Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B040101T/ BS166	**Title of the Course**	Microbiology & Plant Pathology	**L**	**T**	**P**	**C**
Year	**1**	**Semester**	1	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to foster a comprehensive grasp of fundamental concepts in microbiology, phycology, mycology, plant pathology, and diseases, with a focus on exploring methods for disease control and the practical applications of microbiology in various fields.						

Course Outcomes	
CO1	Students will be able to gain knowledge about ancient Indian botany and various microscopy techniques and other equipment used in the microbiology field.
CO2	Students will be able to develop a comprehensive understanding of the diverse world of microorganisms (bacteria and viruses), their structures, behaviors, and the economic significance.
CO3	Students will be able to explain classification and diversity of Algae and Fungi and their economic importance.
CO4	Students will be able to gain knowledge about mushroom cultivation, lichenology, mycorrhiza, and uses of microbes in various fields.
CO5	Students will be able to learn about plant-pathogen interaction, diseases from their initiation and progression to the various defense mechanisms employed by plants and the methods used for disease control.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**A. Botanical Legacies: Ancient India to Modern Science** **B. Microbial Techniques & Instrumentation**	**A**. Introduction to Indian ancient, Vedic and heritage Botany and contribution of Indian Botanists (in all branches), in context with the holistic development of modern science and technology, has to be taught, practiced and assessed via class interaction/ assignments / self-study mentioned under Continuous Internal Evaluation (CIE). **B.** Microscopy – Elementary knowledge of Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy. Common equipment of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge. spectrophotometer, fermenters.	6	CO1
2	**Microbial world**	Eukaryotic and prokaryotic cells, Gram positive and Gram-negative bacteria, Structure of a bacteria, Bacterial Growth curve, factors affecting growth of microbes; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Sporulation and reproduction in bacteria. Viruses, general characteristics, Structure of viruses: Structure of T4; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma.	8	CO2
3	**Phycology**	Range of thallus organization in Algae, Pigments, Reserve food –Reproduction, Classification and life cycle of –Chlorella, Oedogonium, Chara, Polysiphonia. Economic importance of algae - Role of algae in soil fertility- biofertilizer; Commercial products of algae –biofuel, Agar.	8	CO3
4	**Mycology**	General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. General characters of Mastigomycotina: Synchytrium, Zygomycotina: Rhizopus, Ascomycotina: Saccharomyces Basidiomycotina: Puccinia, Agaricus; Deuteromycotina: Alternaria. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality,	8	CO3
5	**Mushroom Cultivation, Lichenology & Mycorrhiza**	Mushroom cultivation. General account of lichens, reproduction, and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.	6	CO4
6	**Plant Pathology**	Disease concept, Symptoms, Disease cycle, Primary and secondary inoculum, Pathogenicity and pathogenesis, Koch's Postulates. Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post-penetration), Defense mechanism with special reference to Phytoalexin, Resistance- Systemic acquired and induced systemic.	8	CO5
7	**Diseases and Control**	Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late Blight of Potato, Black Stem Rust of Wheat, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco, Citrus Canker, Little leaf of brinjal, Damping off seedlings; Disease management: Quarantine, Chemical, Biological, Integrated pest disease management.	8	CO5
8	**Applied Microbiology**	Food fermentations and food produced by microbes, microbial products, Production of antibiotics, alcoholic beverages & genetic recombinant vaccines. Biofertilizers and Plant growth promoting rhizobacteria & biopesticides, Microbiology of water, Single cell proteins, bioploymers, bioindicators, biosensors, bioremediation.	8	CO4

Reference Books:

1. Hardy G and Totelin L (2015) Ancient Botany (Sciences of Antiquity)
2. Pelczar Jr. MJ, Chan ECS, Krieg NR (1993). Microbiology – Mc Graw Hill. Inc, New York
3. Fritsch F. B 1945, Structure and Reproduction of Algae Vol.I & II.Cambridge University Press.
4. Singh V., Pandey P.C and Jain D.K 1998, A Textbook of Botany for Undergraduate

5.	Vashishta B. R 1990, Botany for Degree Students, Vol 1,2 and 3. S.Chand & Co.
6.	Alexopoulos C.J & MIMS C.V 1988. Introductory Mycology, John Wiley & Sons.
7.	Agriose, G.N. (2005). Plant Pathology, 5th edition Academic Press, Inc., Ainsworth, G.C. and Sussman, A.A. (Eds).
8.	Mehrotra R.S. (1983) Plant Pathology, Tata-McGraw-Hill Education

e-Learning Source:

Unit IA

i. https://indianculture.gov.in/rarebooks/economic-botany-india

https://www.infinityfoundation.com/mandala/t_es/t_es_tiwar_botany_frameset.htm

ii.https://www.researchgate.net/publication/335715457_Ancient_Indian_rishi's_Sages_knowledge_of_botany_and_medicinal_plants_since_Vedic_period_was_much_older_than_the_period_of_Theophrastus_A_case_study-_who_was_the_actual_father_of_botany

iii. https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India

iv. https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17_2_17_PKBhattacharyya.pdf

v. http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis_info/botany_history.pdf

vi. https://www.plantsdiseases.com/p/symptoms.html

vii. https://www.plantsdiseases.com/p/pathogenic-diseases-in-plants.html

Other Units

http://egyankosh.ac.in/handle/123456789/53530

https://www.onlinebiologynotes.com/algae-general-characteristics-classification/

http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293

	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	2	3	
CO2	3	1					1	2	2		
CO3	3	1					1	2	2	3	
CO4	3	1				2	1	2	2	3	
CO5	3	1					1	2	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: 2024-25							
Course Code	B040102P/ BS167	**Title of the Course**	Techniques in Microbiology & Plant Pathology	**L**	**T**	**P**	**C**
Year	**1**	**Semester**	1	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	This course is designed to make students well acquainted with techniques in microbiology and plant pathology.						

