Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BE201	**Title of the Course**	Biochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The course deals with an understanding of biological macromolecules and their chemical properties and three dimensional structures in relationship to their biological function.						

Course Outcomes	
CO1	The students will learn about the macromolecules, their properties and functions such as carbohydrates, lipids, proteins, and nucleic acids, and also the functions and structures of vitamins and hormones.
CO2	The students will learn about the carbohydrate metabolism in both respiration and photosynthesis and understand how the body meets the carbohydrate requirements, and how the carbohydrate metabolism regulates the synthesis of several other biomolecules.
CO3	The students will understand about the synthesis and degradation of lipids, in the body.
CO4	The students will understand about the synthesis and degradation of amino acids in the body.
CO5	The students will understand about the synthesis (through de novo and salvage pathways) and degradation of nucleic acids in the body.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Role of water in biological processes and structures and functions of biomolecules	Solvent, solute, solutions, water and its properties, hydrogen ion concentration, Buffers system. General structure, function and classification of carbohydrates (mono, di and poly saccharide.), lipids (Fatty acids, Phospholipids, Glycolipids, Waxes), proteins (primary, secondary and tertiary) and nucleic acid (Purines, pyrimidines, nucleosides, nucleotides) Structure and functions of vitamins and hormones.	8	CO1
2	Carbohydrates metabolism	Introduction, Glycolysis and its regulation, Oxidative and reductive decarboxylation, TCA cycle, Amphibolic role of TCA cycle, Anaplerotic reactions, glyoxylate cycle, pentose phosphate pathway, Oxidative phosphorylation (energy metabolism). Biosynthesis of polysaccharides: Photosynthesis, gluconeogenesis.	8	CO2
3	Lipid metabolism	Oxidation of fatty acids-saturated and unsaturated, beta, omega oxidations and regulations. Biosynthesis of fatty acids, cholesterol and phospholipids.	8	CO3
4	Amino acid metabolism	Biosynthesis and oxidation of glutamate, serine and aspartate family amino acids and their regulation. Urea cycle, Nitrogen fixation, (Biological, nif gene)	8	CO4
5	Nucleic acid metabolism	Biosynthesis of purines & pyrimidines by de novo & salvage pathway and their regulations. Biodegradation of purines and pyrimidines and regulation.	8	CO5

Reference Books:

1. Hames and Hooper; Instant notes on biochemistry; Viba Books PVT. Ltd. New York.
2. Nelson, Cox; Lehninger's, Principle Biochemistry; Macmillan Worth Publication.
3. L. Stryer; Biochemistry.
4. Voet and Voet; Biochemistry; Freeman WH and Co.
5. Mathews et al; Biochemistry; Pearson education.
6. S.C Rastogi; Biochemistry; Tata Macgraw Hill.

e-Learning Source:

https://drive.google.com/file/d/1xNN5TZncTJ48yOIyoifCZaMn2FzbDw5w/view?usp=sharing

	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	PSO5	PSO6
CO1	2	1	2	3	1	2		1				3	3	1	1			
CO2	2	3	2	3	1	2		1				3	3	1	1			
CO3	2	3	2	3	1	2		1				3	3	1	1			
CO4	2	3	2	3	1	2		1				3	3	1	1			
CO5	2	3	2	3	1	2		1				3	3	1	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	BE 202	**Title of the Course**	Microbiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course utilizes the theoretical approach to the study of microorganisms and offers the student a comprehensive knowledge of the fundamentals of microbiology.						

Course Outcomes	
CO1	The students will learn about the basics of microbiology and their classification.
CO2	The students will learn about the microbial mechanism of pathogenecity
CO3	The students will learn about the microbial nutrition and growth and understanding of different techniques to get pure culture.
CO4	The students will learn about the different aseptic techniques used to control the microorganisms.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to microbiologyand microbial diversity	Microbiology and its scope, Biogenesis and Abiogenesis theories, Koch's postulates. Microbial diversity: Morphology, structure and microbial diversityof bacteria, fungi, viruses and protozoa. Characteristic of prokaryotic and eukaryotic cells	8	1
2	Pathogenesis of microorganisms:	Some common pathogenic microorganisms: Bacterial (tuberculosis, gall), viral(SARS, TMV), fungal (red rot of sugar cane, dermatitis) and protozoan (malaria).	8	2
3	Microbial nutrition and Genetics	Microbial media design and types, microbial isolation techniques: dilution, pourplate and streak plate, Microbial growth curve and growth measurements, pure culture, starter culture, cultural characteristics of bacteria, Types of staining (Gram Staining and Endospore staining) Genetic **exchange methods:**transformation, conjugation and transduction.	8	3
4	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	4

Reference Books:

1. Prescott, Harley and Klevin: Microbiology; 2nded.
2. Brock, Micheal and Clark: Microbiology of Microorganisms; 12th edition.
3. Introduction to Microbiology: Pelczar.

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1				2		2			2	1	2	
CO2	3	3	3	3	2	1	3	2	2	1	1	3	3	3	2
CO3	2	1	1	2	3	1	1	1	1	1	1	2	2	2	1
CO4	3	3	3	2	2		3	1	1		1	2	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: 2022-23							
Course Code	ME221	**Title of the Course**	FLUID FLOW AND SOLID HANDLING	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**2**	**1**	**0**	**3**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows. 2. To develop understanding about hydrostatic law, manometers and application energy equation in fluid flow. 3. To imbibe basic laws and equations used for analysis of static and dynamic fluids and to inculcate the importance of fluid flow measurement and its applications in Industries. 4. To give fundamental knowledge of centrifugal pump, reciprocating pump, positive displacement pump and blower 5. To develop understanding about Properties of solids, screening, industrial screening equipment, Crushers, grinders and conveyers.						

Course Outcomes	
CO1	State the Newton's law of viscosity and explain the mechanics of fluids at rest and in motion by observing the fluid phenomena.
CO2	Derive Euler's Equation of motion and Deduce Bernoulli's equation, application of Bernoulli's equation
CO3	Explain the working principle and working of flow measuring devices.
CO4	Explain the working of hydraulic machine-like centrifugal pump, reciprocating pump, positive displacement pump etc.
CO5	Explain the handling of solid, industrial screening equipment and size reduction equipment.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Fluid Properties Fluid Statics	Physical properties of fluids, ideal and real fluids, Newtonian and Non-Newtonian fluids, surface tension etc. Fluid pressure, Hydrostatic Law and Manometer.	8	CO1
2	Fluid Kinematics Fluid dynamics	Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, continuity equation. Euler's equation of motion, Bernoulli's equation from Euler's equation, Applications of Bernoulli's equation. Losses in pipe flow.	8	CO2
3	Flow measurements	Construction, working and application of flow measuring devices: Orifice meter, Nozzle flow meter, Venturi meter, Rota meter and Pitot tube. Simple calculation on them.	8	CO3
4	Pumping and compressing	Classifications, working, Introduction to vector diagram and work done by impeller. Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels. Introduction of positive displacement pump, blowers and fluidization.	8	CO4
5	Solid and their handling	Properties of solids, screening, industrial screening equipment, determination of particle size, screen analysis, size reduction of solids, stages of reduction, operating variables, intermediate and fine size reduction, power requirement and mechanism, Power driven machines: Crushers, grinders and conveyers.	8	CO5

Reference Books:

Introduction of Fluid Mech'anics by Robert W. Fox and Slan T. Mcdonald, John urley & sons,Ny. Fourth Ed.

Unit Operation in Chemical Engg., Mccable Smith., 5th edition Tata McGraw publication House

Bedger W.L. and Bancharo J. T. "Introduction to Chemical Engineering" Tata McGraw publication House.

Hydraulic Machines: Jagdish Lal, Metropolitan Book Co.

