Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS212	**Title of the Course**	Molecular Biology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to 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	CO1
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	CO2
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	CO3
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	CO4
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	CO5

Reference Books:

1. Lewin B. (2000). Genes VII. Oxford University press
2. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1987). Molecular biology of the gene.
3. 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	2		3	2
CO2	3	1					1	2		3	2
CO3	3	1					1	2		3	2
CO4	3	1					1	2		3	2
CO5	3	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: 2020-21							
Course Code	BS366	**Title of the Course**	PLANT ECOLOGY, PHYTOGEOGRAPHY AND ECONOMIC BOTANY	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this paper is to develop the understanding of basics of ecology, phytogeography and economic botany.						

Course Outcomes	
CO1	Understand the basics of Ecosystem and Ecology
CO2	Concept, components, Fundamental of dynamics of ecology.
CO3	Have knowledge about pollution, renewable and non-renewable, management problem of depletion of natural resources.
CO4	Understand phytogeography and Plant ecological adaptations.
CO5	Learn about the economic importance of plants.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Plant Ecology	Definition, scope, branches, Ecological factor affecting the vegetation. Ecosystem: Structure, its biotic and abiotic components, food chain and food web, ecological pyramids, energy flow, biogeochemical cycles.	8	CO1
2	Productivity	Primary and secondary productivity and their measurements. Plant succession: causes. Process types: Hydrosere, Xerosere (Lithosere and Psammosere). Community: Structure and development	8	CO2
3	Pollution	Pollution of air, water, Noise, their causes, Renewable and non-renewable, management problem of depletion of natural vegetation; endangered plants. Red data book. National parks and sanctuaries	8	CO3
4	Plant adaptations	Hydrophytes, Xerophytes and Halophytes (morphological, anatomical and physiological adaptations). Phytogeography: Introduction, continuous and discontinuous distribution, Phytogeography of India, Plant indicators	8	CO4
5	Economic importance of plants	Use of plants as food as Cereals, Legumes, Spices, Beverages, feed and fodder. Plants as a source of wood, fiber, paper and pulp and medicines	8	CO5

Reference Books:

1. Odum Ecology
2. P. D. Sharma, Ecology

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1				3	1						
CO2	3	1				3	1						
CO3	3	1		1		3	1						
CO4	3	1				3	1						
CO5	3	1		1		3	1						

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS321	**Title of the Course**	Plant anatomy and embryology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to make students aware of the scope and importance of plant anatomy and embryology of angiospermic plant, Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information of various tissue systems, anomalous secondary growth in plants, know fertilization, endosperm and embryogeny.						

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

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

Reference Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS361	**Title of the Course**	Applied and economic zoology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to give students in depth knowledge about the economic importance of various animal species. The students will also be made aware about the diseases caused by parasites.						

Course Outcomes	
CO1	The students will learn about the transmission, prevention, and control of diseases like Dengue, Malaria, Amoebiasis etc
CO2	The students will get an in-depth knowledge of life cycle and pathogenicity of animal and human parasites like Trypanosoma, Giardia, Wucheraria etc.
CO3	The students will learn about the life cycle and control of various vectors and pests
CO4	The expected outcome is to provide the students an in-depth understanding of integrated pest management.
CO5	The students will learn about the culturing of economically important species like fishes, honeybees etc.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Epidemiology of infectious diseases	Transmission, prevention and control of diseases: Tuberculosis, Amoebiasis, Dengue, Malaria, and Swine flu. Brief account of Rickettsia, Borellia, Treponema and Leptospira	8	CO1
2	Structure, life cycle and Pathogenicity	Causes, symptoms and control of the following parasites of domestic animals and humans: Trypanosoma, Giardia, Diphyllobothrium, Hymenolepis, Dracunculus, Wuchereria , Faciolopsis and Paragonimus. Plant Nematodes, nature of their damage and control measures including Meloidogyne	8	CO2
3	Vectors and pests	Vectors like mosquito, house fly, bed bug, louse and their control. Pest, types, characteristic features, life cycle, nature of damage and control of termite, cockroach, cloth moth, grain moth, wax moth, gundhi bug, sugarcane leaf-hopper and rodents	8	CO3
4	Bionomics and control of stored grain pests	Corcyra, Trogoderma, Callosobruchus and Sitophilus. Classification of insect control with reference to chlorinated hydrocarbons, organophosphates, carbamates and synthetic pyrethroid, General aspects of Integrated Pest Management (IPM)	8	CO4
5	Animal culture	Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture, Lac-culture	8	CO5

Reference Books:

1. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
2. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributers.
3. Chaudhury, S.K. (1996) Practice of fertility Control, A Comprehensive Textbook. B.I.Churchill Livingston Pvt Ltd, India.
4. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.

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	PSO6	PSO7
CO1	3	1				1	1	1	3	2	1		
CO2	3	1				1	1	1	3	2	1		
CO3	3	1				1	1	1	3	2	1		
CO4	3	1		1		1	1	1	3	2	1		
CO5	3	1				1	1	1	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: 2020-21							
Course Code	BS362	**Title of the Course**	Ecology and animal behaviour	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basics of ecology, chronobiology and animal behavior.						