Course Outcomes	
CO1	Students will be able to understand the instruments, techniques, lab etiquettes and good lab practices for working in a microbiology laboratory.
CO2	Students will develop skills for identification, and culturing of bacteria
CO3	Students will learn to identify Fungi, Lichens and Algae.
CO4	Students will be able to identify different plant diseases, stages in the life cycle of Puccinia.
CO5	Students will be able to isolate lactic acid bacteria from curd. Additionally, they will learn to produce hydrolytic enzymes from immobilized bacterial cells and conduct enzymatic assays for amylase.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Experiment 1**	• Study of laboratory safety and good laboratory practices • Study of principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pH meter • To carry out the procedure of buffer preparation & titration • To learn the cleaning and sterilization techniques of glass wares • To identify bacteria. • To learn technique of Gram's staining • To study the cultural characteristics of bacteria on NA.	20	CO1 & CO2
2	**Experiment 2**	• To identify fungi by lactophenol cotton blue method. • To study the specimens of button stage and full-grown mushrooms • To study specimens of crustose, foliose, and fruticose lichens. • To study algae: Volvox, Chara, Polysiphonia	15	CO3
3	**Experiment 3**	• Preparation of fungal media (PDA) & Sterilization process. • Identification: Pathological specimens of a bacterial and viral disease. • Slides of uredial, telial, pycnial & aecial stages of Puccinia • Isolation of phyllosphere microflora	15	CO4
4	**Experiment 4**	• Isolation of lactic acid bacteria from curd • Immobilized bacterial cells for production of hydrolytic enzymes. • Enzyme assay of amylase	10	CO5

Reference Books:

1. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Aneja K.R. Bergey 's Manual of Determinative Bacteriology
3. Cappuccino, J. C. and Sherman, N. (1992). Microbiology: A laboratory manual, Addison Wesley Pub. Co
4. Benson HJ (1994). Microbiological Applications, WmC Brown Publishers, Oxford.
5. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

e-Learning Source:

https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf

http://nhb.gov.in/pdf/Cultivation.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
CO1	3	1	1	2		1	1	2	2	2	
CO2	3	1				1	2	2	2	2	
CO3	3	1				1	1	2	2	2	
CO4	3	1				2	1	2	2	3	
CO5	3	1				1	2	2	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: 2024-25							
Course Code	B040103V/ BS168	**Title of the Course**	Biofertilizer Technology	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**2**	**1**	**0**	**3**
Pre-Requisite	10+2biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of general characters, types and application of biofertilizers						

Course Outcomes	
CO1	Know the types and formulation of biofertilizers.
CO2	Understand the basics and types of algal biofertilizers
CO3	Study the cyanobacterial biofertilizers
CO4	To be familiar with mycorrhizal biofertilizers
CO5	Understand the concept of organic farming

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	General account of biofertilizers	General account about the microbes used as biofertilizer – *Rhizobium* – isolation, identification, mass multiplication, carrier-based inoculants, Actinorrhizal symbiosis. Study of *Rhizobium* nodules in roots.	**6**	**CO1**
2	Algal biofertilizers	*Azospirillum*: isolation and mass multiplication – carrier-based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance, and mass multiplication. Production of carrier based biofertilizer formulation (demo).	**8**	**CO2**
3	Cyanobacterial biofertilizers	Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation. Survey of commercial biofertilizers and their active components.	**8**	**CO3**
4	Mycorrhizal biofertilizers	Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth, and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants. Examination of VAM in roots.	**6**	**CO4**
5	Organic farming	Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. Visit/virtual visit to any organic farm /biocomposting unit.	**8**	**CO5**

Reference Books:

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi. 6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

e-Learning Source:

https://vlab.amrita.edu/?sub=3&brch=73

https://www.youtube.com/watch?v=O1FfEbpaiHw

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

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

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

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B050101T/ BS164	**Title of the Course**	Cytology, Genetics, and Infectious Diseases	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of structure and functions of cell organelles nucleus and chromatin structure, cell cycle, cell division and cell signalling, mendelism and sex determination, extensions of mendelism, genes and environment, human chromosomes and patterns of inheritance, and infectious diseases.						