Hydraulics and Fluid Mechanics: Modi and Seth, Standard Book House

e-Learning Source:

https://www.youtube.com/watch?v=fa0zHI6nLUo&list=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEm

https://www.youtube.com/watch?v=HGbbdXNcIQA&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt

https://youtu.be/elUIbOnJc7c?t=556

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		2						3	3	2	2
CO2	3	3	3	2		3						3	3	3	2
CO3	3	3	3	2		3						3	3	2	1
CO4	3	2	2	2		3						3	3	2	1
CO5	3	3	2	1		3						3	3	2	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	MT203	**Title of the Course**	**Numerical and Statistical Analysis**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**2**	**1**	**0**	3
Pre-Requisite	10+2 with PCM/PCB	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of numerical and statisticalanalysis. Numerical and statistical analysis plays very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to calculate and analyze Errors in numerical computations. Students will also be able to find the solutions of algebraic and transcendental equations using Bisection method, Iteration method, False position method and Newton-Raphson method.
CO2	Students will be able to understand difference operators and Factorial polynomials.They will also be able to interpolation for equal and unequal intervals by using Newton's forward and backward formula, Stirling's formula, Bessel's formula Laplace Everett's interpolation, Divided difference, Newton's divided difference formula, LaGrange's Interpolation formula.
CO3	Students will be able to compute differentiation using interpolation methods and will also be able to find Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, Simpson's3/8 rule, Boole's rule, Weddle's rule.
CO4	Students will be able to understand the concept of probability, addition and multiplication theorem of probability, conditional probability and probability distributions namely Binomial distribution, Poisson distribution and Normal distribution.
CO5	Students will be able to understand the concept of probability, addition and multiplication theorem of probability, conditional probability and probability distributions namely Binomial distribution, Poisson distribution and Normal distribution.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction of Algebraic method	Errors in numerical computations, numerical solution of algebraic and transcendental equations by Bisection method, Iteration method, Regula false method, Newton-Raphson's method.	**8**	CO1
2	Factorial Polynomial	Finite differences: forward and backward differences, properties of operators, factorial polynomials, Interpolation: Newton Gregory forward and backward interpolation formula. Interpolation formula for unequal intervals, divided differences formula, central interpolation formula: Bessel, Stirling and Laplace Everett's interpolation formulae	8	CO2
3	Concept of Numerical	Numerical differentiation, Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, 3/8 rule, Boole's rule, Weddle's rule.	8	CO3
4	Concept of probability	Probability: Classical and axiomatic definition of probability. Addition and Multiplication theorem of probability. Conditional probability. Probability distributions: Binomial distribution, Poisson distribution and Normal distribution.	8	CO4
5	Concept of Hypothesis	Testing of Hypothesis: Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, critical region, type I and II error, power of a test. Test of significance based on t, F and chi-square distribution. Basic concepts of Simple random sampling and Stratified random sampling. Analysis of variance (ANOVA): One-way and two-way classification.	**8**	CO5

Reference Books:

1. Text book of Numerical Analysis: H.C. Saxena (S. Chand Publication), **2.** Numerical Analysis: S. S., Shastri

3. Numerical Analysis: B.S. Grewal. **4.** Numerical Analysis: A.R. Vashistha., **5**.Q. S Ahmad, V. Ismail and S.A Khan: Biostatistics, laxmi Publications

6.S.C. Gupta and VK. Kapoor: Fundamental of Mathematical Statistics, Sultan Chand publication

e-Learning Source:

https://nptel.ac.in/courses/111/106/111106101/, https://www.youtube.com/watch?v=QqhSmdkqgjQ

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	2	1	2	2	2	2	2	1	3	2
CO2	3	1	2	3	3	3	2	2	2	2	2	2	3	2	2
CO3	3	1	2	3	3	3	2	2	2	2	2	2	1		1
CO4	3	1	2	3	3	3	3	3	3	3	3	3	2		1
CO5	3	1	2	3	3	3	3	3	3	3	3	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: 2020-21							
Course Code	CS228	**Title of the Course**	Concepts of Web Development	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course utilizes the theoretical approach to the study of web development and offers the students comprehensive knowledge of the basic concepts of Web development.						

Course Outcomes	
CO1	The students will learn about the basics of web development.
CO2	The students will learn about the Hypertext language like Html/DHTML.
CO3	The students will learn CSS language.
CO4	The students will learn JavaScript language.
CO5	The students will learn basic of XML.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
Unit-1	Introduction to Web development strategies	History of Web,Protocols governing Web, Creating Websites for individual and Corporate World, Cyber Laws, Web Applications, Writing Web Projects, Identification of Objects, Target Users, Web Team, Planning and Process Development.	8	1
Unit2	Basic of HTML/DHTML	Introduction to HTML and DHTML, Basic structure of HTML/DHTML, Basic tags of HTML, Attribute, Element, Paragraphs,Heading tag, Font tag, Formatting tags, Creating links, Table, frames, List.	8	2
Unit3	CSS	Introduction to CSS, Syntax, Comments, Colors, Backgrounds, Borders, Margins, Padding, Box Model, Outline, Text, Font, Icon, Links, List, Layout.	8	3
Unit4	JavaScript	Introduction to JavaScript, Syntax, Statement, Comments, Variables, Keywords(Let, Const),Operators, Data types, Functions, Objects, Events, Strings, Arrays.	8	4
Unit5	XM	Introduction to XML, How can XML be used, XML Tree, XML syntax Rule, Elements, Attributes, Namespaces, Displaying XML, XML Validator, XML DOM.	8	5

Reference Books:

1-Bushan, "Collaborative Web Design Addison Wesley

2-Jeffrey Jackson "With Technologies-A Computer Science Perspective". Pearson Education

3 -XML& Related Technologies by Atul Kata Pearson Education India.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	2		2	1	1	2	1	2	1
CO2	3	3	3	3	2	1	3	2	2	1	1	3	3	3	2
CO3	2	1	1	2	3	1	1	1	1	1	1	2	2	2	1
CO4	3	3	3	2	2	2	3	1	1	1	1	2	3	2	1
CO5	2	3	2	1	3	2	1	1	1	1	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: 2020-2021							
Course Code	BE205	**Title of the Course**	PLANT PHYSIOLOGY	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To build up the knowledge of students in pertinent plant physiological processes and physiological aspects of crop yield.						

Course Outcomes	
CO1	Understand a plant cell with respect to different organelles, their physiological functions, growth and development and the transport of water and nutrients.
CO2	Understand the transport of water, gases and nutrients in plants.
CO3	Understand essential minerals, macro and micronutrients, their role and deficiency symptoms and analyze the growth of plants in their absence.
CO4	Understand the role of growth regulators and phytochromes in plants. Evaluate the effect of growth regulators on the growth and development of plants.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant cells, tissues, and organs	Cell organelles and their physiological functions; Structure and physiological functions of cell walls; Growth and development in plants.	8	CO1
2	Transport in plants	Movement of water, gases and nutrients; Cell to cell transport-Diffusion, facilitated diffusion, active transport; Plant–water relations–Imbibition, water potential, osmosis, plasmolysis; Long distance transport of water–Absorption, apoplast, symplast, transpiration pull, root pressure and guttation; Transpiration – Opening and closing of stomata; Uptake and translocation of mineral nutrients, Transport of food, phloem transport.	8	CO2
3	Mineral nutrition	Essential minerals, macro and micronutrients and their role; Mineral deficiency and their symptoms; Mineral toxicity; Elementary idea of Hydroponics as a method to study mineral nutrition.	8	CO3
4	Plant growth regulators in plant phytochromes	Auxin, gibberellin, cytokinin, ethylene, ABA; Seed dormancy; Vernalization; Phytochromes- mode of action; photoperiodism-short day, long day and day neutral plants; photoperiodic induction; photoperiod and plant flowering.	8	CO4