Course Outcomes	
CO1	Autecology and Synecology, Levels of organization, Laws of limiting factors, Study of physical factors.
CO2	Concept, components, Fundamental of dynamics of ecology.
CO3	Introduction to Ethology and different Patterns of Behaviour.
CO4	Social Behaviour, Concept of Society; Communication and the senses, sexual selection.
CO5	Introduction and history of chronobiology, biological rhythms, photoperiodism, biological clocks and human health.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	History of Ecology	Autecology and Synecology, Levels of organization, Laws of limiting factors, Study of physical factors.	8	CO1
2	Ecosystem	Concept, components, Fundamental operations, Ecological pyramids and Ecological efficiencies, energy flow, food chain, food webs and trophic levels, ecological niche. Types of ecosystem (one example in detail), Ecological succession. Adaptation: Aquatic, terrestrial, aerial and arboreal.	8	CO2
3	Introduction to Ethology	Patterns of Behaviour-Stereotyped Behaviours (Orientation, reflexes), individual behavioral patterns, Instinct Vs learnt behavior, Learning: Imprinting, habituation and sensitization, associative learning: punishment and reward learning, trial and error learning; taste aversion learning, cache retrieval; social learning, gene- environmental effect on behavior.	8	CO3
4	Social Behaviour	Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.	8	CO4
5	Chronobiology	Introduction and history of chronobiology, biological rhythms: definition, type and their characteristics, free run, entrainment, seasonal rhythms, photoperiodism, biological clocks and human health.	8	CO5

Reference Books:

Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.

Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

Robert Leo Smith Ecology and field biology Harper and Row publisher

John Alcock, Animal Behaviour, Sinauer Associate Inc., USA

Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				3	1	2	3	1	
CO2	3	1				3	1	2	3	1	
CO3	3	1	2			3	1	2	3	1	
CO4	3	1	2	1		3	1	2	3	1	
CO5	3	1				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	BS363	**Title of the Course**	Fundamentals of biomolecules	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	2	0	0	2
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to learn about biomolecules						

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	Introduction to Biomolecules	Carbohydrates- Structure, classification and properties of Monosaccharides, Disaccharides and Polysaccharides.	8	CO1
2	Amino acids and Proteins	Structure, Classification and properties of amino acids, Peptide bond, Proteins- primary, secondary, tertiary and quaternary structures.	8	CO2
3	Lipids	Structure, function, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, Phospholipids, Lipoproteins, Glycoproteins.	8	CO3
4	Nucleic acids	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	CO4
5	Vitamin	Sources, dietary requirements, function and deficiency disorders of water and fat soluble vitamins.	8	CO5

Reference Books:

Principles of Biochemistry- Albert L. Lehninger CBS Publishers & Distributors

Biochemistry – Lubert Stryer Freeman International Edition.

Biochemistry – Keshav Trehan Wiley Eastern Publications

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: 2017-18							
Course Code	CH314	**Title of the Course**	Advance Inorganic Chemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	The main objective of this course is to understand the bonding in coordination compounds, electronic spectra and magnetic behaviour of the coordination compounds and some important inorganic compounds. The other important objective is tostudy the reaction mechanism in coordination compounds and importance of inorganic metals in bio-inorganic chemistry.						

Course Outcomes	
CO1	Understand the concept of coordination chemistry with different theories.
CO2	Understand and evaluate the electronic spectra and magnetism of transition metal complexes.
CO3	Study of some important inorganic compounds and their applications
CO4	Understand the different reaction mechanisms in coordination compounds.
CO5	Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Bonding in coordination compounds	Electronic configuration (3d, 4d, 5d) and general periodic trends, comparative study of first/second/third transition series elements, IUPAC nomenclature of coordination compounds, VBT (hybridization/magnetism/geometry) of $Ni(CN)_4^{2-}$, $NI(CO)_4$, $Ni(Cl)_4^{2-}$, $Fe(CN)_6^{3-}$, $Fe(CN)_6^{4-}$, Elementary Crystal Field Theory: splitting of dn configurations in octahedral, square planar and tetrahedral fields, factioras affecting 10 Dq value, crystal field stabilization energy, pairing energy, Magnetic moment from crystal field theory, high spin and low spin complexes, Static and Dynamic Jahn-Tellar distortion.	8	CO1
2	Spectra and magnetism of transition metals	Spectro-chemical series of ligands, Laporte's selection rule, colour of complexes, spectroscopic ground states, selection rules for electronic spectral transitions, charge transfer spectra, LS coupling. Types of magnetism and temperature dependence of magnetic susceptibility, Curie and Curie-Weiss law, Measurement of magnetic susceptibility by Gouy method, Faraday method.	8	CO2
3	Selected topics in advanced inorganic compounds	Structure/synthesis/various chemical reactions of potassium dichromate, potassium permanganate, potassium chromate, sodium thiosulphate. Structure/synthesis/various chemical reactions of fluorides and oxides of xenon, Zeise's salt, silicones, borazine, phosphazine. S4N4, P4, P4O6, P4O10. Extractive metallurgy for self-reduction method (Copper and lead), cyanide process and chemical reactions (silver and gold).	8	CO3
4	Reaction mechanism of ligand displacement reactions	Substitution reaction in square planar complexes (Trans effect), mechanism of substitution reaction, Electron transfer reactions and its classification. Outer sphere electron transfer mechanism, chemical activation, Marcus theory, cross-reactions, thermodynamical/kinetic parameters, inner-sphere electron transfer mechanisms, effect of the nature of metal/ligandss, bridging group effects, cross reactions.	8	CO4
5	Bioinorganic chemistry	Biological role of inorganic metals in human body (description only), Electron transfer proteins, Metal ion transport and storage, Feritin and its structure, Oxygen transport by heme proteins, hemoglobin and myoglobin, Dioxygen transport (hemoglobin, hemocyanin and Blue copper proteins), Biomineralization (ferritin), zinc finger protein, Carbonic anhydrase, carboxy peptidase, carboxypeptidase A/B.	8	CO5

Reference Books:

Inorganic Chemistry: Structure and Reactivity, James E. Huheey, Harper and Row Publishers, New York

Advanced Inorganic Chemistry: F.A. Cotton and G. Wilkinson, Interscience.

