Integral University, Lucknow

Effective from Session: 2013-14							
Course Code	CH215	**Title of the Course**	Fundamental of Physical Chemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	Elementary Mathematics				
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of physical chemistry. By using the principle of physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completing the course, the student will be able explore the subject into their respective dimensions.						

Course Outcomes	
CO1	Students are able to understand the order and molecularity of reaction, concept of activation energy method of integration, half-life method and isolation and their applications.
CO2	Students would restate the definition of system, surrounding, closed and open system, extensive and intensive properties and understand the first law of thermodynamics by taking isothermal & adiabatic processes.
CO3	Students evaluate fundamentals of electrochemistry and understand the concept of pH, solubility and its application.
CO4	Students would get inside the sound knowledge of gas and their properties and examine the relationships between gas temperature, pressure, amount, and volume.
CO5	Students will be able to understand the key concepts for lowering of vapor pressure, elevation in boiling point and depression in freezing point. They are able to distinguish between osmosis and reverse osmosis and their applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Chemical Kinetics	Rate of a reaction, factors influencing the rate of a reaction, concentration, solvent, temperature, pressure, light, catalyst concentration dependence of rates, mathematical characteristics of simple chemical reactions- First & second order, half-life. Determination of order of reaction (integration, method), Arrhenius equation, concept of activation energy.	8	CO1
2	Thermodynamics	Definition and explanation of terms- System, boundary, surrounding. Homogeneous system, isolated system, Closed system, Open system. Intensive and extensive properties. First law of Thermodynamics: statement and equation- Cp, Cv relationship- Calculation of W, q, dU and dH for the expansion of ideal gases under reversible- isothermal and adiabatic conditions.	8	CO2
3	Electrochemistry	Galvanic Cells, Electrode potential, Standard electrode potential, Nernst equation, Electrochemical series and its applications: measurement of pH,Solubility and solubility product and its applications	8	CO3
4	Gaseous state	Ideal and real gases, Causes of deviation from ideal behaviour, van der Waals gas equation and their limitations. Kinetics gas equation, deduction of gas laws from kinetic gas equation, kinds of velocities: Root mean square, average and most probable velocities. Calculation of molecular velocities.	8	CO4
5	Colligative Properties	Lowering of vapour pressure, Raoult's law, Determination of molecular mass of solute from lowering of vapour pressure, Elevation of boiling point, relation between elevation of boiling point and lowering of vapor pressure, Depression of freezing point and relation between Depression of freezing point and lowering of vapor pressure. Determination of molecular mass of solute from depression of freezing point , Osmosis and osmotic pressure, vant't Hoff equation.	8	CO5

Reference Books:

1. Principles of Physical Chemistry by Puri Sharma and Pathan by Vishal Publishing House.
2. Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
3. Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
4. Atkin's Physical Chemistry, Atkin, Oxford Press.

e-Learning Source:

1. https://nptel.ac.in/courses/104106089
2. https://onlinecourses.swayam2.ac.in/nce19_sc15/preview
3. https://www.bonsecourscollege.edu.in/box-chemistry.php

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS112	**Title of the Course**	Fundamentals of Biochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the concept of biochemistry.						

Course Outcomes	
CO1	The students will understand structure, classification and types of carbohydrates.
CO2	The students will understand structure, classification and properties of amino acids, protein structure.
CO3	The students will understand structure, function, classification and properties of fatty acids and lipids.
CO4	The students will understand structure, function, and type of nucleic bases, nucleoside, nucleotide and nucleic acids .
CO5	The students will understand structure, function, and type of Vitamins.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Carbohydrates	Carbohydrates- Structure, classification and properties of Monosaccharides, Disaccharides and Polysaccharides.	8	CO-1
2	Amino acid and proteins	Structure, Classification and properties of amino acids, Peptide bond, Proteins- primary, secondary, tertiary and quaternary structures.	8	CO-2
3	Lipids	Structure, function, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, Phospholipids, Lipoproteins, Glycoproteins.	8	CO-3
4	Nucleic acid	Purines and pyrimidines, nucleosides, nucleotides, polynucleotides, DNA types- A DNA, B DNA and Z DNA and their function. mRNA, rRNA and tRNA and their function, Forces stabilizing nucleic acid structure.	8	CO-4
5	Vitamin	Sources, dietary requirements, function and deficiency disorders of water and fat soluble vitamins.	8	CO-5