Reference Books:

1. Plant Physiology by Lincoln Taiz and Eduardo Zeiger
2. Plant Physiology by Frank Salisbury and Cleon Ross.
3. Text Book of Plant Physiology, Biochemistry, and Biotechnology by V.K. Varma and Mohit
4. Varma, S. Chand Ltd.

e-Learning Source:

https://www.youtube.com/watch?v=gUwwvGB0gz8

https://www.youtube.com/watch?v=xEF8shaU_34

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	2	2	1	1	1	2	3	2	2	2
CO2	1	1	1	2	2	2	2	1	1	1	2	3	2	1	2
CO3	1	1	1	3	2	1	1	1	1	1	1	3	3	2	1
CO4	1	2	3	3	3	1	1	1	1	2	2	3	3	2	1

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BE206	**Title of the Course**	Animal Physiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	1	0	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To familiarize students with the principles and basic facts of Animal Physiology with focus on organ-system physiology, however, cellular and molecular mechanisms will be discussed in order to present a current view of physiological principles. Furthermore, emphasis will be placed on nervous, muscular, cardiovascular, respiratory, renal, digestive, and endocrine physiology. Where appropriate, basic chemical and physical laws will be reviewed in order to enhance and promote student understanding.						

Course Outcomes	
CO1	Students will learn about the types of the tissues, mechanism of blood coagulation, RBC membrane structure and functions and anticoagulants.
CO2	Students will learn about the functioning and physiology of cardiovascular system and respiratory system.
CO3	Students will understand the concept of digestion of various biomolecules and functioning of excretory system.
CO4	Students will acquire the knowledge of nervous system, muscular system, endocrine systems, their physiology and basic functions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Tissues	Types of tissue. Epithelium- organization and types. The basement membrane. Bone and cartilage. The extracellular matrix of epithelial and non-epithelial tissues. Elementary details of ECM components. Blood and circulation-Composition and functions of blood. Separation of plasma and serum. Plasma proteins in health and disease. Red blood cells- formation and destruction. The RBC membrane- principal proteins (spectrin, ankyrin, glycophorins). Composition and functions of WBCs. Blood coagulation- mechanism and regulation. Fibrinolysis. Anticoagulants.	8	CO1
2	Cardiovascular and Respiratory System	Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation. Respiratory system-transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.	8	CO2
3	Digestive and Excretory system	Digestion, absorption, energy balance, BMR. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system-Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance.	8	CO3
4	Neuromuscular System and Endocrinology	Structure of neuron. Propagation of action potential: The neuromuscular junction. The acetylcholine receptor. Gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system. Structure of skeletal muscle. Sequence of events in contraction and relaxation of muscle. Endocrine glands, basic mechanism of hormone action, hormones and diseases.	8	CO4

Reference Books:

Lodishetal. Molecular Cell Biology 6th ed. 2007, WH Freeman.

Murray et al. Harper's Illustrated Biochemistry 27th ed. McGraw Hill 2006.

Smith et al. Principles of Biochemistry. Mammalian Biochemistry. McGraw Hill 7th ed.

De Robertis and De Robertis. Cell and Molecular Biology. Lippincott 2001.

Alberts et al. Molecular Biology of the cell 5th ed. Garland Sci. 2007.

Guyton and Hall.Textbook of Medical Physiology 12ed 2011.

e-Learning Source:

https://drive.google.com/file/d/13hs2l-WfHzfR3AKhzWq-lFYVO5ODYvpW/view?usp=sharing

	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
CO1	1	1	2	2		1	2		1	1		3	3	2	3
CO2	1	1	2	1		1	2		1	1		3	2	2	3
CO3	1	1	2	2		1	2		1	1		3	2	2	3
CO4	1	1	2	1		1	2		1	1		3	2	2	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	ES202	**Title of the Course**	Disasters, Management	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	2	1	**0**	**3**
Pre-Requisite	10+2 having a minimum of 45% marks in the aggregate from a recognized Board/University	**Co-requisite**					
Course Objectives	• To Study the types of Disasters and its profile in India. • Knowledge of causes and impacts of Disasters, and Case studies of National and Global Disasters. • To learn about risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters. • Basic concepts of Disaster Management Cycle and its Risk Reduction Measures. • To know the National Acts and policies for mitigating disasters. Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.						

Course Outcomes	
CO1	Students are able to learn types of disasters and its profile in India
CO2	Students are able to understand the causes and impacts of disasters on environment
CO3	Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction
CO5	To understand the concept of Disaster Management Cycle and its Risk Reduction

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to disaster	Introduction to Disasters, Concepts, Definition and types (Natural and Man-made), Disaster profile of India.	8	CO1
2	Impact of Disaster	Causes and Impacts of Disasters, Global and National Perspective, Case studies from Disasters, Large Hydro projects and its risks for Disasters	8	CO2
3	Disaster Risk Reduction	Approaches to Disaster risk Reduction, Safety issues in mitigating Industrial disasters, Case studies, EHS etc.	8	CO4
4	Disaster Management	Disaster Management Cycle, Risk Reduction Measures (Preparedness, Mitigation, Response	8	CO3
5	Disaster Act. and Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, NDRF,	8	CO3

Reference Books:

(1) Gupta Harsh K., Disaster Management, Hyderabad University Press. Publications-Meerut.

(2) Sethi, V.K., Disaster Management, New Delhi Maxford Books

(3) Bhattacharya, Tushar, Disaster Science and Management, New Delhi Tata Mc Graw Hill.

(4) Nidhi Gauba, Dhawan/ Ambrina Sardar Khan, Disaster Management and Preparedness, CBS

e-Learning Source:

https://www.youtube.com/watch?v=9WIwlljva_s

https://www.youtube.com/watch?v=uA_OLKfQpYA

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

PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	1	3	2	1	1	2	1	1	1	1	-	-	-
CO2	2	2	2	1	2	3	3	2	2	2	2	2	1	1	1	-	-	-
CO3	3	2	2	1	2	2	3	2	2	2	1	2	2	1	1	-	-	-
CO4	3	2	2	1	2	2	3	2	2	1	1	2	1	1	1	-	-	-
CO5	3	1	3	2	2	2	2	2	3	2	1	2	1	1	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:							
Course Code	BM-226	**Title of the Course**	Human Values & Professional Ethics,	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**3**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To understand the moral values that ought to guide the Management profession, Resolve the moral issues in the profession, To justify the moral judgment concerning the profession. To create an awareness on Management Ethics and Human Values.To inspire Moral and Social Values and Loyalty. Intended to develop a set of beliefs, attitudes, and habits that engineers should display concerning morality. To create awareness about the important global issues: . Multinational corporations - Environmental ethics - computer ethics - weapons development						

Course Outcomes	
CO1	Development of moral and ethical values, right understanding and relationships
CO2	Knowledge of Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property rights and its laws.
CO3	Awareness about the Professional Responsibility of engineers, Responsibility of engineers related to risks, hazards and safety.
CO4	Development of Engineers Ethics. Understanding of variety of moral issues, moral judgment concerning the profession.
CO5	Understanding of various of global issues; Environmental ethics - computer ethics - weapons development.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Human Value Education	Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration. Its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly.	6	CO1
2	Introduction to Ethical Concept	Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law.	6	CO2
3	Professional Responsibility	The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, hazards and risks.	6	CO3
4	Engineers Ethics	Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles theories about right action – Self-interest - customs and religion - uses of ethical theories. Valuing Time – Cooperation – Commitment.	6	CO4
5	A Glimpse of Life Stories, Global Issues	Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs. Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership.	6	CO5

Reference Books:

1. R.S. Naagarazan 2006, "A Textbook on Professional Ethics and Human values" New Age International Publisher.
2. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.

e-Learning Source:

1. Value Education website, http://www.uptu.ac.in . 2. Story of Stuff, http://www.storyofstuff.com

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
CO1	3	3	2	3	3			3		2		2	2	2	3
CO2	3	3	2	3	3			2					2	3	3
CO3	2	3	2	3	2			3		3			3	3	3
CO4	2	3	2	3	2			2				1	3	3	2
CO5	3	2	3	3	2			3		2		1	2	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: 2020-21							
Course Code	BE203	**Title of the Course**	Biochemistry Lab	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	0	0	6	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course will give the knowledge of estimations and separation of various biomolecules using standard protocols.						

