understanding of state of the art techniques/instruments used in various reputed research institutions. and industries
CO2	Take part in Group discussion and learn Team work.
CO3	Enhance communication and social skills by communication with peers.
CO4	Student shall be able to plan and improve the Technical Report writing skills
CO5	Have created Interest to pursue lifelong learning.

	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		3	3
CO2	3	2	2	1			3				3
CO3	3	2	2	1			3				3
CO4	3	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**