Course Outcomes	
CO1	Understand the structure and function of cell organelles.
CO2	Understand the basics of chromatin structure and its location, cell cycle and cell signaling.
CO3	Understand the basic principles of genetics, Mendel's laws and the deviations from conventional patterns of inheritance, and to comprehend how the environment plays an important role by interacting with genetic factors.
CO4	Understand how to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families.
CO5	Understand the mechanisms of pathogenic infection in humans.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Structure and Functions of cell organelles-I	Plasma membrane: chemical structure—lipids and proteins, Cell-cell interaction: cell adhesion molecules, cellular junctions. Endomembrane system: protein targeting and sorting, endocytosis, exocytosis. Introduction to national and international Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences.	**8**	**CO1**
2	Structure and Function of Cell Organelles II	Cytoskeleton: microtubules, microfilaments, intermediate filaments. Mitochondria: Structure, oxidative phosphorylation. Peroxisome and ribosome: structure and function.	**6**	**CO1**
3	Nucleus and Chromatin Structure	Structure and function of nucleus in eukaryotes. Chemical structure and base composition of DNA and RNA. Chromatin organization: structure of Chromosomes. Types of DNA and RNA	**8**	**CO2**
4	Cell cycle, Cell Division and Cell Signalling	Cell division: mitosis and meiosis. Cell cycle and its regulation, apoptosis. Signal transduction: intracellular signalling and cell surface receptors, via G-protein linked receptors.	**8**	**CO2**
5	Mendelism and Sex Determination	Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses. Complete and Incomplete Dominance, Penetrance and expressivity. Sex Determination: XX/XY, XX/XO, ZW/ZZ, & ZW/ZO sex-determination system. Sex-linked characteristics and Dosage compensation.	**6**	**CO3**
6	Extensions of Mendelism, Genes and Environment	Extensions of Mendelism: Multiple Alleles, Gene Interaction. The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics. Cytoplasmic Inheritance, Genetic Maternal Effects. Interaction Between Genes and Environment: Environmental Effects on Gene Expression.	**8**	**CO3**
7	Human Chromosomes and Patterns of Inheritance	Chromosomal anomalies: Structural and numerical aberrations with examples. Pedigree analysis. Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant	**8**	**CO4**
8	Infectious Diseases	Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms. Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: Trypanosoma and Giardia.	**8**	**CO5**

Reference Books:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

e-Learning Source:

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: 2024-25							
Course Code	B050102P/ BS165	**Title of the Course**	Cell Biology & Cytogenetics Lab	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to train the students in basic experiments of cytogenetics.						

Course Outcomes	
CO1	At the completion of the course students will learn Hands-on to use simple and compound microscopes.
CO2	The students will be able to prepare slides and stain them to see the cell organelles.
CO3	The students will be familiar with the basic principle of life, how a cell divides leading to the growth of organism and reproduces to form new organisms.
CO4	The students will be able to identify the chromosomal aberrations by preparing karyotypes.
CO5	The students will be able to learn how chromosomal aberrations are inherited in humans by pedigree analysis in families.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Experiment 1**	a. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue. b. To check the permeability of cells using salt solution of different concentrations.	15	CO1
2	**Experiment 2**	a. To study the different stages of Mitosis in root tip of onion. b. To study the different stages of Meiosis in grasshopper testis.	15	CO2
3	**Experiment 3**	a. Study of parasites (eg. Protozoans, helminths etc.) from permanent slides. b. To learn the procedures for preparation of temporary and permanent stained/unstained slides. c. Study of mutant phenotypes of *Drosophila.* d. Preparation of polytene chromosomes.	15	CO3 & CO4
4	**Experiment 4**	a. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human). b. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided. c. To prepare family pedigrees.	15	CO5

Reference Books:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).

2. Alberts et al: Molecular Biology of the Cell: Garland (2002).

3. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

e-Learning Source:

https://www.vlab.co.in
https://zoologysan.blogspot.com
www.vlab.iitb.ac.in/vlab
www.onlinelabs.in
www.powershow.com
https://vlab.amrita.edu
https://sites.dartmouth.edu

	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									
CO2	3	1					1				
CO3	3	1					1				

CO4	3	1					1				
CO5	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: 2024-25							
Course Code	B11010V/BS144	**Title of the Course**	Biomolecules and nutrition	**L**	**T**	**P**	**C**
Year	1	**Semester**	I	**2**	**0**	**1**	**3**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	**The objective of this course is to develop an understanding of basics of Biomolecules structure and function, role of nutrients in human health.**						

Course Outcomes	
CO1	Develop an understanding of general properties, classification and nomenclature of biomolecules.
CO2	Develop an understanding about importance of food and nutrition.
CO3	Develop an understanding of macronutrients.
CO4	Develop an understanding about micronutrients.
CO5	Develop an understanding of nutritional deficiency diseases.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Biomolecules general aspects**	Theory: Biomolecules general aspects: carbohydrates, proteins, fats, vitamins and minerals. Practical: Tests for carbohydrates.	8	**CO1**
2	**Overview of Food and Nutrition**	Theory: Overview of Food and Nutrition- Classification of food and nutrients, Importance of dietary fibers, Malnutrition, Food Commodities (Cereal millets, pulses, milk & milk products, meat, fish, poultry, fruits & vegetables, fats & oils, beverages). Practical: Tests for proteins & amino acids.	8	**CO2**
3	**Role of macronutrients in nutrition:**	Theory: Role of macronutrients in nutrition- Physiological roles of Carbohydrates, Protein, Lipids. Practical: Virtual labs on quantification of macronutrients	8	**CO3**
4	**Role of micronutrients**	Theory: Role of micronutrients in nutrition- Biochemical and physiological role of Vitamins & Minerals, Bioavailability & Requirements. Practical: Calculation of BMR	8	**CO4**
5	**Nutritional Deficiency Diseases**	Theory: Nutritional Deficiency Diseases- excess and deficiency of vitamins. Source, deficiency and excess of trace elements such as calcium, sodium, potassium, phosphorus, iron, iodine. Practical: Case studies on nutritional deficiency diseases.	8	**CO5**

Reference Books:

Srilakshmi B (2018): Food Science, 7th Colour Ed. New Age International (P) Ltd.