Course Outcomes	
CO1	The students will be able to learn how to perform the estimations of biomolecules like carbohydrates, nucleic acids and proteins in-vitro.
CO2	The students will acquire skills related to isoelectric precipitation in context of amino acids.
CO3	The students will acquire skills related to separation of biomolecules using chromatography.
CO4	The students will be able to determine how lipids are extracted in-vitro from the living samples and also know the methods for separation of biomolecules using electrophoresis.
CO5	The students will be able to learn the concept of enzyme kinetics and how the concentration of enzymes are estimated in living cell by in-vitro analysis.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Carbohydrates	Estimation of carbohydrates	6	CO1
2	Proteins	Estimation of proteins	6	CO1
3	Nucleic acids	Estimation of nucleic acids	6	CO1
4	Isoelectric point	Isoelectric precipitation	6	CO2
5	Paper chromatography	Separation of amino acids by paper chromatography	6	CO3
6	TLC	Thin layer chromatography	6	CO3
7	Lipids	Extraction of lipids	6	CO4
8	Electrophoresis	Gel electrophoresis	6	CO4
9	Enzyme kinetics	Assay of enzyme activity and enzyme kinetics	6	CO5

Reference Books:

1. S.K. Sawhney; Introductory Practical biochemistry; Narrosa Pub.
2. J. Jayaraman; Lab. Manual in Biochemistry; New Age Int. Pub.
3. Wilson and Walker; Practical Biochemistry; Cambridge publication. David T Plummer; An introduction to practical biochemistry; Tata McGraw Hill.

e-Learning Source:

https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20Biochemistry.pdf

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

4- 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	BE 204	**Title of the Course**	Microbiology lab	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**6**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The objective of this lab is to utilizes the practical approach to the study of microorganisms, their isolation and culturing and offers the student a comprehensive knowledge of microbiology and their application						

Course Outcomes	
CO1	The students will learn about the fundamentals of microbiology and its importance in the field of biotechnology, medical microbiology and immunology.
CO2	The students will be able to prepare different nutrient media and its sterilization and inoculation. They will also learn about different methods of staining of bacteria and spores.
CO3	They will also learn how to perform the experiments to get pure culture from mixed population and its quantitative and qualitative analysis.
CO4	Knowledge of these experiments will be immensely beneficial for the students for the higher studies related to Microbiology, Medical Microbiology and Biotechnology.
CO5	The students will get the industrial exposure for better understanding of subject

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Nutrient media preparation	Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)	6	1
2	Culture of microorganisms and staining	Culture of microorganisms using various techniques. Simple and differential staining procedures, endospore staining, flageller staining, cell wall staining, capsular staining, negative staining.	6	2
3	Bacterial colony counting	Bacterial colony counting and observation of different forms of bacteria	6	3
4	Isolation of microbes	Isolation of microbes from soil samples and determination of the number of colony forming units.	6	4
5	Determination of growth curve	Study of growth curve of E. coli	6	5

Reference Books:

Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

e-Learning Source:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	1	1	1	1	2		1	2	1	1	1	3	3	3	1
CO2	2	2	2	2	3	2	1	1	2	1	2	3	3	3	1
CO3	1	1	2	1	3	1	2	2	1	1	1	2	3	3	1
CO4	1	1	1	1	2	1	3	3	2	1	1	2	2	3	2
CO5	2	1	1	2	1	3	2	3	1	2	2	2	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: 2017-18							
Course Code	ME223	**Title of the Course**	Fluid Mechanics Lab	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To impart practical knowledge/techniques to verify Bernoulli's Theorem and its application. • To impart practical knowledge/techniques to Plot the flow pattern net using the Hele-Shaw apparatus • To impart practical knowledge/techniques to study the transition from laminar to turbulent flow and determine the lower critical Reynolds number. • To impart practical knowledge/techniques to measure the flowrate in pipe flow and find the velocity distribution in the pipe flow. • To impart practical knowledge/techniques to determine the variation of friction factor 'f', for turbulent flow in commercial pipes and find the Coefficient of Discharge in rectangular notch.						

Course Outcomes	
CO1	Learn the concept of Bernoulli's Theorem and apply it to find the discharge using Venturi meter and Orifice meter.
CO2	Plot the flow pattern net using the Hele-Shaw apparatus
CO3	Study the transition from laminar to turbulent flow and determine the lower critical Reynolds number.
CO4	To calibrate the venturi meter, orifice meter and find the velocity distribution in the pipe flow.
CO5	Determine the variation of friction factor 'f', for turbulent flow in commercial pipes. and find the C_D in rectangular notch.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Bernoulli's Equation	To verify Bernoulli's Equation experimentally.	4	CO1
2	Hele-Shaw apparatus	To Plot the flow net using the Hele-Shaw apparatus	4	CO2
3	Laminar and Turbulent flow	To Study the transition from laminar to turbulent flow and determine the lower critical Reynolds number.	4	CO3
4	Venturi meter	To calibrate a venturi-meter and study the variation of the coefficient of discharge with the Reynolds number.	4	CO4
5	Orifice meter	To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.	4	CO4
6	Velocity Distribution	To study the velocity distribution in a pipe.	4	CO4
7	Friction factor	To study the variation of friction factor 'f', for turbulent flow in commercial pipes.	4	CO5
8	Notch apparatus	To calibrate a given v-notch or a rectangular notch and determine the coefficient of discharge	4	CO5

e-Learning Source:

https://fm-nitk.vlabs.ac.in/

	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
CO1	3	3	2	2	2	3			3	2		3	3	2	3
CO2	3	3	2	3	2	2			3	2		3	3	3	2
CO3	3	3	3	2	2	2			3	2		3	2	2	2
CO4	3	3	3	2	3	3			3	2		3	3	2	2
CO5	3	3	3	3	2	3			2	2		3	3	2	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: 2020-2021							
Course Code	BE207	**Title of the Course**	Immunology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The students will be able to identify the cellular and molecular basis of immune responsiveness.						