Reference Books:

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Bochemistry-J.L.Jain S.Chand and Company
5. Fundamentals of Biochemistry- J.L. Jain S. Chand and Company

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	1	3	1	1
CO2	3	1					1	1	3	1	1
CO3	3	1					1	1	3	1	1
CO4	3	1					1	1	3	1	1
CO5	3	1					1	1	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	BS203	**Title of the Course**	Cell Biology and Genetics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	This course is designed to enable the students to understand the cell structure and its functions, signal transduction and genetics.						

Course Outcomes	
CO1	Develop an understanding of the cell structure and their functions, cytoskeleton and prokaryotic and eukaryotic cells
CO2	Learn about Cell Division, Membrane transport, transduction, cell senescence and Programmed Cell Death.
CO3	Learn about Chromosomes, Chromosomal Variations, Chromosome mapping, structural and numerical aberrations
CO4	Learn about basic genetics, epistasis, Concepts of allosomes and autosomes, Linkage and Crossing Over.
CO5	Learn about mutations, human Genetics, DNA damage and repair.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Cell as a Basic unit of Living Systems	Discovery of cell, The Cell theory Ultrastructure of an eukaryotic cell – (both plant and animal cell). Structure and functions of cell organelles, Cytoskeletal structures (Microtubules, Microfilaments); cell motility.	8	CO1
2	Cell Division	Cell cycle, mitosis and meiosis, Membrane transport: active and passive transport, introduction to signal transduction and its molecular mechanism, cell senescence, Programmed Cell Death.	8	CO2
3	Chromosomes: Structural Organization	centromere, telomere, chromonema, euchromatin and heterochromatin, chemical composition and karyotype, nucleosome model, Special types of chromosomes: Salivary gland and Lampbrush chromosomes, Chromosomal Variations, Chromosome	8	CO3
4	Mendelism	Muscles and Movement, Skeletal, cardiac and smooth muscle. Nervous system: central and peripheral nervous system, nerve impulse – its conduction and synaptic transmission, neurotransmitters	8	CO4
5	Mutations	Spontaneous and induced mutations, Physical and chemical mutagens, Mutation at the molecular level, Mutations in plants, animals, and microbes for economic benefit of man. Human Genetics: Karyotype in man, inherited disorders: Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du- Chat syndrome). DNA Damage and Repair: Causes and Types of DNA damage, Major mechanisms of DNA repair: photoreactivation, nucleotide and base excision repairs, mismatch repair, SOS repair.	8	CO5

Reference Books:

1. Animal Cytology & Evolution – MJD, White Cambridge University Publications
2. Molecular Cell Biology – Daniel , Scientific American Books.
3. Cell Biology – Jack D. Burke, The William Twilkins Company.
4. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS221	**Title of the Course**	"Chordates" Animal Diversity-II	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the organization of Protochordata, Urochordata and Cephalochordata, The students will acquire the knowledge about the distinguishing features of chordates and classification of various classes of vertebrates.						

Course Outcomes	
CO1	The students will learn about the origin, characteristics and classification of Protochordates and Chordates.
CO2	Learn about the characteristics and classification of Pisces, their adaptations and associations in relation to their environment.
CO3	Learn about the characteristics and classification of Amphibia, Origin of tetrapods, parental care and paedomorphosis.
CO4	Learn about the characteristics and classification of Reptilia and Aves. Origin of reptiles and birds, Poisonous and non- poisonous snakes in India, flight adaptation and migration in birds.
CO5	Learn about the characteristics and classification of Mammals, their adaptation and dentition.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Chordates	Introduction and origin. Protochordata: Classification and study of habit and general characters of *Balanoglossus, Herdmania and Amphioxus.*	8	CO1
2	Agnatha	General features of living Agnatha; Pisces: General characters and classification of different classes of Pisces (up to order) with examples. General account of respiration, locomotion and migration.	8	CO2
3	Amphibia	General characters and classification of different classes of Amphibia (upto order) with examples. Origin of tetrapods, parental care, paedomorphosis.	8	CO3
4	Reptilia and Aves	General characters and classification of different classes of Reptilia; (up to order) with examples. Origin of reptiles, Poisonous and non- poisonous snakes in India. Aves: Origin of birds, flight adaptation, migration.	8	CO4
5	Mammalia	General characters and classification of different classes of mammals, dentition, general features of egg laying mammals, pouched- mammals, aquatic mammals and primates and their interrelationships.	8	CO5