Mann J and TruswellS (2017) : Essentials of Human Nutrition, 5th Ed. Oxford University Press.

SrilakshmiB (2017): Nutrition Science,6th Multicolour Ed. New Age International (P) Ltd.

e-Learning Source:

www.coursera.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1					1	2					
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: 2024-25							
Course Code	B040201T/ BS177	**Title of the Course**	Archegoniates and Plant Architecture	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	This course aims to identify, classify, and explore the morphology, anatomy, and life cycles of bryophytes, pteridophytes, and gymnosperms, emphasizing their economic importance. Additionally, this course also covers the essential topics like elementary paleobotany, the geological time scale, angiosperm morphology, plant anatomy, reproductive botany, and palynology.						

Course Outcomes	
CO1	Students will be able to classify and develop critical understanding on morphology, anatomy, reproduction, and economic importance of bryophytes
CO2	Students will be able to classify and develop critical understanding of morphology, anatomy, reproduction, and economic importance of pteridophytes
CO3	Students will be able to classify and to learn general characters of gymnosperms (morphology, anatomy, reproduction, and economic importance) and elementary paleobotany and evolution of plants.
CO4	Students will be able to gain knowledge about external and internal structures of flowering plants.
CO5	Students will be able to learn about the basics of reproductive biology of plants and fundamentals and applied aspects of palynology.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Archegoniates & Bryophytes**	Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy, and reproduction of Marchantia and Sphagnum (Developmental details not to be included), economic importance of bryophytes.	7	CO1
2	**Pteridophytes**	General characteristics, Classification (up to family), life cycle of pteridophytes with special reference to *Pteris*, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	8	CO2
3	**Gymnosperms**	Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, Morphology, anatomy, and reproduction in *Cycas*; economic importance	8	CO3
4	**Paleobotany**	General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale. Brief account of process of fossilization & types of fossils and study techniques; Contribution of Birbal Sahni	8	CO3
5	**Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence)**	Morphology and modifications of roots, stem, and leaf. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds.	7	CO4
6	**Plant Anatomy**	Meristematic and permanent tissues, Organs (root, stem, and leaf). Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica-Corpus theory. Secondary growth - Root and stem- cambium (structure and function) annular rings, Anomalous secondary growth in dicot stem: Boerhaavia and monocot stem: Dracaena.	7	CO4
7	**Reproductive Botany**	Plant Embryology, Structure of microsporangium, microsporogenesis, Structure of megasporangium and its types, megasporogenesis, Structure and types of female gametophyte, types of pollination, Methods of pollination, Germination of pollen grain, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	8	CO5
8	**Palynology**	Pollen structure, pollen morphology, pollen allergy, Applied Palynology: Basic concepts, Forensic palynology, Role in taxonomic evidence.	7	CO5

Reference Books:

1. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
2. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand & Co.
3. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and Company
4. Singh V., Pandey P.C and Jain D.K (1998) A Textbook of Botany for Undergraduate
5. Vashishta B. R .1990, Botany for Degree Students, Vol 1,2 and 3. S.Chand & Co.
6. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
7. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House,.
8. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
9. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

e-Learning Source:

https://www.anbg.gov.au/bryophyte/what-is-bryophyte.html
https://pteridoportal.org/portal/index.php
https://www.conifers.org/zz/gymnosperms.php
https://palynology.org/
https://www.sciencelearn.org.nz/resources/100-plant-reproduction
https://palaeobotany.org/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1				1	1	2	2	2	1
CO2	3	1				1	1	2	2	2	1
CO3	3	1				1	1	2	2	2	1
CO4	3	1				1	1	2	2	2	1
CO5	3	1				1	1	2	2	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: 2024-25							
Course Code	B040202P/ BS178	**Title of the Course**	Land Plant Architecture	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	II	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	**The objective of this course is to develop the understanding of morphology, anatomy, reproduction, and economic importance of bryophytes, pteridophytes, gymnosperms and angiosperms.**						

Course Outcomes	
CO1	Students will be able to classify and develop critical understanding on morphology, anatomy, and reproduction of bryophytes
CO2	Students will be able to classify and develop critical understanding of morphology, anatomy and reproduction of pteridophytes
CO3	Students will be able to classify and to learn general characters of gymnosperms (morphology, anatomy, reproduction, and economic importance) and elementary paleobotany and evolution of plants.
CO4	Students will be able to gain knowledge about external and internal structures of flowering plants.
CO5	Students will be able to learn about the basics of reproductive biology of plants and fundamentals and applied aspects of palynology.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Experiment 1**	Marchantia- morphology of thallus, W.M. rhizoids and scales, V.S. thallus through Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanent slides). Study of habit of ferns, T.S. of leaf, rhizome, W.M. of sori.	15	CO1 & CO2
2	**Experiment 2**	a. Cycas – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and Rachis, micro and megasporophyll, V. S of male cone and female cone, T. S. of entire microsporophyll and V. S. of ovule; Pinus - Branch of indefinite growth, spur shoot, T. S of needle. b. Visit Birbal Sahni Institute of Palaeosciences or a virtual conference with their scientists to learn about fossilization. c. Mark and know about Indian geographical sites rich in plant fossils.	15	CO3
3	**Experiment 3**	a. Study of diversity in leaf shape, size, and other foliar features (preparation of herbarium) b. Study of morphology of Fruits; Flowers- study of different types from fresh/ preserved specimens c. Study of modifications in Roots, stems and leaves d. Study of normal & anomalous secondary thickening – *Dracaena*/ *Boerhaavia diffusa* e. Study of T.S. of stem, leaf and stomata of monocot and dicot.	15	CO4
4	**Experiment 4**	a. Structure of anther and pollen grains b. Study of different stages of embryo development in dicots. c. Vegetative propagation by means of cutting, budding and grafting exercises. d. Study of seed germination.	15	CO5