Course Outcomes	
CO1	Describe the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.
CO2	Describe the various aspects of immunological response and how it is triggered and regulated.
CO3	Understand the rationale behind various assays used in immunodiagnostic of diseases and will be able to transfer knowledge of immunology in clinical perspective.
CO4	Explain the principles of Graft rejection and Auto immunity.
CO5	Demonstrate a capacity for problem-solving about immune responsiveness, knowledge of the pathogenesis of diseases and designing of immunology-based interventions for effective treatment.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	The immune system	Introduction, Characteristics of innate and adaptive immunity, Humoral and cell mediated immunity, Cells and molecules of immune system, Primary and Secondary lymphoid organs, antigens, antigenicity and immunogenicity, Factor affecting the immunogenicity.	8	CO1
2	humoral immunity	B-Iymphocytes and their activation, structure and function of immunoglobulin, immunoglobulin classes and subclasses, Clonal selection of antibody production, polyclonal and monoclonal antibody and diagnosis, idiotypic antibodies, Structure and function of MHC molecules.	8	CO2
3	Cellullar Immunology	Thymus derived Lymphocytes (T Cells) their classification, antigen presenting cells (APC), Exogenous and endogenous pathways of antigen processing and presentation, cytokines and their role in immune response macrophage activation and granuloma formation, immunosuppression, immune tolerance. Structure, function and application of cytokines.	8	CO3
4	Antigen and antibody reaction	Serological techniques-ELISA, RIA and Immunoblotting. Immunity to Infection: Hypersensitivity reactions, complement system adjuvants, dose of antigens, types of vaccine preparation, Immunity against infectious diseases (virus, bacteria and protozoan).	8	CO4
5	Auto Immunity	Graft rejection, evidence and mechanisms of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanisms of immunity to tumour antigens.; Auto antibodies in humans, pathogenic mechanisms, experimental models of autoimmune disease treatment of auto immune disorders and cancer.	8	CO5

Reference Books:

1. Kuby's Immunology- Murry, 5thed.
2. Ivan M. Roitt, J. Brostoff and David K. Male. Immunology, Glower Medical Publishers, London.

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	PSO5	PSO6
CO1	1	2	2	3	3	3	2	1	1	2	2	2	3	1	1			
CO2	1	1	2	3	2	3	1	1	1	1	1	2	3	1	1			
CO3	2	2	1	3	3	3	1	1	2	2	3	3	3	1	1			
CO4	1	2	3	3	3	3	2	3	2	2	3	3	3	1	1			
CO5	1	2	3	3	3	3	2	3	2	2	3	3	3	1	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	BE208	**Title of the Course**	Enzymology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The objective of the course is to provide a deeper insight into the fundamentals of enzyme structure, function and kinetics of enzymes. Also it deals with current applications and future potential of enzymes.						

Course Outcomes	
CO1	The students will be introduced to enzymes. They will be able to classify and name the enzymes. They will also learn about the physic-chemical properties of enzymes.
CO2	The unit will help the students to understand the enzyme kinetics.
CO3	The students will learn about the applications of some industrially used enzymes.
CO4	The students will learn about enzyme stabilization and immobilization.
CO5	The students will know how to isolate intra/extra cellular enzymes from microorganisms. This will be helpful in courses such as fermentation technology and downstream processing. The students will also learn about the recent therapeutic and industrial applications of enzymes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Enzymes	Introduction, classification and nomenclature of enzymes. Active site, isoenzymes, coenzymes, cofactors, turn over number, enzyme specificity, enzyme activity, specific activity, multi-enzyme complexes, Physico-chemical characteristic of enzymes. Effect of pH, temperature and substrate concentration on enzyme actvity.	8	CO1
2	Enzyme kinetics	Enzyme kinetics, derivation of Michaelis Menten equation, measurement of Km and Vmax, Enzyme inhibition, kinetics of competitive, non-competitive and un-competitive inhibition of enzymes. Effect of pH, temperature and substrate concentration on enzyme kinetics. Allosteric enzymes and their kinetics.	8	CO2
3	Introduction to industrial enzymes	Topoisomerases, chymotrypsin, glyceraldehyde 3-phosphate dehydrogenase, lysozyme, carboxypeptidase, ribonuclease, lactases and ribozyme and their mechanism of action.	8	CO3
4	Folding and Stability studies	Molecular folding and defolding of enzymes. Stability of enzymes. Methods of enzyme immobilizations and their applications.	8	CO4
5	Isolation, purification, and characterization of the enzymes from microorganisms	Isolation, purification, and characterization of the enzymes from microorganisms. Intra cellular and extra cellular enzymes, Methods for lysis of plant, animal and microbial cell. Use of detergents in isolation of membrane proteins. Industrial, diagnosis and therapeutic application of enzymes.	8	CO5

Reference Books:

1. Murray Moo-Young-Comprhensive Biotechnology, II & IVth Vol.
2. Biochemistry- D. J. Voet & J. G. Voet, 6th ed.
3. Methods in Enzymology- A series.
4. Enzyme Kinetics-Hans Bisswanger, Wiley Publication.
5. Biocatelysis: Fundamentals and Application- A.S. Bommarius et al., Wiley Publication.

e-Learning Source:

https://youtu.be/gJNMryCX3YY

	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	PSO5	PSO6
CO1	1	1	1	1	1	1		1				3	3	1				
CO2	1	3	2	3	2	2		1				3	3	3				
CO3	1	2	2	3	2	2	3	1				3	3	3				
CO4	1	2	2	2	3	3	1					3	3	3				
CO5	3	3	3	3	3	3	3	3				3	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: 2020-21							
Course Code	BE209	**Title of the Course**	Molecular Biology	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**3**	**1**	**0**	**4**
Pre-Requisite	Molecular biology	**Co-requisite**	None				
Course Objectives	**The objective of the course is learning and understanding the DNA Replication, Transcription, Protein Synthesis and Post Translational Modifications**						

Course Outcomes	
CO1	Relate concepts of mutations and its types.
CO2	Describe the general principles of replication in both prokaryotic and eukaryotic organisms. Discuss the various enzymes used in replication, transcription processes
CO3	To study about the process of transcription in both prokaryotes and eukaryotes and also the modifications of eukaryotic mRNA.
CO4	Describe the general principle of protein synthesis in both prokaryotes and eukaryotes
CO5	Learn about Operon concept, gene regulation and post translational changes in proteins

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Central Dogma of Life**	Central Dogma, Mutation: Spontaneous, induced; Chemical and physical mutagens; Non sense mutation; Missense mutation; Frame shift mutation; Suppressor mutation; Different methods of DNA repair and SOS response; transposable elements: retrotransposon, mechanism of transposition.	8	1
2	**DNA Replication**	DNA replication in prokaryotes: Roles of DnaA, Helicase, HD protein, Primase, DNA gyrase, Topoisomerase, DNA Polymerase III, DNA Polymerase I, DNA ligase, Fidelity, Regulation; DNA replication in eukaryotes: Autonomously replicating sequence, Origin recognition complex, Minichromosome maintenance proteins, DNA polymerases α, δ, ε, Nucleases, DNA ligase, Telomeres, Regulation; Mitochondrial DNA replication; Reverse transcriptase	8	2
3	**Transcription**	Transcription in prokaryotes: Outline of process, Promoter, RNA polymerase; Transcription in eukaryotes: Outline of process, Promoters, Enhancers, RNA polymerase I, II, III; Post transcriptional modifications: End modifications (Addition of 5` cap and 3‟ Poly A tail in mRNA), RNA splicing - Self splicing and Spliceosome mediated splicing, Cutting events or action of ribonucleases, Covalent modifications, RNA editing, Alternative splicing	8	3
4	**Translation**	Genetic code, Wobble hypothesis; Translation in prokaryotes and eukaryotes: Outline of process, Types of RNA, Structure of ribosome, Aminoacyl RNA transferase	8	4
5	**Post-Translational Modifications**	Post - translational processing: Intein splicing, Chemical modification, Proteolytic cleavage, Zymogen activation; Regulation of gene expression: Operon concept: Lac and Trp	8	5

Reference Books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene, 4 th ed
3. Genetics – Strickberger, 2 nd
4. Microbial Genetics- D. Frifielder.
5. Baltimore- Molecular Biology of the Cell
6. Benjamin Levin - Genes VIII, 8 th ed.

e-Learning Source:

1. DNA Replication, https://www.youtube.com/watch?v=T1aR77FLdi0
2. Operon Concept, https://www.youtube.com/watch?v=h_1QLdtF8d0

	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	PSO5	PSO6
CO1	CO1	1	2	1	1	1	1	1	2	1	1	1	3	3	3			
CO2	CO2	3	3	2	1	1	1	2	1	2	1	1	3	3	3			
CO3	CO3	3	3	2	2	1	1	1	2	2	1	1	3	3	2			
CO4	CO4	3	3	2	3	2	1	2	2	1	1	1	3	3	1			

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BE210	**Title of the Course**	Introduction to Bioinformatics	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	2	1	0	0
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The basic objective is to give students an introduction to the basic practical techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem-solving in real research problems. The students will become familiar with the use of a wide variety of internet applications and biological databases and will be able to apply these methods to research problems.						