Reference Books:

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
4. E.L. Jordan & P.S. Verma, 1998. Chordate zoology. (S. Chand & Co.).
5. R.L.Kotpal, 2000. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut).
6. G.S. Sandhu, 2005. Objective Chordate Zoology. Campus Books, vii.

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS222	**Title of the Course**	Angiosperm Morphology and Taxonomy	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to impart an insight into the habit, vegetative characters and diversity, internal structure and reproduction of the most evolved group of plants, the Angiosperm, to understand the distinguishing features of angiosperm families and get an insight into the fruit, seed development and inflorescence.						

Course Outcomes	
CO1	To have basic understanding of classification and taxonomy of the flowering plants.
CO2	To have an idea about the phylogenetic relationship in angiosperms.
CO3	Comprehend the organization of plant body and important modifications of stems, leaves and roots.
CO4	Describe the important characteristics of dicot families as Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitacece
CO5	Describe the important characteristics of dicot and monocot families as Asteraceae, Solanaceae Poaceae, Liliaceae, and Orchidaceae

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant systematics	Nomenclature of plants; the international code of botanical nomenclature. Documentation: Herbarium: Functions, preparation and management; important herbaria and botanical gardens of the world and of India; Flora; Keys; Numerical taxonomy and chemotaxonomy	8	CO1
2	Angiosperm taxonomy	Unique features of angiosperms and diversity; identification, brief reference of Angiosperm Phylogeny Group (APG) Classification: Bentham and Hooker; Comparative account of outline of various systems of classification of angiosperms (Bentham & Hooker, Engler & Prantl and Hutchinson); Origin and evolution of angiosperms.	8	CO2
3	Organization of plant body	Important modifications of stems, leaves and roots, Inflorescence: major types, Flower: Floral whorls, Parts, Flower as a modified shoot, Fruits: major types, Seed: Types	8	CO3
4	Angiospermic Families(A)	Study of main characters and economic importance of angiospermic families: Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitacece	8	CO4
5	Angiospermic Families(B)	Study of main characters and economic importance of angiospermic families: Asteraceae, Solanaceae Poaceae, Liliaceae, and Orchidaceae	8	CO5

Reference Books:

1. Angiosperm Phylogeny Group An update of the Angiosperm Phylogeny Group classification for the orders and families of the floweringplants: APG II. Botanical Journal of the Linnaean Society 141: 399- 436.
2. Crawford, D.J. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
3. Cronquist, A. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
4. Singh, G. Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition

e-Learning Source:

1. https://www.udemy.com/course/plant-anatomy-systematics-and-taxonomy/

https://endeavour.kew.org/challenge/ks-5/tree-of-life/taxonomic-categories

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				1	1	3			
CO2	3	1					1	3			
CO3	3	1					1	3			
CO4	3	1					1	3			
CO5	3	1					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: 2020-21							
Course Code	BS223	**Title of the Course**	Biochemistry and Animal Diversity Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the general test and diversity and classification of animals.						

Course Outcomes	
CO1	The students will learn about general tests for carbohydrates including Molisch's test & Benedict's test.
CO2	The students will learn spot test for amino-acids including solubility test and ninhydrin test.
CO3	The students will learn protein estimation through Lowry's method.
CO4	The students will learn about the characteristics and classification of Protochordates and Chordates.
CO5	Learn about the diversity among class Aves and difference between poisonous and non-poisonous snakes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact hrs.**	**Mapped CO**
1	**Exp-01**	Spot test for carbohydrates.	6	CO-1
2	**Exp-02**	Estimation of reducing sugars by Benedict's Method.	6	CO-1
3	**Exp-03**	Spot tests for Amino Acids.	6	CO-2
4	**Exp-04**	Protein estimation.	6	CO-3
5	**Exp-05**	Salient features and classification up to Orders of following with special emphasis on their adaptive characters: a. Protochordata: Herdmania, b. Pisces: Scoliodon, Labeo, c. Amphibia: Rana, Salamander, Bufo, d. Reptilia; Hemidactytus, Chameoleon , Tortoise e. Mamalia: Mouse, Rabbit, Bat.	6	CO-4
6	**Exp-06**	Preparation of an album: study of six common birds.	3	CO-5
7	**Exp-07**	Study of poisonous and nonpoisonous snakes.	3	CO-5