Inorganic Reaction Mechanism, Basolo and R.G. Pearson, John Willey.

e-Learning Source:

https://nptel.ac.in/courses/104/105/104105033/

https://ocw.mit.edu/courses/chemistry/5-112-principles-of-chemical-science-fall-2005/video-lectures/lecture-32-coordination-complexes-and-ligands/

https://www.chem.tamu.edu/rgroup/marcetta/chem362/lectures/Lecture%2029%20subset%20of%20TM%20lecture%20notes.pdf

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3					3	3	3	3	1	1	
CO2	3					3	3	3	3	1	1	
CO3	3					3	3	3	3	1	1	2
CO4	3					3	3	3	3	1	1	1
CO5	3					3	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: 2017-18							
Course Code	CH315	**Title of the Course**	Advance Organic Chemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	The main objective of this course is to study the nomenclature of organic compounds, structure and bonding of organic molecules considering inductive effect, hyperconjugation, mesomeric effects, hydrogen bonding etc., and mechanism of various types of organic reactions.						

Course Outcomes	
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..
CO5	Understand and analyze the structure and classification of dyes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Organometallic and organosulphur compounds	Organomagnesium Compounds: the Grignard reagents, structure and chemical reactions Organolithium Compounds: formation and chemical reactions. Nomenclature, methods of formation and chemical reaction of thiols, sulphonic acids.	08	CO1
2	Heterocyclic compounds	Molecular orbital picture and aromatic charecteristics of pyrrole, furan, thiophene and pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Methods of synthesis and chemical reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis.	08	CO2
3	Carbohydrates	Carbohydrates: classification and configuration and conformation of monosaccharides, Erythro and threodiastereomers, mechanism of osazone formation, Interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Formation of glycosides, ether and esters. Cyclic structure of D(+) glucose. An introduction to disaccharides (maltose, sucrose, lactose) and polysaccharides/starch and cellulose.	08	CO3
4	Acids, peptides, proteins and nucleic acids	Classification, structure and stereochemistry of amino acids, isoelectric point. Classification of protiens, peptides, structure determination, and end group analysis. Nucleic acids: Introduction –Classification of Nucleic Acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA.	08	CO4
5	Dyes	Dyes: Introduction of the history of dyes. Landmarks in the historical development from Natural to synthetic dyes. Introduction and classification of dyes on the basis of structure Colour and chemical constitution of dyes. Structure and uses of phenolphthalein, fluorescein, Eosin, Malachite green, Methylene blue , Indigo. Napthol yellow- S, Crystal violet.	08	CO5

Reference Books:

Advanced Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.

Organic Chemistry Vol.I& II, I.L. Finar

Fundamentals of Organic Chemistry, NafisHaider, S. Chand & Co. Ltd.

A text book of Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.

Organic Chemistry Vol.I, II & III, Dr. Jagdamba Singh, L.D.S. Yadav, Pragati Prakashan.

e-Learning Source:

https://www.khanacademy.org/science/organic-chemistry

https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/Chapter_06%3A_UnderstandingOrganic_Reactions

https://www.dummies.com/education/science/biology/the-basics-of-organic-chemistry/

https://www.toppr.com/guides/chemistry/organic-chemistry/

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1		1		3	3	2	2	2	1
CO2	2	2	1		2		3	2	2	2	2	1
CO3	3	3	1		1		2	3	2	2	2	2
CO4	2	3	1		1		3	3	2	2	2	2
CO5	2	2	1		1		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: 2017-18							
Course Code	CH319	**Title of the Course**	Basics of Chromatographic Techniques	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	2	1	0	3
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	To develop understanding of Separation techniques such as Thin layer chromatography, Paper chromatography, Gas chromatography, High performance Liquid Chromatography and Ion exchange chromatography.						

Course Outcomes	
CO1	Understand the chromatographic techniques and its classification.
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions -removalof interfering radicals.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Separation techniques	Chromatography, Classification of Chromatographic methods, Elution in column chromatography, chromatograms, distribution constant, retention time, stationary phase, mobile phase, principle of adsorption and partition chromatography, column chromatography; principle, adsorbents used, preparation of column, adsorption, elution.	7	CO1
2	Thin layer chromatography	Principle, choice of adsorbent and solvent, Rf value, applications. Paper chromatography; solvents used, principle, Rf value, factors influencing Rf value, applications. Separation ofamino acid mixture.	7	CO2
3	Gas chromatography	Introduction, Principles of gas-liquid chromatography, Instrumentation; Carrier gas system, Sample injection, Columns, Stationary phase, Detectors (Flame Ionization, Electron captureand Thermal conductivity) and Industrial applications.	7	CO3
4	High performance liquid chromatography	Introduction of HPLC, Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector (UV-visible absorption, Electrochemical) and Industrial applications of HPLC.	7	CO4
5	Ion exchange chromatography	Principle, resins, action of resins, experimental techniques, applications, separation of metalions, separation of chloride and Bromide ions - removal of interfering radicals.	7	CO5

Reference Books:

Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.

Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication.

Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.

Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers. Analytical chemistry, D. Kealey, P.J.Haines, Viva books Pvt.

Analytical chemistry- Instrumental Techniques (Vol. II) – Mahindu Singh, Dominant publishers. Ltd

e-Learning Source:

https://microbenotes.com/chromatography-principle-types-and-applications/

https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography

https://www.slideshare.net/nadeemakhter7374/chromatography-34247423

http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1	3	3	3	2		2	
CO2	3	2	2	2	1	3	3	3	2		2	
CO3	3	2	2	2	1	3	3	3	2		2	
CO4	3	2	2	2	1	3	3	3	2		2	
CO5	3	2	2	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: 2020-21							
Course Code	BS364	**Title of the Course**	Applied zoology lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	4	2
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of importance of economic and applied zoology.						

Course Outcomes	
CO1	Temporary and permanent preparation of various animal groups
CO2	Collection and identification of pests.
CO3	Life history of silkworm, honeybee and lac insect.
CO4	Different types of important edible fishes of India.
CO5	Demonstration of counting of cells by haemocytometer, haemoglobinometer, pH meter, Colorimeter. Dissection: Wallago- Afferent and efferent branchial vessels, Cranial nerves

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Exp-01	Permanent Preparation of: Euglena, Paramecium and rectal protozoans from frog	3	CO1
2	Exp-02	Study of prepared slides/ specimens of Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Paramphistomum, Schistosoma, Echinococcus, Dipylidium, Enterobius, Ascaris and Ancylostoma	3	CO1
3	Exp-03	Permanent Preparation of Cimex (bed bug), Pediculus (Louse), Haematopinus (cattle louse), ticks/mites	3	CO1
4	Exp-04	Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly	3	CO1
5	Exp-05	Collection and identification of pests	3	CO2
6	Exp-06	Life history of silkworm, honeybee and lac insect	3	CO3
7	Exp-07	Different types of important edible fishes of India	3	CO4
8	Exp-08	Prepared slides of plant nematodes	3	CO4
9	Exp-09	Demonstration of counting of cells by haemocytometer, haemoglobinometer, pH meter, Colorimeter.	3	CO5
10	Exp-10	Dissection: Wallago- Afferent and efferent branchial vessels, Cranial nerves	3	CO5

	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	1	3	2	3
CO2	3	3					3	1	3	2	3
CO3	3	3		1			3	1	3	3	3
CO4	3	3		1			3	1	3	3	3
CO5	3	3		2	3		3	1	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	BS365	**Title of the Course**	Applied Botany Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	4	2
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of importance of economic and applied Botany.						

Course Outcomes	
CO1	Learn about Preparation of plant culture media and its sterilization.
CO2	Have knowledge of In vitro germination of seeds andinitiation and maintenance of Callus and suspension Culture.
CO3	Know process of Isolation of genomic/plasmid DNA from Plant/Bacteria.
CO4	Have knowledge of Restriction digestion of DNA and Agarose Gel Electrophoresis.
CO5	Have knowledge of PCR.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Exp. 1**	Preparation of plant culture media and its sterilization	6	CO1
2	**Exp. 2**	In vitro germination of seeds	4	CO2
3	**Exp. 3**	Initiation and maintenance of Callus and suspension Culture	4	CO2
4	**Exp. 4**	Isolation of genomic/plasmid DNA from Plant/Bacteria	4	CO3
5	**Exp. 5**	Restriction digestion of DNA	4	CO4
6	**Exp. 6**	Agarose Gel Electrophoresis	6	CO4
7	**Exp. 7**	Demonstration of PCR	4	CO5

	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								3	
CO2	3	3				1				3	
CO3	3	3								3	2
CO4	3	3								3	2
CO5	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	CH316	**Title of the Course**	Chemistry Practical-V	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	4	2
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	Student will be able to work effectively and safely in a laboratory environment, practical/technical/ communication skills,concepts to solve qualitative and quantitative problems,transferable skills like ability to work in teams as well as independently.						

Course Outcomes	
CO1	To develop the understanding of procedural knowledge
CO2	To develop an ability to handle the apparatus carefully, and use the resources wisely.
CO3	To develop a respect for evidence, rationality and intellectual honesty.
CO4	To develop interest and motivation through laboratory which will lead to development of positive attitude?
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

Exp. No.	Content of Unit	Contact Hrs.	Mapped CO
1	Synthesis and Analysis of the Potassium trioxalatoferrate (III), K3[Fe(C_2O_4)$_3$] and determination of its compositionby permagnometry.(a) Potassium trioxalatoferrate (III), K_3[Fe(C_2O_4)$_3$] and determination of its composition by permagnometry.	4	CO1-5
2	Preparation of cis-and trans –bisoxalatodiaqua chromate (III) ion.	4	CO1-5
3	To verify Beer-Lambert law for $KMnO_4$/$K_2Cr_2O_7$ and determine the concentration of the given solution	4	CO1-5
4	Determination of Fe^{3+} content by thiocyanate method.	4	CO1-5
5	Separation of Fluorescein and methylene blue by column chromatography.	4	CO1-5
6	Separation of leaf pigments from leaves	4	CO1-5
7	Resolution of racemic mixture of (+) mandelic acid	4	CO1-5
8	Diazotization/coupling: Preparation of methyl orange and methyl red	4	CO1-5
9	Oxidation: Preparation of benzoic acid from toluence	4	CO1-5
10	Reduction: Preparation of aniline from nitrobenzene	4	CO1-5

Reference Books:

CRC Handbook of Chemistry and Physics: 97th ed.