Course Outcomes	
CO1	Understand the basics of bioinformatics, its evolution, nucleotide databases, and their retrieval tools.
CO2	Explain primary, secondary and composite protein databases and their impact on the display and analysis of biological data.
CO3	Understand the retrieval of biological literature from NCBI bibliographic databases.
CO4	Apply different biological tools to retrieve biological sequences, chemical compounds, scientific articles, and their analysis.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Nucleotide Databases	Definition of Bioinformatics, Biological databases: Nucleotide databases (e.g., GenBank, EMBL, and DDBJ), Biological search engines (e.g., Entrez, SRS, and ARSA).	8	CO1
2	Protein Databases	Biological databases: Protein databases- Primary protein databases (e.g., SwissProt, Tr-EMBL, and PIR), Secondary protein databases (e.g., PROSITE, PRINTS, IDENTIFY, BLOCK, and PFAM), Composite databases (e.g., OWL, and NRDB)	8	CO2
3	Bibliographic databases and File Formats	Biological databases: Literature databases (e.g., PubMed and PubChem), Biological file formats (e.g., GenPept/GenBank, FASTA, and EMBL), Applications of Bioinformatics	8	CO3
4	Practicals	1. Retrieval of nucleotide sequences from different nucleotide databases and their analysis. 2. Retrieval of protein sequences from different protein databases and their analysis. 3. Retrieval of small chemical compounds from PubChem compound databases and their analysis. 4. Briefing about retrieval of scientific articles from PubMed database.	8	CO4

Reference Books:

1. D. W. Mount: Bioinformatics-sequence and genome analysis, Cold Spring Harbor Lab Press
2. Jin Xiong: Essential Bioinformatics, Cambridge University Press.

e-Learning Source:

1. https://vlab.amrita.edu/index.php?sub=3&brch=273&sim=1437&cnt=1
2. https://vlab.amrita.edu/index.php?sub=3&brch=273&sim=1442&cnt=1

	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
CO1	2	2	2	2	3	1	1	1	1	1	1	3	2	1	2
CO2	2	2	1	2	2	1	1	1	1	2	1	3	1	2	2
CO3	1	3	2	2	2	1	1	1	1	2	1	3	2	1	2
CO4	1	2	2	2	3	1	2	1	1	2	1	3	2	2	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: 2022-23							
Course Code	ME222	**Title of the Course**	HEAT TRANSFER OPERATIONS	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**2**	**1**	**0**	**3**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Formulate and predict heat conduction problems without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyze 1D steady conduction problems. 2. Explain the concept of free convection mechanics, dimensionless number and introduction to the empirical correlation. 3. To develop understanding about heat transfer by phase change: boiling process, film wise and dropwise condensation 4. Develop concept of intensity of radiation, radiative heat exchange between two black bodies. 5. Calculate fluid temperatures, mass flow rates, and heat exchange during parallel, counter and cross flow in heat exchangers.						

Course Outcomes	
CO1	Formulate and predict heat conduction problems without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyze 1D steady conduction problems.
CO2	Explain the concept of free convection mechanics, dimensionless number and introduction to the empirical correlation.
CO3	Widening the concepts of convection and solving problems related to its applications
CO4	Strengthening the basics of radiation and understanding the related laws.
CO5	Fundamentals of heat exchangers and its analysis using LMTD methods

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Heat Transfer. Conduction. Steady State One-Dimensional Heat Conduction.	Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation. Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields. Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance. Introduction to general heat conduction equation, one dimensional conduction without heat generation e.g., through plane walls, Cylindrical, Spherical surface and Composite layers etc.	7	CO1
2	Critical Thickness and Fins. Convection Heat Transfer	Insulation materials, critical and optimum insulation thickness. Extended surface: fines and their practical applications. Introduction to unsteady state heat transfer. Fundamentals of convection, Natural and forced convection, Introduction to hydrodynamics and thermal boundary layers.	6	CO2
3	Dimensional analysis Heat transfer with phase change.	Buckingham's π theorem, important dimensional numbers and their significance Dimensional analysis of force and free convection. Condensation of pure and mixed vapors, film wise and drop wise condensation, heat transfer in boiling liquids	6	CO3
4	Heat Transfer equipment	Classification, principles and design criteria, types of exchangers viz. double pipe, shell and tube, plate type, Fouling factors; Overall heat transfer coefficient. Logarithmic mean temperature difference (LMTD) method. Introduction of Effectiveness-NTU method Furnaces and their classification and applications.	6	CO4
5	Radiation & Evaporation	Basic radiation concepts, Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchhoff's law, Black-body radiation exchange, solar radiations, Combined Heat Transfer Coefficient by convection and radiation, Elementary principles, types of evaporators, Single and multiple effect evaporators.	7	CO5

Reference Books:

1. Heat Transfer: J.P. Holman, McGraw Hill, 2. Bedger W.L. and Bancharo J. T. "Introduction to Chemical Engineering" Tata McGraw publication House.

2. Bedger W.L. and Bancharo J. T. "Introduction to Chemical Engineering" Tata McGraw publication House.

3. Mc Adams W.H. "Heat Transmission" McGraw Hill Books Co.

e-Learning Source:

https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785

	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
CO1	3	3	3	2	2	3	2					3	3	2	2
CO2	3	2	2	2	2	3						3	3	3	2
CO3	3	3	3	2	2	3						3	3	2	3
CO4	3	3	3	2	2	3	1					3	3	2	2
CO5	3	3	2	2	3	3						3	3	2	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: 2020-2021							
Course Code	BE213	**Title of the Course**	Plant Biochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	2	1	0	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The main objective of the course is to make students understand the biochemistry of phytochemicals and plant metabolites.						

Course Outcomes	
CO1	Give a detailed account of C3 and C4 pathway of carbon reduction and its regulation and photorespiration. Discuss pigments of photosynthesis, Hill reaction and photosynthetic electron transport chain.
CO2	Describe the structure of nitrate reductase and nitrite reductase. How is ammonia incorporated into organic compounds? Discuss regulation of nitrate assimilation.
CO3	Give an account of the biosynthesis of auxins, cytokinins, gibberllic and abscisic acids..
CO4	Discuss different types of environmental stresses and their impact on plant growth, metabolism and tolerance. What do you understand by anaerobiosis and pathogenesis.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Concept of photosynthesis**	Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C3 and C4 pathway of carbon reduction and its regulation, Photorespiration.	8	CO1
2	**Metabolism of reactions**	Nitrate assimilation- structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation.	8	CO2
3	**Plant Hormones**	Biosynthesis of growth regulating substances-auxins, cytokinins, gibberllic andabscisic acids.	8	CO3
4	**Environmental factors**	Environmental stresses, salinity, water stress, heat, chilling, anaerobiosis, pathogenesis, heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.	8	CO4

Reference Books:

1. Plant Biochemistry by P. M. Dey and J. B. Harborne, Harcourt Aria PTE Ltd. Singapore.
2. Plant Physiology by Salinbury.
3. Plant Physiology by Davin.
4. Lehninger Biochemistry.

e-Learning Source:

https://drive.google.com/file/d/1cVgp-OnY-s0QqJWbYhM91GFCOJv3VeXy/view?usp=sharing

	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
CO1	1	1	1	1		3	1		1			1	1	1	1
CO2	1	1	2	1		3	1		1			1	1	1	1
CO3	1	1	2	1		3	1		1			1	2	1	2
CO4	1	1	2	1		3	1		1			1	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: 2020-2021							
Course Code	BE214	**Title of the Course**	Clinical Biochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	2	1	0	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To equip the students with the knowledge of biochemistry and pathophysiology associated with tests performed in a clinical biochemistry laboratory. Detailed knowledge about the homeostasis of water and electrolytes, inborn errors of metabolisms, diseases and disorders related to kidney, liver, gastrointestinal tract and pancreas will be given. In-depth knowledge of diabetes, cancer and tumor markers regarding diagnosis and their management will also be focused.						