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1				3	3			2
CO2	3	3	1				3	3			2
CO3	3	3	1				3	3			2
CO4	3	3	1				3	3			2
CO5	3	3	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: 2020-21							
Course Code	BS 224	**Title of the Course**	Elementary Biology Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**0**	**0**	**6**	**3**
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the general test and diversity and classification of animals.						

Course Outcomes	
CO1	The students will learn the use of Micrometer and calibration, for measurement of cells.
CO2	The students will learn various phases of cell division.
CO3	The students will know the structure of polytene chromosomes; Barr bodies and learn karyotype analysis
CO4	The students will learn about the vegetative, floral and fruit characters of varied families and in general.
CO5	Learn about the diversity among various plants.

Exp. No.	**Title of Experiment**	**Contact hrs.**	**Mapped CO**
1	Use of Micrometer and calibration, measurement of onion epidermal cells and yeast.	3	CO1
2	Cell division: Mitotic and meiotic studies onion root tips and flower bud	3	CO2
3	Chromosomes: Study of polytene chromosomes by slides; Barr bodies	3	CO3
4	Karyotype analysis – with the help of slides	3	CO3
5	Study of vegetative and floral characters of any one representative genus of following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e) Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitaceae, Asteraceae and Liliaceae.	6	CO4
6	Morphology study of flower parts, inflorescence, seed, fruit types.	6	CO4
7	Mounting of a properly dried and pressed specimen of any twelve wild plants with herbarium label (to besubmitted in the record book).	6	CO5

Reference Books:

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1				3	3			2
CO2	3	3	1				3	3			2
CO3	3	3	1				3	3			2
CO4	3	3	1			2	3	3			2
CO5	3	3	1			2	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	BS202	**Title of the Course**	Biophysical Chemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basic principles, working and applicatication of commonly used biophysical techniques viz spectroscopy, chromatography, Centrifugation, Electrophoresis and the Importance of radioactivity in biological studies including GM counters and Scintillation counting.						

Course Outcomes	
CO1	Understand the basics of biophysics, chemical bonds and concept of thermodynamics.
CO2	Understand the basics and types of spectroscopy.
CO3	know basic principle, methodology and application of various chromatographic techniques
CO4	study centrifugation and electrophoresis - principles and applications
CO5	Understand the importance of radioactivity in biological studies, GM counters and Scintillation counting.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Basics of Biophysics	Chemical bonding–Ionic bond, covalent bond, hydrogen bond and peptide bond, Vander-Waals forces, Principles of thermodynamics	8	CO-1
2	Analytical techniques	Colorimetry, UV-visible spectrophotometry, NMR, IR, Fluorescence and atomic absorption spectroscopy, Mass spectroscopy.	8	CO-2
3	Chromatography	Chromatography: Paper, thin-layer, Column, Ion-Exchange, HPLC, GLC and molecular sieving	8	CO-3
4	Centrifugation & Electrophoresis	Centrifugation principles, Theory, Types, instrumentation and applications. Electrophoresis: Principles, working and applications of PAGE and Agarose gel electrophoresis	8	CO-4
5	Radioactivity	Radioactivity: Types, their importance in biological studies, measure of radioactivity, GM counters, Scintillation counting and Autoradiography	8	CO-5

Reference Books:

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

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3			1
CO2	3	1					2	3			1
CO3	3	1					2	3			1
CO4	3	1					2	3			1
CO5	3	1					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	BS212	**Title of the Course**	Molecular Biology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the concept of different types of genes, DNA replication, Transcription, Translation, regulation of Gene expression in prokaryotes and eukaryotes.						