McGraw-Hill Concise Encyclopedia of Chemistry by McGraw-Hill Education Staff.

A Dictionary of Chemistry by Jonathan Law (Editor); Richard Rennie.

Encyclopedia of Chemistry by Don Rittner; Ronald A.

e-Learning Source:

https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf

http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf

https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

https://www.stem.org.uk/resources/collection/3959/practical-chemistry

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3					3	2	2				2
CO2	3					2	3			2		2
CO3	-				3		2				2	2
CO4	3				1	2	3		1		1	2
CO5	3					3	2	2			1	2

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

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS371	**Title of the Course**	Immunology And Toxicology	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	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 general and advanced features of the Vertebrate Immune system. The students will also acquire the knowledge about the toxic effects of xenobiotics on the environment and individuals.						

Course Outcomes	
CO1	Learn about the basic features of vertebrate immune systems, types of immune cells, innate and adaptive immune responses.
CO2	The students will get an in-depth knowledge of antibody types and its various applications in diagnostics and health care.
CO3	The students will learn about the Major Histocompatibility complex and complement system. They will also be able to understand its role in immune defenses.
CO4	The expected outcome is to provide the students an in-depth understanding of the effects of exposure to toxicants. They will also learn about tests that are available to determine the toxicity of a compound.
CO5	The students will learn about the biochemical and physiological effects of xenobiotics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Overview of Immune System, Innate and Adaptive Immunity	Cardinal features of vertebrate immune system, Hematopoiesis, Cells and organs of the Immune system. Anatomical barriers, Inflammation, Cell and molecules involved in innate Immunity, Adaptive Immunity (Cell-mediated and Humoral)	8	CO1
2	Antigens and Immunoglobulins	Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions (Precipitation reactions, Agglutination reactions, Immunofluorescence and ELISA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.	8	CO2
3	Major Histocompatibility Complex and Complement system	Structure and functions of MHC molecules (MHC I and II), Endogenous and exogenous pathways of antigen processing and presentation, Components and pathways of complement activation, Biological consequences of complement activation	8	CO3
4	Exposure of toxicants	Different routes/methods of exposure, Frequency & duration of exposure Human exposure Dose-response relationship. Selective toxicity: Concept, Significance, Basic mechanisms of selective toxicity. Toxicity Tests: Bioassay, Acute toxicity tests for terrestrial and aquatic animals, Chronic toxicity tests, Concept of Maximum Acceptable Toxicant Concentration (MATC) and safe concentration. Factors affecting toxicity: Factors related to the chemical exposure; surrounding medium and the organisms	8	CO4
5	Toxic effects of Xenobiotics	Local and systemic effects, Immediate and delayed effects Reversible and irreversible effects, Biochemical and physiological effects of xenobiotics, Nanotoxicology Toxicogenomics, Bioaccumulation of Xenobiotics- Concept of bioconcentration & Bioaccumulation and biomagnifications, Bioconcentration factor, Biotransformation of Xenobiotics, Safety evaluation of xenobiotics, Antidotal therapy	8	CO5

Reference Books:

1. Kuby Immunology by J.A. Owen, J. Punt , S.A. Stranford. 7th edition. WH Freeman. 2013
2. Cellular and Molecular Immunology by A.K. Abbas, A.H. Lichtman, S. Pillai. 9th edition. Saunders Elsevier. 2018
3. Janeway's Immunobiology by K. Murphy and W. Casey. 9th edition. Garland Science Publishing 2017. 4. Review of Medical Microbiology and Immunology by W.Levinson. 15thedition.Lange Publication. 2018. 5. Fundamental Immunology by W.E. Paul. 7th edition. Lippincott Williams and Wilkins. 2013
4. Roitt's Essential Immunology by P.J. Delves, S.J. Martin, D.R. Burton, I.M. Roitt. 13th edition. Blackwell Publishing. 2017.

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

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

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

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	BS372	**Title of the Course**	Biology of Insecta and Pest management	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to have a firm foundation in the biology and ecology of insects and get to know about pest ecology.						

Course Outcomes	
CO1	General Features of Insects Distribution and Success of Insects on the Earth, Basis of Insect classification, Classification of Insects up to orders
CO2	External Features, Head – Eyes, Types of antennae, Mouth parts w.r.t. Feeding habits, Thorax- Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia.
CO3	Structure and physiology of Insect body systems - Integumentary, Digestive, Excretory, Circulatory, Respiratory, Endocrine, Reproductive and Nervous system, Sensory receptors, Growth and Metamorphosis
CO4	Definition and its ecology, Pest status,Features responsible for evolutionary success of Insect species, Factors responsible for achieving the status of pest, Economic injury level, Economic threshold, Action threshold, Pest spectrum, Pest complex, Carrying capacity, Secondary pest outbreak, Pest surveillance and Sampling.
CO5	The students will learn about the History, Different phases of pest control, Quarantine, Physical, Cultural, Chemical, Biological control, Genetic and Biotechnological methods of control. PheromonesProduction and their use in pest surveillance and management