Reference Books:

1. Bendre and Kumar, A textbook of Practical Botany. Vol I, II., Rastogi Pub. Meerut.
2. James Bidlack, Shelley Jansky, Kingsley R Stern. Laboratory Manual for Stern's Introductory Plant Biology.
3. Santra SC and Chatterjee. 2005. College Botany Practical Vol. I. New Central Book Agency (P) Ltd.
4. Pandey, BP; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.

e-Learning Source:

http://arnoldia.arboretum.harvard.edu/pdf/articles/1977-37-1-propagation-manual-of-selected-gymnosperms.p

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

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

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

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B050203V/ BS179	**Title of the Course**	Apiculture	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**2**	**1**	**0**	**3**
Pre-Requisite	10+2biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of honey bee and its culture.						

Course Outcomes	
CO1	Know the history of beekeeping
CO2	Understand the Honey Bee morphology, Anatomy and Life cycle
CO3	Study the honeybee enemies and diseases
CO4	To be familiar with beekeeping: tools and equipment
CO5	Understand the honey processing and bee hive products

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Apiculture - scope, importance	History of beekeeping: Definition, Beekeeping worldwide and In India. Traditional beekeeping, Modern beekeeping, Urban or backyard beekeeping. Role of Central Honey Bee Research & Training Institute	**6**	**CO1**
2	Honey Bee morphology, Anatomy and Life cycle	Classification and morphology of Honey bees, Types of honey bees- indigenous, exotic, Species of honey bees. Social organization in honey bees: Colony life and social organization – Queen, drone, worker.	**8**	**CO2**
3	Honeybee Enemies and Diseases	Bee enemies – Enemy: Mites, Wax Moths, Ants, Bee Eaters, Garden Lizards, Bears Disease management – Identification, Preventive and control measures of the diseases.	**8**	**CO3**
4	Beekeeping: Tools and Equipment	Basic requirements for beekeeping start up BIS standard Tools used in apiculture. Introduction to types of bee boxes and Their Parts	**6**	**CO4**
5	Bee Economy	Honey extraction & handling - Quality control standards. Products of Apiculture Industry and its Uses: Honey, Bees Wax, Propolis, etc Visit/virtual visit to any apiculturist/unit/farm	**8**	**CO5**

Reference Books:

1. Gupta, J.K., Sharma, H K and Thakur, R K. 2009. Practical Manual on Beekeeping.Department of Entomology and Apiculture, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan,

2. Gatoria, G.S., Gupta, J. K., Thakur, R.K. and Singh, J. 2011. Mass queen bee rearing and multiplication of honey bee colonies. All India Co-ordinated project on honey bees and pollinators, ICAR, HAU, Hisar

3. Graham, J M (1992) The hive and the honey bee. Dadant and Sons, Hamilton, IIlinois.

4. Mishra R.C. (1995) Honey bees and their management in India. ICAR Publication, New Delhi.

5. Singh, S. (1971) Beekeeping in India, ICAR publication.

e-Learning Source:

https://www.google.com/search?q=apiculture+virtual+ab&sourceid=ie7&rls=com.microsoft:en-US&ie=utf8&oe=utf8#fpstate=ive&vld=cid:a2dd87e2,vid:K6-Jv2iRAKU,st:602

https://www.youtube.com/watch?v=xVl3frJRdc4

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

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

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

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B050201T/ BS175	**Title of the Course**	Biochemistry and Physiology	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of basics of structure, functions and metabolism of biomolecules and fundamental knowledge of animal physiology.						

Course Outcomes	
CO1	To understand the structure function of carbohydrate, lipid and about enzyme catalyzed reaction.
CO2	To understand the basics of metabolism of carbohydrates and catabolism of amino acid and nucleotide.
CO3	To understand the structure, process and regulation of digestion, absorption, and respiratory system.
CO4	To understand blood and cardiovascular system, excretion and osmoregulation.
CO5	To comprehend the regulatory mechanisms for maintenance of function in the body.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Structure and Function of Biomolecules**	Classification, Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides), Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids), Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins, Simple and conjugate proteins.	**8**	**CO1**
2	**Enzyme Action and Regulation**	Classification of enzymes; Mechanism of enzyme action, Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Enzyme inhibition, Allosteric enzymes.	**8**	**CO1**
3	**Metabolism of Carbohydrates and Lipids**	Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, Glycogenolysis and Glycogenesis Lipids: Biosynthesis of palmitic acid, β-oxidation.	**8**	**CO2**
4	**Metabolism of Proteins and Nucleotides**	Catabolism of amino acids: Transamination, Deamination, Urea cycle**,** Nucleotides, Review of mitochondrial respiratory chain, Oxidative phosphorylation.	**6**	**CO2**
5	**Digestion and Respiration**	Structural organization and functions of gastrointestinal tract and associated glands, Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins. Histology of trachea and lung, Mechanism of respiration, Transport of oxygen and carbon dioxide in blood Respiratory pigments, Chloride shift, Dissociation curves and the factors influencing it.	**8**	**CO3**
6	**Circulation and Excretion**	Components of blood and their functions, Blood groups: ABO and Rh factor, Structure of mammalian heart, Cardiac cycle; Structure of kidney and its functional unit; Mechanism of urine formation.	**7**	**CO4**
7	**Nervous System and Endocrinology**	Structure of neuron, resting membrane potential, Origin of action potential and its propagation across nerve fibres. Types of synapses. Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them Classification of hormones; Mechanism of Hormone action.	**8**	**CO5**
8	**Muscular System**	Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction.	**7**	**CO5**