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

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Genome organization	Central Dogma, Definition of gene, types of genes (split genes, overlapping genes; pseudogenes, cryptic genes), concept of intron and exon. Genome organization in prokaryotes. Complexity of eukaryotic genome, nucleosome model and higher order structure of DNA. Organellar genome (Mitochondria and chloroplast). Insertion elements and transposons.	8	CO-1
2	DNA Replication	DNA as genetic material. Semiconservative mode of replication. Mechanism of Replication in prokaryotes and eukaryotes. Enzymes and proteins involved in replication, Theta model and Rolling circle model.	8	CO-2
3	Transcription	Properties of prokaryotic and eukaryotic promoters. RNA polymerase, transcription factors. Mechanism of transcription. Post-transcriptional modifications of eukaryotic mRNA (capping, polyadenylation and splicing)	8	CO-3
4	Genetic code	Genetic code, adaptor role of t-RNA, Wobble hypothesis. Mechanism of translation in Prokaryotes and Eukaryotes, Post-translational modifications of proteins.	8	CO-4
5	Regulation of Gene expression	Operon concept (Lac operon), transcriptional activation, galactose metabolism in yeast. Introduction to DNA repair systems (Photoreactivation, Base excision repair, Nucleotide excision repair, Mismatch repair)	8	CO-5

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. Lehninger: Principles of Biochemistry (2017) by Nelson and Cox Seventh edition, WH Freman and Co.
4. Lodish H, Baltimore D, Berk A, Zipursky SL, Darnell J. (1995). Molecular cell biology.
5. Karp.G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS231	**Title of the Course**	Ecology & Adaptation	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The course has been designed to make students aware of is to enable students to understand the plant communities, ecological adaptations along with biotic and abiotic environmental factors, phytogeographic and zoogeographic realms, vegetation types of India, plant types and succession, adaptation in animals along with their behavior.						

Course Outcomes	
CO1	The students will be able to learn the approaches to the study of ecology.
CO2	Understand the role and importance of biotic & abiotic environment factors in sustenance of plant life
CO3	The course will impart importance of phytogeography and zoogeography to teach managing regional flora
CO4	To understand the role and importance of adaptation in the sustenance of animal life.
CO5	Understand importance of phytogeography and zoogeography to teach managing regional flora.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Ecology	Inter-relationships between living world and environment, Concept of Biosphere, Biomes, Ecosystem, Food chain, Food web. Introduction to Biogeochemical cycles, Hydrologic cycle. Concept of habitat and niche. Environment related concepts and laws (theory of tolerance, laws of limiting factors).	8	CO-1
2	Biogeography	Phytogeography, Phytogeographic realms, major plant communities of the world, Vegetation of India, Community characteristicsorganization and concept of habitats and niche. Zoogeography: Zoogeographic realms, Threatened species of animals	8	CO-2
3	Adaptation in plants	Plant types: Hydrophytes - Hydrilla, Eichhorina, Nymphaea, Typha. Xerophytes – Nerium, Casuarina, Saccharum, Begonia. Ecological succession.: Plant succession – xeroseres, hydroseres	8	CO-3
4	Adaptation in animals	Aquatic, terrestrial, aerial and arboreal. 8 Animal Behavior: Introduction to Ethology, Patterns of behavior (taxes, reflexes, instinct and motivation); biorhythms; learning and memory, Migration of fishes & birds.	8	CO-4
5	Population and Community Ecology & Population	Characteristics and regulation, Population attributes, density, natality, mortality, age ratio, sex ratio, dispersal and dispersion of population, exponential and logistic growth, life history strategies, population interactions, predation-types, predator-prey system, functional and numerical response, host-parasite interactions, social parasitism, symbiosis	8	CO-5

Reference Books:

1. Mishra, A. Environmental Studies Selective and Scientific Books, New Delhi
2. Allaby, M. Basics of Environmental Science Routledge .
3. Smith, T.M. and Smith, R.C. Elements of Ecology Ist editon Pearson Publications .
4. Miller, G.T Environmental Science 11th edition Brooks/Cole .
5. Kormondy, E.J. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS232	**Title of the Course**	Plant Physiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the concept of plant physiology.						