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	General Features of Insects Distribution and Success of Insects on the Earth, Basis of Insect classification, Classification of Insects up to orders	8	CO1
2	General morphology of insects	External Features, Head – Eyes, Types of antennae, Mouth parts w.r.t. Feeding habits, Thorax- Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia.	8	CO2
3	Physiology of insects	Structure and physiology of Insect body systems - Integumentary, Digestive, Excretory, Circulatory, Respiratory, Endocrine, Reproductive and Nervous system, Sensory receptors, Growth and Metamorphosis	8	CO3
4	Pest	Definition and its ecology, Pest status,Features responsible for evolutionary success of Insect species, Factors responsible for achieving the status of pest, Economic injury level, Economic threshold, Action threshold, Pest spectrum, Pest complex, Carrying capacity, Secondary pest outbreak, Pest surveillance and Sampling.	8	CO4
5	Integrated pest management	The students will learn about the History, Different phases of pest control, Quarantine, Physical, Cultural, Chemical, Biological control, Genetic and Biotechnological methods of control. PheromonesProduction and their use in pest surveillance and management	8	CO5

Reference Books:

1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
2. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
3. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
4. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
5. Entomology & Pest Management, Pedigo, L. P.,Prentice Hall, New Jersey, USA

e-Learning Source:

https://drive.google.com/file/d/10mZ9xd1a9KpCyKSgWZg4twscU1f8E4l/view?usp=sharing

https://drive.google.com/file/d/1lyrJKOgYRnyzwOXXAGgVlRUyzO0GF54/view?usp=sharing

https://docs.google.com/document/d/1QYsLalw3yyuI_SsBq_wZcTv34aVwjs17/edit?usp=sharing&ouid=114812600151870954936&rtpof=true&sd=true

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BS373	**Title of the Course**	Soil Science and Plant Pathology	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	This course is designed to develop the understanding of basics of soil science and plant diseases.						

Course Outcomes	
CO1	Students will be able to have knowledge about soil, its components and soil formation.
CO2	Students will be able to understand basics of soil profile and its physical properties and chemical properties.
CO3	Students will have the knowledge of soil reaction, organic matter and Bio-fertilizers.
CO4	Students will be able to understand the concept of plant disease, their general types, host pathogen relationship and Plant disease resistance.
CO5	Students will have the knowledge of some representative plant diseases, their transmission, symptomatology and management.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Soil	Pedological and Edaphological concept and components of soil, Important soil forming minerals and rocks, weathering of rocks and minerals, Soil forming factors and processes.	8	CO.1
2	Development of soil profile	Physical properties of soil and their significance, Chemical properties of soil, cation and anion exchange phenomenon and their importance in agriculture. Soil air: Definition, composition and factors affecting the composition of soil air. Soil water: Retention potential, soil moisture constant, movement of soil water, Soil colloids- Nature, structure, properties, types, chemical composition and their importance.	8	CO.2
3	Soil's reaction	Factors controlling pH of soil and influence of soil reaction on availability of nutrients. Soil organic matter: composition and their maintenance in soil, humus formation and its importance in soil fertility management, Bio- fertilizers.	8	CO.3
4	Concept of plant disease	Definition and terms, Classification of plant diseases, Identification of Plant diseases: Koch's Postulates. Types of plant diseases. Introduction to Flor's hypothesis, disease triangle surveillance, disease epidemics and epidemiology, Host pathogen relationship; Plant immunity- innate and acquired Plant disease resistance.	8	CO.4
5	Plant diseases: transmission, symptoms and management	Bacterial blight of rice, Late blight of potato, Downy mildew of bajra (Green ear disease), White rust of crucifers, Rust and Loose smut of wheat, Tikka disease of groundnut, Red rot of sugarcane.	8	CO.5

Reference Books:

Soil Science: Brady

Soil Science and Ecology; P. D. Sharma

Plant Pathology; Mehrotra and Aneja

Plant Pathology; Ainsworth

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS202	**Title of the Course**	Biophysical Chemistry	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	This course is designed to develop the understanding of electromagnetic radiation, absorption spectrum, Beer's law and Lambert's law, Principle, working and applications of spectrophotometer, Chromatography and concept of partition coefficient and application of various chromatographic techniques, Centrifugation and Electrophoresis-Principles and applications, Importance of radioactivity in biological studies, 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, Van Der-Waals forces, Principles of thermodynamics.	8	CO1
2	Analytical techniques	Spectrophotometry and colorimetry, Spectroscopic techniques: UV-visible spectroscopy, NMR, IR, Fluorescence and atomic absorption spectroscopy, X-ray crystallography.	8	CO2
3	Chromatography	Paper, thin-layer, column, HPLC, GLC and molecular sieving	8	CO3
4	Centrifugation	Principles, types, instrumentation and applications. Electrophoresis: Principles and applications (PAGE and Agarose gel electrophoresis).	8	CO4
5	Radioactivity	Types, their importance in biological studies, measure of radioactivity, GM counters and Scintillation counting.	8	CO5

Reference Books:

Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.

Bliss, C.J.K (1967) Statistics in Biology, Vol. I c Graw Hill, New York.
.

Campbell R.C (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge.

Daniel (1999) Biostatistics (3rd Edition) Panima Publishing Corporation.

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS374	**Title of the Course**	Biological techniques and biostatistics	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The main objective of the course is to provide students the knowledge about various biological techniques and their applications. Students will also know about biostatistics and its importance in data analysis.						

