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	**4**	**2**	**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 evaluate genome organization and synthesize functional models for its biological significance.
CO2	The students will be able to analyse the mechanisms of DNA replication in prokaryotes and eukaryotes, and propose strategies for its regulation
CO3	The students will be able to critically evaluate different types of DNA damages and Repair systems and formulate approaches to prevent/combat DNA damage.
CO4	The students will be able to critically evaluate translation mechanisms in prokaryotes and eukaryotes and propose approaches for their regulation.
CO5	The students will be able to Integrate knowledge of DNA sequence classes, post-transcriptional and post-translational modifications, and construct strategies for regulating gene expression.

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:

https://www.coursera.org/learn/dna-decoded#modules

https://www.udemy.com/course/dna-repair-concepts/?srsltid=AfmBOoq-Pm_T0Ly302rWBdh4jKd0TbeHoV_kEfvHIzFiIfa6u_aUUZP_

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3	2	1	
CO2	3	1					2	3	2	2	
CO3	3	1	2		1	1	2	3	2	3	
CO4	3	1					2	3	2	3	
CO5	3	1					2	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: 2025-26							
Course Code	B100305V/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 principles and application of molecular techniques employed in the diagnosis of diseases.						

Course Outcomes	
CO1	The student will be able to evaluate the mechanisms of the human genome and critique their association with the pathogenesis of common diseases using evidence-based analysis.
CO2	The student will be able to critically evaluate types of infectious diseases (bacterial, viral, fungal, protozoan, helminthic), their transmission modes, and propose diagnostic strategies.
CO3	The student will be able to critically evaluate genetic disorders and propose techniques for their diagnosis.
CO4	The student will be able to evaluate different types of cancers and their genetic underpinnings, and analyse the applications of molecular diagnostics in human cancer detection and treatment.
CO5	The student will be able to critically evaluate molecular diagnostic tools and propose their applications in clinical diagnostics and research.

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 disease, and coronary disease **Virtual Lab:** Demonstration of Extraction of DNA from Animal Sample	10	CO1
2	Infectious Diseases and History of Diagnostics	Types of infectious diseases- bacterial, viral, fungal, protozoan, 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 helminths. **Virtual Lab:** Demonstration of Gram staining to identify bacteria	10	CO2
3	Major Genetic disorders, its causes & Diagnosis.	Genetic disorders: Sickle cell anaemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis, and Sex – linked inherited disorders **Case Study:** A case study on any one of the genetic diseases. (Sickle cell anaemia, Duchene muscular Dystrophy, Retinoblastoma, Cystic Fibrosis or 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. **Case Study:** A case study on any type of cancer	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. **Virtual Lab:** Demonstration of Polymerase Chain Reaction	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; https://www.coursera.org/specializations/cancer-biology; https://onlinecourses.nptel.ac.in/noc24_ge36/preview

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3	2	2	1
CO2	3	1					2	2	2	2	1
CO3	3	1	2				1	3	1	3	
CO4	3	1	2				1	2	1	3	
CO5	3	1					2	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: 2023-24							
Course Code	B100303T/ BS208	**Title of the Course**	Basics of Microbiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**4**	**2**	**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	Students will be able to classify and analyze the basics and history of microbiology and general classification of microbes and extremophiles
CO2	Students will be able to classify and evaluate the microbes in extreme environments and microbial interactions
CO3	Students will be able to critically analyze the control of Microorganisms and staining techniques
CO4	Students will be able to critically evaluate the basic details of growth of microbes and recombination in Prokaryotes
CO5	Students will be able to compare and evaluate the 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 formulate genomic DNA isolation strategies from bacteria.
CO2	The students will be able to plan experiments for genomic DNA extraction from plant or animal tissues.
CO3	The students will be able to design studies for isolation of plasmid DNA (*E. coli*).
CO4	The students will be able to evaluate the process of restriction digestion of DNA.
CO5	The students will be able to perform experiments to analyze the size of DNA using 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:

https://vlab.amrita.edu/

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

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

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	Students will be able to develop critical understanding of Instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.
CO2	Students will be able to critically analyze and understand the staining techniques
CO3	Students will be able to perform the processes involved in culturing of microbes as cleaning and sterilization of glassware, media preparation.
CO4	Students will be able to perform design the process of isolation of bacteria and fungi from soil/ air/water/ other sources
CO5	Students will be able to critically analyze 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	1	3	2	3	
CO2	3	1				3	1	1	3	3	
CO3	3	1				3	1		3	3	3
CO4	3	1				3	1		3	3	3
CO5	3	1				2	1		3	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: 2022-23							
Course Code	B100401T / BS218	**Title of the Course**	Industrial Biotech and Bioprocess Technology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**4**	**2**	**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	The student will able to analyze processes involved in isolation of microorganisms and their strain improvement.
CO2	The student will able to formulate media and type of fermentation for the growth of microorganisms in industrial processes.
CO3	The student will develop understanding about the design and types of fermenters and operation of fermenters.
CO4	The student will able to design industrial production process of alcohols, antibiotic and enzymes and other biologically active compounds by industrial microbiological fermentation.
CO5	The student will develop understanding about the policies of IPR and entrepreneurship and regulation of bioethics.

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, Fed batch 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**	CO4
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.
8. Richard HB, Julian ED, Arnold LD. (2010) Manual of Industrial Microbiology and Biotechnology, 3rd Edition

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/
https://ocw.mit.edu/high-school/biology/exam-prep/cellular-energetics/fermentationcellular-respiration/fermentation/

Integral University, Lucknow

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				1	1	3	3	3	3
CO2	3	1				1	1	3	3	2	3
CO3	3	1				1	1	3	3	3	3
CO4	3	1				1	1	3	3	3	3
CO5	3	1	1		3	3	1	3	3	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: 2023-24							
Course Code	B100403T/BS256	**Title of the Course**	Infection and immunity	**L**	**T**	**P**	**C**
Year	II year	**Semester**	IV Sem	**4**	**2**	**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	The students will be able to analyze and compare the characteristics of various infectious diseases and examine their modes of transmission.
CO2	The students will be able to evaluate and compare various laboratory diagnostic methods for identifying infectious agents
CO3	The students will be able to analyze and compare the structures and functions of antigens, examine the organization of the immune system.
CO4	The students will be able to analyze and compare the structures and functions of MHC molecules and examine the mechanisms of complement activation.
CO5	The students will be able to evaluate and critique various immunological techniques, assess immune response mechanisms, and justify vaccination strategies.

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

Reference Books:

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

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

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

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

e-Learning Source:

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

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

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

Effective from Session: 2023-24

Integral University, Lucknow

Course Code	B100402P/ BS219	Immunological Techniques Lab	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:

https://onlinecourses.nptel.ac.in/

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

Course Outcomes	
CO1	Student will be able to Critically Evaluate the blood groups and the variations in differential WBC counts.
CO2	Student will be able to Evaluate the effects of detergents and concentrations on RBC membrane.
CO3	Student will be able to Evaluate the applications of ELISA and Dot ELISA, interpreting the relevance of these assays.
CO4	Student will be able to Analyze the antigen-antibody interaction pattern by Ouchterlony Double diffusion assay.
CO5	Student will be able to Analyze the 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:

https://onlinecourses.nptel.ac.in/

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

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

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

Integral University, Lucknow

Effective from Session: 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 evaluate the design, workflow, and contamination prevention strategies for setting up a molecular medicine laboratory, including sample handling and preparation protocols.
CO2	To critically analyze the conformational dynamics of biomolecules and diseases caused by protein misfolding.
CO3	To assess the principles and methodologies used in studying tissue and cell structures and propose advanced preparative techniques for light and electron microscopy visualization.
CO4	To design experimental protocols by integrating principles and technical aspects of animal cell culture for research applications.
CO5	To critically evaluate the principles and applications of molecular techniques used in disease diagnostics, propose their role in clinical research advancements.

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:

https://www.khanacademy.org/test-prep/mcat/biomolecules

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

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

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