Course Outcomes	
CO1	The students will be able to explain the concept of Importance of water, Diffusion and water potential, Osmosis, Ascent of sap, Transpiration and its significance; Factors affecting transpiration, guttation.
CO2	The students will be able to explain the Essential elements, macro and micronutrients, Role of essential elements; Absorption of mineral salts, Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem, Composition of phloem sap.
CO3	The students will be able to explain the Photosystem I and II, Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. Nitrogen metabolism Biological nitrogen fixation; Nitrate and ammonia assimilation.
CO4	The students will be able to describe the Enzymes: general structure and properties, Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. role and applications in agri-horticulture. Seed Physiology: Dormancy, Breaking of dormancy, Germination.
CO5	The students will be able to discuss Plant response to light and temperature: Photomorphogenesis, Plant movements, Photoperiodism, (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Growth response to temperature, Vernalization. Introduction to Stress physiology.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant water relations	Importance of water, Diffusion and water potential, Osmosis, Ascent of sap, Transpiration and its significance; Factors affecting transpiration, guttation.	8	CO-1
2	Mineral nutrition and transport	Essential elements, macro and micronutrients, Role of essential elements; Absorption of mineral salts, Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem, Composition of phloem sap.	8	CO-2
3	C and N metabolism	Photosystem I and II, Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. Nitrogen metabolism Biological nitrogen fixation; Nitrate and ammonia assimilation.	8	CO-3
4	Plant growth regulators	Enzymes: general structure and properties, Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. role and applications in agri-horticulture. Seed Physiology: Dormancy, Breaking of dormancy, Germination.	8	CO-4
5	Growth and development	Plant response to light and temperature: Photomorphogenesis, Plant movements, Photoperiodism, (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Growth response to temperature, Vernalization. Introduction to Stress physiology.	8	CO-5

Reference Books:

1. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P.,. Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3 Bajracharya, D.,. Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Frank B. Salisbury, Cleon W. Ross: Plant Physiology. Wadsworth Publishing Company

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS233	**Title of the Course**	Animal Physiology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the fundamental knowledge of animal physiology.						

Course Outcomes	
CO1	Understand the process of digestion and absorption.
CO2	Understand blood and cardiovascular system.
CO3	Students will gain knowledge of the muscle and nervous system.
CO4	Students are understands the detailed concepts of respiration, excretion and osmoregulation.
CO5	Students gain fundamental knowledge of reproductive and endocrine systems.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Digestion and absorption	Digestion and absorption: Role of salivary glands, liver, pancreas and intestinal glands. Digestion and absorption of carbohydrates, lipids and proteins.	8	CO1
2	Blood and Circulatory System	Blood: Composition of blood, blood cells, plasma proteins and Rh factor; Blood coagulation – mechanism and regulation. Circulatory & Cardiovascular System: Heart and circulation; cardiac cycle.	8	CO2
3	Respiration, Excretion and osmoregulation	Respiration: Respiratory volumes, Haemoglobin and oxygen transport, carbon dioxide transport, Bohr's effect and chloride shift. Excretion and osmoregulation: Structure of nephron, urine formation and its regulation; excretory product.	8	CO3
4	Muscle and Nervous system	Muscle system: Muscles and Movement, Skeletal, cardiac and smooth muscle. Nervous system: central and peripheral nervous system, nerve impulse – its conduction and synaptic transmission, neurotransmitters.	8	CO4
5	Endocrine and Reproductive system	Endocrine system: Endocrine glands and their functions; Nature of hormones; Regulation of hormone secretion; Mode of action of hormones. Reproductive system: testis, ovary, Spermatogenesis, Oogenesis, Totipotency.	8	CO5

Reference Books:

1. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia.1988.
2. Introduction to Physiology by Davidson H and Segal M.B. Academic Press.
3. Fox S I – Human Physiology, (McGraw Hill, 1998, ISBN:0071157069)
4. Physiological basis of Medical practice, West J.B., Best andTaylor.
5. Moffett D and Schauf C L – Human Physiology: Foundations & Frontiers, (Mosby, 1993, ISBN:801669030)
6. Seeley R, Stephens T and Tate P – Anatomy & Physiology, (McGraw-Hill, 1999, ISBN:0071169881)
7. Sherwood L – Human Physiology: From Cells to Systems, (Wadsworth Publishing, 2000,ISBN:0534568262)

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					2	3	1		
CO2	3	1					2	3	1		
CO3	3	1					2	3	1		
CO4	3	1					2	3	1		
CO5	3	1					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	BS234	**Title of the Course**	Molecular Biology & Microbiology Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students learn about basic molecular and microbiological techniques.						