Course Outcomes	
CO1	Students will learn about the concept of water and electrolyte homeostasis, blood pH and acidosis and alkalosis.
CO2	Students will learn about the concept of inborn errors of metabolism related to disorders of amino acid metabolism, disorders of carbohydrate metabolism, disorders of purine, pyrimidine and porphyrin metabolism and disorders of lipid metabolism-lipid storage diseases, fatty liver.
CO3	Students will understand the concept of various pathological tests related to kidneys and Protein energy malnutrition-Marasmus and Kwashiorkor.
CO4	Students will understand the concept of various pathological tests related to Liver function tests, Gastric function tests, Pancreatic and intestinal function tests. Classification of diabetes and Cancer knowledge will be focussed along with Tumour markers (AFP, CEA, hCG only).

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Hydrogen ion and Electrolyte Homeostasis**	Hydrogen ion homeostasis: Factors regulating blood pH-buffers, respiratory and renal regulation. Acid-base balance- causes, biochemical findings and management of metabolic and respiratory acidosis and alkalosis. Water, sodium and potassium homeostasis: Distribution of water and electrolytes in the ECF and ICF.	8	CO1
2	**Inborn Errors of Metabolism**	Disorders of amino acid metabolism- aminoaciduria, phenylketonuria, alkaptonuria, cystinuria, and maple syrup urine disease. Disorders of carbohydrate metabolism-glycogen storage diseases, galactosemia, fructose intolerance Disorders of purine, pyrimidine and porphyrin metabolism-Hyperuricemia and gout, Hypouricemia. Disorders of lipid metabolism- lipid storage diseases, fatty liver.	8	CO2
3	**Kidney and Nutritional Disorders**	Kidney function tests: Glomerular and tubular function tests. Abnormal constituents of urine.Pathogenesis, biochemical findings and management of glomerulonephritis, renal failure, nephrotic syndrome Protein energy malnutrition- Marasmus and Kwashiorkor.	8	CO3
4	**Liver and Gastrointestinal Disorders, Diabetes, and Cancer**	Liver function tests (excretory, synthetic, detoxification and metabolic).Plasma enzymes in liver disease. Jaundice- neonatal. Gastric function tests. Pathogenesis, biochemical findings and management of peptic ulcer and gastritis. Pancreatic and intestinal function tests. Classification of diabetes. Metabolic abnormalities–glycosuria. Acute and long term complications, Diagnosis and management. Cancer: Differences between benign and malignant tumours. Morphological and biochemical changes in tumourcells. Tumour markers (AFP, CEA, hCG only).	8	CO4

Reference Books:

Principles of Internal Medicine. Harrison's Vol 1 & 2, 14th edition McGraw Hill, 1998.

Harper's Biochemistry McGraw Hill, 27th ed, 2006.

Biochemistry – A case-oriented approach. Montgomery *et al*. Mosby.1990 5th editon.

Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott, 2005, 5th edition.

Guyton and Hall. Textbook of Medical Physiology 12 ed 2011.

e-Learning Source:

https://drive.google.com/file/d/1cVgp-OnY-s0QqJWbYhM91GFCOJv3VeXy/view?usp=sharing

	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
CO1	1	1	1	1		3	1		1			1	1	1	1
CO2	1	1	2	1		3	1		1			1	1	1	1
CO3	1	1	2	1		3	1		1			1	2	1	2
CO4	1	1	2	1		3	1		1			1	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: 2020-2021							
Course Code	BM-215	**Title of the Course**	Applied Thermodynamics of Bioengineers	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV				
Pre-Requisite	None	**Co-requisite**	none				
Course Objectives	In this course, students learn how to apply knowledge of the laws of thermodynamics, chemistry, physics, and engineering to analyze and solve physical and chemical problems encountered in chemical and biochemical engineering. The course gives the student the opportunity to analyze and interpret data, to identify, formulate, and solve engineering problems, and to use the techniques, skills, and modern engineering tools necessary for engineering practice.						

Course Outcomes	
CO1	The students will learn about the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications.
CO2	The students will understand the concept of reaction mechanism of fluids and their energy calculation with the help of different thermodynamic models.
CO3	The students will able to calculate the equilibrium conversion for single and multiple reactions and effect of different parameters on equilibrium constant.
CO4	The students will able to calculate the equilibrium conversion for single and multiple reactions and effect of different parameters on equilibrium constant.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction of thermodynamic properties	A generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges.	8	CO1
2	Thermodynamic properties of fluids	Partial molar properties, concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models.	8	CO2
3	Chemical Reaction equilibria	Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.	8	CO3
4	Thermodynamics of microbial growth kinetics	Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert–Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.	8	CO4

Reference Books:

1. 1. Smith J.M., Van Ness H.C., and Abbot M.M. “Introduction to Chemical Engineering Thermodynamics”, 6th Edition. Tata McGraw-Hill, 2003.
2. 2. Narayanan K.V. “A Text Book of Chemical Engineering Thermodynamics”, PHI, 2003.
3. Christiana D. Smolke, “The Metabolic Pathway Engineering Handbook Fundamentals”, CRC Press Taylor & Francis Group, 2010.

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
CO1	3	3	2	3	3			3		2		2	2	2	3
CO2	3	3	2	3	3			2					2	3	3
CO3	2	3	2	3	2			3		3			3	3	3
CO4	2	3	2	3	2			2				1	3	3	2
CO5	3	2	3	3	2			3		2		1	2	2	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: 2020-2021							
Course Code	CS-203	**Title of the Course**	Law & Information security	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Knowledge about cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft 2. Knowledge on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents. 3. Knowledge about Information System and principles of Information Security (as confidentiality, integrity, and availability) 4. Knowledge of cryptography and techniques used to detect and prevent network intrusions.						

Course Outcomes	
CO1	Understand key terms and concepts in cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft
CO2	Keep an appropriate level of awareness, knowledge and skill on the disciplines oftechnology, E-business and law to allow them to minimize the occurrence andseverity of information security incidents.
CO3	Understand about Information System and principles of Information Security (as confidentiality, integrity, and availability)
CO4	Understand about cryptography and techniques used to detect and prevent networkintrusions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of Cyber Law	Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, Copy Right, Trademark law, Law related to semiconductor layout &design.	8	**CO 1**
2	E - Commerce	Security Threats to E - Commerce, Virtual Organization, Business Transactions on Web, EGovernance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E- Agreement, Legal recognition of electronic and digital records, E- Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures - Technical issues, legal issues, Electronic Records, Digital Contracts, and Requirements of Digital Signature System.	7	**CO 2**
3	Investigation and Ethics	Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security threats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs.Introduction to biometric security and its challenges, Finger prints.Cyber crime forensic: CASE STUDY in Cyber Crime	9	**CO 3**
4	Information security	Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security services - Authentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection.	9	**CO 4**

Reference Books:

1. Harish Chander “Cyber Law and IT Protection” , PHI Publication, New Delhi
2. Merkov, Breithaupt,“ Information Security”, Pearson Education
3. “Cyber Law in India” - Farooq Ahmad-Pioneer books.
4. K. K. Singh, Akansha Singh “Information Security and Cyber law”, Umesh Publication, Delhi

e-Learning Source:

https://nptel.ac.in/courses/106106129

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1	1	2	3	2	2	2	3	1	3	2	2
CO3	2	2	2	2	1	1	3	2	3	1	1	2	2	1	2
CO4	3	2	1	2	3	1	1	3	2	2	3	3	2	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	BE211	**Title of the Course**	Immunology Lab	**L**	**T**	**P**	**C**
Year	2nd	**Semester**	4th	0	0	4	2
Pre-Requisite		**Co-requisite**					
Course Objectives	To acquaint the student with the various techniques used in immunology-based research specifically isolation, purification and identification of Antibodies.						