Course Outcomes	
CO1	Understand the basics of different types of microscopy, their principles and applications.
CO2	Gain knowledge about Principles, types, instrumentation and application of various instruments used in laboratories.
CO3	Develop understanding about the concepts of Electrophoretic and chromatographic techniques.
CO4	Understand the concepts of sampling, measures of tendency and measures of dispersion.
CO5	Acquire knowledge about testing hypothesis, errors of inference and distribution-free test.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Principles of microscopy	Light microscopy, Fluorescence microscopy, Confocal microscopy, Transmission and Scanning electron microscopy.	8	CO1
2	Principles, types, instrumentation and application of instruments	pH Meter, Colorimeter, Microtome, Spectrophotometer and Centrifuge	8	CO2
3	Electrophoresis	Principles and applications (PAGE and Agarose gel electrophoresis), Principle and application of Paper chromatography: Column chromatography, HPLC, Molecular sieve chromatography; Affinity chromatography.	8	CO3
4	Sampling, Measures of central tendency	Arithmetic mean, mode, median, Measures of dispersion: Range, variance, standard deviation and standard error.	8	CO4
5	Overview of testing	Overview of testing of hypothesis, Errors of inference and distribution types, Distribution-free test - Chi-square test, G-test.	8	CO5

Reference Books:

Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.

Keith Wilson and John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.

Bliss, C.J.K (1967) Statistics in Biology, Vol. Ic Graw Hill, New York.

Campbell R.C (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge.

e-Learning Source:

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

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

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

Integral University, Lucknow

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

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

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Aseptic Techniques for Callus and suspension culture	Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokininis and Gibberellins). Callus and suspension	8	CO1
2	Haploid plant production	Haploid plant production: microspore and ovule culture, Organ Culture and their applications, Somatic Embryogenesis: Techniques and applications. Protoplast Culture, somatic hybridization, methods of protoplast fusion: chemical and electro fusion, practical application of somatic hybridization	8	CO2
3	Role of tissue culture & Techniques of transformation	Role of tissue culture in agriculture, horticulture and forestry, Transgenic plants, Technique of transformation: Agrobacteriummediated and physical methods (Microprojectile bombardment and electroporation).	8	CO3
4	Primary Culture	Primary Culture: Cell lines, and cloning, isolation and mechanical disaggregation of tissue, enzyme. Secondary Culture: transformed animal cells and continuous cell lines. Monolayer formation, Synchronization	8	CO4
5	Expression of Cloned proteins in animal cell	Expression of Cloned proteins in animal cell: Expression vector, over production and downstream processing of the expressed proteins, Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies, HAT selection	8	CO5

Reference Books:

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

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS331	**Title of the Course**	COMPUTATIONAL SCIENCES & BIOINFORMATICS	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The objective of this course is to provide basic knowledge of computer networking and internet working devices, fundamental concepts of Internet and web technologies, biological databases, algorithms and flowchart design, sequence alignment and data mining.						

Course Outcomes	
CO1	Know basics of Bioinformatics
CO2	Have knowledge of GenBank's, EMBL, DDBJ, Swissprot, PIR/NBRF, IG, GCG, FAST
CO3	Know about basics of Sequence Alignment
CO4	Utilize and configure computer peripheral devices, install and operate system and application software. Establish a small computer network and utilize resource sharing.
CO5	Design flowcharts, apply algorithms to solve problems and make use of biological databases. Design and develop a website with limited features. Have a strong foundation of knowledge about the structure of computer system.

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

Reference Books:

Reilly "Developing Bioinformatics computer skills".

J.F. Griffiths "An intro to generic Analysis"

Andreas D. Baxevanis "Bioinformatics: A practical Guide to the analysis of genes and proteins"

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

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

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

Integral University, Lucknow

Effective from Session:							
Course Code	CH317	**Title of the Course**	Chemistry of Polymers	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	The main objective of this course is to study the mechanism of polymer preparation, their processing techniques, commercialuses, identification techniques and preparation process of vinyl polymers, polyamides, polyesters, synthetic rubbers, cellulose and copolymer resins.						

Course Outcomes	
CO1	Student will be able to evaluate the different mechanisms of polymer preparation and their classification.
CO2	Student will be able explain various polymer reactions such as hydrolysis, acidolysis, crosslinking etc.
CO3	Understand the colligative properties of Polymers and evaluate the identification techniques such as NMR and FTIR of Polymers.
CO4	Understand the degradation and its types.
CO5	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubbers.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Polymer introduction	Basic concepts of polymer science, Classification of polymers, Average molecular weight and Molecular weight distribution. Polymerization: Mechanism and kinetics of: Free radical addition polymerization, Ionic addition polymerization, Coordination polymerization, Step growth polymerization.	8	CO1
2	Polymer reactions	Introduction; types- hydrolysis, acidolysis, addition, substitution,halogenation,hydrogenation, crosslinking, curing, (brief mechanism and usefulness of each reaction to be highlighted with examples).	8	CO2
3	Structure and properties	Thermal transitions, Crystallinity, Molecular weight characterization, Nuclear Magnetic Resonance (NMR) and Fourier Transform Infrared (FTIR) techniques.	8	CO3
4	Polymer degradation	Introduction, Types of degradation- thermal degradation, mechanical degradation, degradation by ultrasonic waves, photo degradation, degradation by high-energy radiation, oxidative degradation and hydrolytic degradation and biodegradation.	8	CO4
5	Synthesis, properties and applications	Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethylmethacrylate, Polyethene,Polybutadiene, Polyvinylidene, Polycarbonates, Polyesters, Polyurethanes, Phenolic polyesters, Polyamides, Polysulphones.	8	CO5

Reference Books:

Principles of polymer chemistry: A Ravve, 2nd Edition, Kluwer Academic publications

Polymer Science and technology: Joll. R. Fried, Prentice – Hall.