Course Outcomes	
CO1	The student will be able to isolate, purify genomic DNA and Estimate nucleic acid
CO2	The student will be able to conduct Biochemical tests like starch hydrolysis, gelatin liquefaction and separation of amino acids by chromatography.
CO3	The student will be able to explain the principle of sterilization principle and usage of instruments like Compound microscope, Autoclave, etc.
CO4	The student will be able to explain media preparations and various staining techniques.
CO5	The student will be able to conduct experiments like isolation of bacteria and fungi from soil/ air/water and Growth curve analysis.

Exp. No.	**Title of Experiment**	**Contact hrs.**	**Mapped CO**
Exp-01	Isolation and purification of genomic DNA.	3	CO-1
Exp-02	Estimation of DNA and RNA	3	CO-1
Exp-03	Biochemical tests–starch hydrolysis, gelatin liquefaction.	3	CO-2
Exp-04	Separation of amino acids by paper chromatography.	3	CO-2
Exp-05	Cleaning and sterilization of glass ware.	3	CO-3
Exp-06	Study instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge	3	CO-3
Exp-07	Media preparation: Nutrients agar, Nutrient broth and LB	3	CO-4
Exp-08	Staining Techniques: Simple, Negative staining, Gram staining, Endospore staining, fungal staining.	3	CO-4
Exp-09	Isolation of bacteria and fungi from soil/ air/water – dilution and pour plate methods.	3	CO-5
Exp-10	Study Growth curve of bacteria.	3	CO-5

Reference Books:

1. Keith Wilson John Walker John M. Walker “Principles and Techniques of PracticalBiochemistry”
2. Joseph Sambrook David W. Russell Joe Sambrook “Molecular Cloning: A Laboratory Manual”
3. William M., Ph.D. O'Leary Robert Dony Wu “Practical Handbook of Microbiology”

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1				3	3			2
CO2	3	3	1				3	3			2
CO3	3	3	1				3	3			2
CO4	3	3	1				3	3			2
CO5	3	3	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: 2020-21							
Course Code	BS 235	**Title of the Course**	Physiology and Ecology lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	6	3
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the physiology and ecology.						

Course Outcomes	
CO1	The students will learn to Determination of osmotic potential of plant cell sap by plasmolytic method, to study the effect of two environmental factors (light and wind) on transpiration by excised twig.
CO2	The students will learn Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
CO3	The students will know the Study of xerophytic modification in plants: any three specimens as Acacia/ Argemone /Asparagus Opuntia/ Calotropis), Study of hydrophytic modification in plants (any two specimens as Hydrilla/Echornia/Water lily).
CO4	The students will learn about Demonstrate the activity of any enzyme and study the effect of pH and enzyme concentration, to study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
CO5	Learn about the Comparison of the rate of respiration in any two parts of a plant, Demonstration of R.Q.

Exp. No.	**Title of Experiment**	**Mapped CO**
1	Determination of osmotic potential of plant cell sap by plasmolytic method, to study the effect of two environmental factors (light and wind) on transpiration by excised twig.	CO1
2	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.	CO2
3	Study of xerophytic modification in plants: any three specimens as Acacia/ Argemone /Asparagus Opuntia/ Calotropis), Study of hydrophytic modification in plants (any two specimens as Hydrilla/Echornia/Water lily).	CO3
4	Demonstrate the activity of any enzyme and study the effect of pH and enzyme concentration, to study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.	CO4
5	Comparison of the rate of respiration in any two parts of a plant, Demonstration of R.Q.	CO5

Reference Books:

e-Learning Source:

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

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

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