Course Outcomes	
CO1	The student will be able to learn isolation, purification and identification of Antibodies.
CO2	The students will be able to learn about various for identification of Antigen-Antibody samples and Immunoelectrophoresis techniques.
CO3	The student will acquire skills related to ELISA (Enzyme Linked Immunosorbent Assay) and Dot- ELISA
CO4	The student will be able to learn about principles involved in checking protein expression by Western blot technique
CO5	The students will be able to understand the basis of ABO blood group typing and significance of RBC and WBC count by Heamocytometer.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Double diffusion techniques**	Double diffusion techniques for identification of Antigen-Antibody samples.	3	CO1
2	**Immuno-electrophoresis techniques.**	Immuno-electrophoresis techniques.	6	CO2
3	**ELISA**	ELISA (Enzyme Linked Immunosorbent Assay)	6	CO3
4	**Dot-ELIS-**	Immunoblotting Using ELISA-dot	3	CO3
5	**Western blot analysis**	Western blot technique (Demonstration)	3	CO4
6	**Blood groups**	ABO blood group typing	6	CO5
7	**Cell counting**	RBC and WBC count by Heamocytometer	6	CO5

Reference Books:

Immunology by David Male (Editor); Victoria Male (Editor); Ray Stokes Peebles (Editor)

Review of Medical Microbiology and Immunology, Sixteenth Edition by Warren E.

Oxford Handbook of Clinical Immunology and Allergy by Gavin Spickett.

Cellular and Molecular Immunology by Abul K.

e-Learning Source:

https://www.avit.ac.in/lab/immunology_bioprocess_engineering_lab/download/17BTCC89/lab_manual.pdf

	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
CO1	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO2	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO3	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO4	1	2	1	2	1	1	1	2	2	1	1	2	3	3	3
CO5	1	2	1	2	1	1	1	2	2	3	1	2	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: 2020-2021							
Course Code	BE212	**Title of the Course**	Molecular Biology Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	4	2
Pre-Requisite	Molecular Biology	**Co-requisite**					
Course Objectives	To acquaint the student with the various techniques used in molecular biology-based research specifically isolation, purification and identification of DNA and RNA.						

Course Outcomes	
CO1	The student will be able to learn isolation, purification and identification of DNA.
CO2	The students will be able to learn about various for identification of DNA
CO3	The student will acquire skills related estimation of RNA
CO4	The student will be able to learn about principles involved in identifying Tm of DNA and RNA
CO5	The students will be able to understand the basis Electrophoresis

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**DNA Estimation**	Estimation of DNA by DPA method	3	CO1
2	**RNA Estimation**	Estimation of RNA by Orcinol method	6	CO2
3	**Tm Determination**	Determination of Tm of DNA and RNA	6	CO3
4	**DNA Isolation**	Isolation of Plasmid DNA	3	CO3
5	**Genomic DNA**	Isolation of Bacterial genomic DNA	3	CO4
6	**Plant DNA Isolation**	Isolation of Plant DNA	6	CO5
7	**Electrophoresis**	Visualization of DNA by Agarose Gel Electrophoresis	6	CO5

Reference Books:

Immunology by David Male (Editor); Victoria Male (Editor); Ray Stokes Peebles (Editor)

Oxford Handbook of Clinical Immunology and Allergy by Gavin Spickett.

Cellular and Molecular Immunology by Abul K.

Molecular Biology by Sambrook

e-Learning Source:

https://www.youtube.com/watch?v=pgP6wvsi0rY

	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
CO1	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO2	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO3	1	2	1	2	1	1	2	1	2	1	1	3	3	3	3
CO4	1	2	1	2	1	1	1	2	2	1	1	2	3	3	3
CO5	1	2	1	2	1	1	1	2	2	3	1	2	3	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: 2022-23							
Course Code	ME224	**Title of the Course**	HEAT TRANSFER OPERATIONS	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**2**	**1**	**0**	**3**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Formulate and predict heat conduction problems without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyze 1D steady conduction problems. 2. Explain the concept of free convection mechanics, dimensionless number and introduction to the empirical correlation. 3. To develop understanding about heat transfer by phase change: boiling process, film wise and dropwise condensation 4. Develop concept of intensity of radiation, radiative heat exchange between two black bodies. 5. Calculate fluid temperatures, mass flow rates, and heat exchange during parallel, counter and cross flow in heat exchangers.						

Course Outcomes	
CO1	Formulate and predict heat conduction problems without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyze 1D steady conduction problems.
CO2	Explain the concept of free convection mechanics, dimensionless number and introduction to the empirical correlation.
CO3	Widening the concepts of convection and solving problems related to its applications
CO4	Strengthening the basics of radiation and understanding the related laws.
CO5	Fundamentals of heat exchangers and its analysis using LMTD methods

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Heat Transfer. Conduction. Steady State One-Dimensional Heat Conduction.	Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation. Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields. Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance. Introduction to general heat conduction equation, one dimensional conduction without heat generation e.g., through plane walls, Cylindrical, Spherical surface and Composite layers etc.	7	CO1
2	Critical Thickness and Fins. Convection Heat Transfer	Insulation materials, critical and optimum insulation thickness. Extended surface: fines and their practical applications. Introduction to unsteady state heat transfer. Fundamentals of convection, Natural and forced convection, Introduction to hydrodynamics and thermal boundary layers.	6	CO2
3	Dimensional analysis Heat transfer with phase change.	Buckingham's π theorem, important dimensional numbers and their significance Dimensional analysis of force and free convection. Condensation of pure and mixed vapors, film wise and drop wise condensation, heat transfer in boiling liquids	6	CO3
4	Heat Transfer equipment	Classification, principles and design criteria, types of exchangers viz. double pipe, shell and tube, plate type, Fouling factors; Overall heat transfer coefficient. Logarithmic mean temperature difference (LMTD) method. Introduction of Effectiveness- NTU method Furnaces and their classification and applications.	6	CO4
5	Radiation & Evaporation	Basic radiation concepts, Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchhoff's law, Black-body radiation exchange, solar radiations, Combined Heat Transfer Coefficient by convection and radiation, Elementary principles, types of evaporators, Single and multiple effect evaporators.	7	CO5

Reference Books:

1. Heat Transfer: J.P. Holman, McGraw Hill
2. Bedger W.L. and Bancharo J. T. "Introduction to Chemical Engineering" Tata McGraw publication House.
3. Mc Adams W.H. "Heat Transmission" McGraw Hill Books Co.
4. Kern D.Q. " Process Heat Transfer" McGraw Hill Books Co.
5. Heat Transfer; R. Yadav, Central Publishing House, Allahabad.

e-Learning Source:

https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785

https://www.youtube.com/watch?v=sKnE5qvz0fc&list=PLbRMhDVUMngeygd_uWiLqa3fzA2h7vdRx

https://www.youtube.com/watch?v=IedD23t5jI4&list=PLpCr5N2IS7Nmu22MOgDWOr0sSIIpUNUz3

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

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

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