Principles of polymer systems: F. Rodriguez, Claude Cohen, C.K. Ober, L.A. Archer, Vth Edition, Taylor & Francis

Introduction to polymers: R.J. Young and P.A. Lovell, 2nd Edition, Netron Thornes publications

Polymer chemistry – an introduction, Malcolm D. Stevens, Oxford University press.

e-Learning Source:

https://www.youtube.com/watch?v=kMHYNuyKQ2Q&list=PLBAcrca02tZdHmbDFvnOA6ZYTJPnF5sMe

https://www.youtube.com/watch?v=Gzin6mP-tUM&list=PLLy_2iUCG87CbDZMn4eP_XT09XTJOVooJ

https://www.youtube.com/watch?v=68fF7Tnl0wE

https://www.youtube.com/watch?v=YZf5q-ICf8Y

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3					3	3	3	3	3	3	3
CO2	3					3	3	3	3	3	3	3
CO3	3		1			3	3	3	3	3	3	3
CO4	3		1			3	3	3	3	3	3	3
CO5	3		1			3	3	3	3	3	3	3

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

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

Integral University, Lucknow

Effective From Session: 2017-2018							
Course Code	CH309	**Title of the Course**	Chemical Process Industry	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	The main objective of this course is to study the composition, preparation, properties and uses of ammonia, nitric acid, phosphorus chemical, glass, cement, ceramics and refractories and their related toxic hazards on the health of consumer.						

Course Outcomes	
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.
CO3	Understand the composition of glass and their types, properties and uses.
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.
CO5	Understand the classification, properties and uses of ceramics and refractories and their respective characteristics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Synthetic nitrogen products	Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control,Hazards and safety and Effluent management.	8	CO1
2	Chloro – alkali industrial products	Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammoniumphosphate, superphosphate, triple superphosphate. Lime, gypsum, Silicon, calcium carbide.	8	CO2
3	Glass	Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.	8	CO3
4	Cement	Introduction, Composition, Types of cement, Portland cement; raw Materials, manufacture of Cement by wet & Dry process, Reaction in the Kiln, setting of cement, Testing & Uses of cement.	8	CO4
5	Ceramics and refractories	Introduction, Types of ceramics materials, properties and applications. Refractories, classification of refractories, characteristics of refractories materials, properties of refractories. Neutral refractories; Silicon carbide. Acid refractories; High Alumina refractories.	8	CO5

Reference Books:

Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.

Groggins P.M., Unit Process in Organic Synthesis, 5th edition, International student edition, Pubs: McGraw-Hill Book Co., New York, 1998.

Dryden's outlines of Chemical Technology, edited and revised by Gopala Rao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.

Industrial Chemistry B.K.Sharma, goel publishing house.

Chemical process industries N.R Nerris shreve.

Chemical process principales: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)

e-Learning Source:

https://encyclopedia2.thefreedictionary.com/chemical+process+industry

https://www.youtube.com/watch?v=RjZJjneJ5fk

https://www.chemicalprocessing.com/

https://www.britannica.com/science/phosphorus-chemical-element

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	3	2	3	2		1	1
CO2	3	2	3	2	1	3	2	3	2		1	1
CO3	3	2	3	2	1	3	2	3	2		2	1
CO4	3	2	3	2	1	3	2	3	2		1	1
CO5	3	2	3	2	1	3	2	2	2		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: 2017-2018							
Course Code	CH308	**Title of the Course**	Spectroscopic Techniques	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	Students able to understand the interaction of electromagnetic radiation with the materials, spectroscopic techniques like Ultraviolet, FT-IR, Nuclear Magnetic Resonance spectroscopy and mass spectrometry.						

Course Outcomes	
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry and atomic absorption spectrophotometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), Mclaffertyrearrangements.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	UV spectroscopy	Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated dienes and polyenes.	8	CO1
2	IR spectroscopy	Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.	8	CO2
3	NMR spectroscopy	Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling,, Interpretation of NMR spectra of some representative compounds.	8	CO3
4	Mass spectroscopy	Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters,acids, anhydrides), molecular ion peak, metastable peak, Mclafferty rearrangements, Nitrogen rule.	8	CO4
5	Atomic absorption spectrophotometry	Introduction, Principle, Instrumentation, Sample preparation, Internal standardand standard addition, calibration and applications of AAS.	8	CO5

Reference Books:

Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.

Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V Edition Tata Mc Grawhills

Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications.

Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.

Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication.

Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.

Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.

e-Learning Source:

https://www.youtube.com/watch?v=2Y8pSoS0d1g

http://www.infocobuild.com/education/audio-video-courses/chemistry/ApplicationOfSpectroscopicMethods-IIT-Madras/lecture-25.html

https://scrippslabs.com/summary-of-spectroscopic-techniques/

https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1	3	3	3	2		2	
CO2	3	2	2	2	1	3	3	3	2		2	
CO3	3	2	2	2	1	3	3	3	2		2	
CO4	3	2	2	2	1	3	3	3	2		2	
CO5	3	2	2	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: 2020-21							
Course Code	BS375	**Title of the Course**	Project and training	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	0	0	8	4
Pre-Requisite		**Co-requisite**					
Course Objectives	The main objective of this course is to acquaint the student with various techniques used in contemporary research in biotechnology or allied areas.						

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

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

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

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