Reference Books:

Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)

Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)

Introduction to Physiology by Davidson H and Segal M.B. Academic Press

Fox S I – Human Physiology, (McGraw Hill, 1998, ISBN: 0071157069)

Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988.

e-Learning Source:

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

CO5	3	1	..	..	..	..	2	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: 2024-25							
Course Code	B050202P/BS176	**Title of the Course**	Physiological, Biochemical & Hematology Lab	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to train the students in basic understanding of medical diagnostics & public health.						

Course Outcomes	
CO1	The students will be able to qualitatively analyze about the biomolecules
CO2	The students will be able toperform basic hematological tests
CO3	The students will be able toperform basic hematological laboratory tests
CO4	The students will be able to distinguish between normal and abnormal cellsto predict the diagnosis ofhematological disorders and diseases.
CO5	The students will be able to perform blood cell counting using haemocytometer

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Experiment 1**	a. Ninhydrin test for α-amino acids b. Benedict's test for reducing sugar and iodine test for starch	15	CO-1
2	**Experiment 2**	a. Action of salivary amylase under optimum conditions b. Qualitative tests of functional group in carbohydrates, proteins and lipids	15	CO-1
3	**Experiment 3**	a. Recording of blood pressure and glucose level by using a sphygmomanometer and glucometer, respectively b. To study different mammalian blood cell types using Leishman stain.	15	CO2 & CO3
4	**Experiment 4**	a. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal,Thyroid and Parathyroid b. Counting of RBCs and WBCs using Haemocytometer	15	CO4 & CO5

Reference Books:

1. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
2. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
3. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. HeritagePublishers, New Delhi

e-Learning Source:

1. https://www.vlab.co.in
2. https://zoologysan.blogspot.com
3. www.vlab.iitb.ac.in/vlab
4. www.onlinelabs.in
5. www.powershow.com
6. https://vlab.amrita.edu
7. https://sites.dartmouth.edu

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BS263	**Title of the Course**	Chordata "Agnatha to Mammals"	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The students will acquire the knowledge about the classification of various classes of vertebrates i.e. Pisces, Reptiles, Aves and Mammals.						

Course Outcomes	
CO1	General features of living Agnatha and classification of cyclostome, General features of pisces and classification, fish migration, osmoregulation and locomotion.
CO2	General features and classification of amphibia, parental care, pedogenesis.
CO3	General features and classification of reptiles, poisonous and non-poisonous snakes
CO4	General features and classification of birds, migration, flight adaptations.
CO5	General features and classification of mammals, monotremata, aquatic mammals.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Agnatha	General features of living Agnatha and classification of cyclostomes up to classes; Pisces: General features and Classification (up to orders) with examples; Osmoregulation, locomotion and migration in Fishes.	8	CO1
2	Amphibia	General characters and classification of different classes of Amphibia (upto orders) with examples; Origin of tetrapods, parental care, paedomorphosis.	8	CO2
3	Reptiles	General characters and Classification up to orders; Origin of reptiles, Poisonous and non-poisonous snakes, Biting mechanism in snakes.	8	CO3
4	Aves	General features and Classification up to orders; Origin of birds, Flight adaptations and migration in birds.	8	CO4
5	Mammals	General characters and classification upto orders; general features of egg laying mammals, pouched-mammals and aquatic mammals, Origin of mammals.	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.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1				1	2		3	3	1	
CO2	3	1				1	2		3	3	1	
CO3	3	1				1	2		3	3	1	
CO4	3	1				1	2		3	3	1	
CO5	3	1				1	2		3	3	1	

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

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

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	CH221	**Title of the Course**	Inorganic and Physical Chemistry-I	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	1	0	3
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	This course aims to provide fundamental knowledge of elements of block s and p, noble gas chemistry, heat, and thermodynamics. This course would play a significant role in higher studies.						

Course Outcomes	
CO1	Explain the properties of alkali and alkaline earth metals, and their oxides, hydrides etc. Diagonal relationship
CO2	Discuss the structure of diborane, Lewis acid nature of boron trihalides, preparation of carbides & silicones, preparation & industrial applications of nitride, hydrazine & hydroxylamine.
CO3	Explain types of oxides and oxyacids, their structure and of inter-halogen compounds, pseudo halogens & clatherate compounds
CO4	Use thermochemical equations to relate the amount of heat energy transferred in reactions in reactions at constant pressure (ΔH) to the amount of substance involved in the reaction
CO5	Demonstrate understanding of key concepts related to the second law of thermodynamics, including alternative statements of the second law, the internally reversible process, and the Kelvin temperature scale

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Chemistry of s Block Elements**	General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water. solvation and complex formation by S- block.	7	CO1
2	**Chemistry of p Block Elements**	Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like oxides, oxyacids and of group 13-16, hydrides of boron-diborane and higher boranes, borazine, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.	7	CO2
3	**Chemistry of Noble Gasses**	Chemical properties of the noble gases, discovery of O^{2+} PtF^{6-} and O_2XeF_6.Chemistry of xenon, structure and bonding in xenon compounds.	7	CO3
4	**Thermochemistry**	Standard state, standard enthalpy of formation – Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy,Kirchhoff's equation.	7	CO4
5	**Second Law of Thermodynamics**	Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature. Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium. Gibbs and Helmholtz functions: Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities.	7	CO5

Reference Books:

Lee, J.D. Concise Inorganic Chemistry, Pearson Education.

Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles ofStructure and Reactivity, Pearson Education 2006.

Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry,Oxford, 1970.

Castellan, G. W. Physical Chemistry, Published by Narosa.

Physical Chemistry, Puri Sharma &Pathania. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press

e-Learning Source:

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101090/lec1.pdf

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106096/lec9.pdf

https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
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 flowering plants: 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/
2. 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	PO8	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			

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS113	**Title of the Course**	Fundamentals of Microbiology	**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 develop the understanding of basics of microbiology, classification of microbes, control of microorganisms, microbes in extreme environments and microbial interactions and basics of Recombination in Prokaryotes.						

Course Outcomes	
CO1	Know the basics of microbiology.
CO2	Have knowledge of the general classification of microbes.
CO3	Understand basics of Control of Microorganisms.
CO4	Study bacteriophages and microbes in extreme environments and microbial interactions.
CO5	Know the basics of recombination in Prokaryotes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	History and classification of microbiology	History and classification of microbiology: Pasteur's experiments, Various forms of microorganisms (bacteria, fungi, viruses, protozoa, PPLOs); Nutritional classification of microorganisms; Nature of the microbial cell surface, gram positive and gram negative bacteria; Growth curve.	8	CO1
2	Control of Microorganisms	Control of Microorganisms: Physical agents (Autoclave, Hot air oven, Laminar airflow and membrane filter.), chemical agents (Alcohol, Halogens and Gaseous agents, antibiotics), Radiation Methods (UV rays). Pathogenesis of microorganisms: Some common pathogenic microorganisms: Bacterial (tuberculosis, gall), viral (SARS, TMV), fungal (red rot of sugar cane, dermatitis) and protozoan (malaria).	8	CO2
3	Microbes in extreme environments and microbial interactions	Microbes in extreme environments and microbial interactions: The thermophiles alkalophiles, acidophiles and symbiosis and antibiosis among microbial population, N2 fixing microbes in agriculture and forestry.	8	CO3
4	Recombination in Prokaryotes	Recombination in Prokaryotes: Transformation, Conjugation and Transduction.	8	CO4
5	Bacteriophage	Bacteriophage: Lytic and lysogenic cycle. Stains and staining techniques: Principles of staining, Types of stains – simple stains, structural stains and Differential stains.	8	CO5

Reference Books:

1. Introduction to Microbiology, Ingraham, 2ed.
2. Brock Biology of Microorganisms, Madigan et al, 9th ed.
3. General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
4. Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hil
5. Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
6. The Microbial World, Roger Y. Stanier, Prentice Hall
7. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press, USA
8. Lewin, B., Gene VI New York, Oxford University Press.

e-Learning Source:

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1				2	2					
CO2	3	1				2	2					
CO3	3	1				2	2					
CO4	3	1				3	1					
CO5	3	1				1	1					

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

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

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	CH222	**Title of the Course**	Organic and Physical Chemistry-I	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	Students will be able to understand the about the chemistry of aliphatic hydrocarbons, properties, mechanism of addition and elimination reactions, conformational analysis of alkanes and cycloalkanes, stability and reactivity, aromaticity and substitution reactions of homocyclic & heterocyclic compounds, solutions and colligative properties and chemical Equilibrium.						

Course Outcomes	
CO1	Understanding of mechanism of eliminations, oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation, Allylic and benzylic bromination.
CO2	Comprehension of conformational analysis, Relative stability and energy diagrams of alkanes, Chair, Boat and Twist boat forms of cyclohexane with energy diagrams, analyse and compare relative stability of mono substituted cycloalkanes.
CO3	To create basics for the aromaticity, Hückel's rule, of homocyclic & heterocyclic compounds, electrophillic and substitution reactions & their mechanism, directing effects of the groups.
CO4	Able to evaluate different types colligative properties like relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and amount of solute.Know about lowering of vapour pressure, Raoult's and Henry's Laws and their applications,
CO5	Analyze the criteria of thermodynamic equilibrium, chemical equilibria in ideal gases, Le Chatelier Principle, equilibrium between ideal gases and a pure condensed phase.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Chemistry of aliphatic hydrocarbons**	General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1CB reactions. Saytzeff and Hofmann eliminations. Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.	8	CO1
2	**Conformational analysis of alkanes and cycloalkanes**	Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Chair, Boat and Twist boat forms of cyclohexane with energy diagrams; Relative stability of mono substituted cycloalkanes, cyclopropane ring, anana bonds.	8	CO2
3	**Aromatic hydrocarbons**	Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups: Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene..	8	CO3
4	**Solutions and colligative properties**	Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) depression of freezing point, (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.	8	CO4
5	**Chemical equilibrium**	Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Free energy of mixing and spontaneity. equilibrium between ideal gases and a pure condensed phase	8	CO5

Reference Books:

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.

Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.

Francis Carey Organic Chemistry, Published by McGraw-Hill Education.

Physical Chemistry, Puri Sharma & Pathania.

Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

e-Learning Source:

https://study.com/academy/lesson/unsaturated-hydrocarbon-definition-examples.html

https://mymedia.ou.edu/media/Lecture+13+-+Conformations+of+Alkanes+and+Cycloalkanes+%5BCHEM3053-001%5D/0_rmpfppnb

https://www.google.com/search?q=solutions+and+colligative+properties

https://onlinecourses.nptel.ac.in/noc22_cy39/preview

https://www.google.com/search?q=chemical+equilibrium+with+applications

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

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

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

Integral University, Lucknow

Effective from Session:							
Course Code	CH223	**Title of the Course**	Chemistry Practical-III	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	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, and 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	ContactHrs.	Mapped CO
1	Determination of acetic acid in commercial vinegar using NaOH.	4	CO1-5
2	Determination of alkali content – antacid tablet using HCl.	4	CO1-5
3	Estimation of calcium content in chalk as calcium oxalate by permanganometry. Estimation of ferrous and ferric by dichromate method.	4	CO1-5
4	Estimation of copper using thiosulphate.	4	CO1-5
5	Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime).	4	CO1-5
6	Detection of following functional groups present in the given mono-functional organic compounds, a) Carboxylic acid, b) Phenol	4	CO1-5
7	To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/ strong acid and determinethe enthalpy of ionization of the weak acid/weak base.	4	CO1-5
8	The equilibrium between Fe^{3+} and $Fe(CNS)^{2+}$.	4	CO1-5
9	To study the effect of concentration on equilibrium.	4	CO1-5
10	Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.	4	CO1-5

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.

Practical Organic Chemistry, A.I.Vogel.

Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.

Experimental Inorganic Chemistry –W.G.Palmer.

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	1	-	1	3	3	3	3	2	2	2	1
CO2	3	1	-	-	3	3	3	3	2	2	2	1
CO3	1	1	-	1	3	3	3	3	2	2	2	1
CO4	3	1	-	1	3	3	3	3	2	2	2	3
CO5	3	1	-	1	3	3	3	3	2	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: 2015-16							
Course Code	BS262	**Title of the Course**	Animal Diversity II Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	6	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	Students will understand about different vertebrate species from different animal group.						

Course Outcomes	
CO1	External characters of Scoliodon,
CO2	Permanent stained preparation of ampullae of Lorenzini, Glycerine and permanent preparation of placoid scales, Study of the permanent histology (various organs) slides
CO3	Dissection: Scoliodon
CO4	Study of the following specimens: *Herdmania, Amphioxus, Anguilla, Acipenser, Ambystoma, Rana, Varanus, Viper, Heloderma, Naja, Pavo, Psittacula, Porcupine, Platypus, Oryctolagus, Armadillo,Manis*
CO5	Embryonic membranes-Whole mount of 72 hr chick embryo, Study of poisonous and non-poisonous snakes, Difference between Crocodile, Alligator, and Gavialis

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	External features	External characters of Scoliodon,	6	CO1
2	Slides	Permanent stained preparation of ampullae of Lorenzini, Glycerine and permanent preparation of placoid scales, Study of the permanent histology (various organs) slides	6	CO2
3	Dissections	Dissection: Scoliodon	6	CO3
4	Specimens	Study of the following specimens: *Herdmania, Amphioxus, Anguilla, Acipenser, Ambystoma, Rana, Varanus, Viper, Heloderma, Naja, Pavo, Psittacula, Porcupine, Platypus, Oryctolagus, Armadillo,Manis*	6	CO4
5	Embryology/models	Embryonic membranes-Whole mount of 72 hr chick embryo, Study of poisonous and non-poisonous snakes, Difference between Crocodile, Alligator, and Gavialis	6	CO5

Reference Books:

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. Pough H. Vertebrate life, VIII Edition, Pearson International.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1						2	3					1	2				
CO2	1						2	3					1	2				
CO3	1						2	3					1	2				
CO4	1						2	3					1	2				
CO5	1						2	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: 2020-2021							
Course Code	BS271	**Title of the Course**	Evolutionary Biology and Wildlife	**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 have a firm foundation in the evolution of fauna and its habitat.						

Course Outcomes	
CO1	Continental distribution, Aspects and Patterns of animal distribution (Continuous, Discontinuous and Bipolar), Factors affecting distribution, Geological distribution and Geographical distribution with their characteristic fauna, Wallace's line, Animal Diversity: Alpha, Beta and Gamma
CO2	Theories of origin of life, Missing link, Natural selection (Example: Industrial melanism), Types of natural selection (Directional, Stabilizing, Disruptive), Sexual selection, Concept of genetic drift
CO3	Concepts of Evolution, Theories of evolution: Lamarckism, Criticism of Lamarckism, Neo-Lamarckism, Darwinism, Theory of sexual, artificial and natural selection, Objection to Darwinism, Neo-Darwinism, Evidences of evolution
CO4	Speciation, Modes of speciation (Allopatric, Sympatric and Parapatric), Morphological, Genetic and Biological species concept, Monotypic and Polytypic species, Subspecies categories (Clines and Deme)
CO5	Modern Concepts (IUCN categories), endangered species, Different projects launched for the preservation of animal species, Important sanctuaries, national parks of India, in-situ and ex-situ conservation of wildlife

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Animal distribution	Continental distribution, Aspects and Patterns of animal distribution (Continuous, Discontinuous and Bipolar), Factors affecting distribution, Geological distribution and Geographical distribution with their characteristic fauna, Wallace's line, Animal Diversity: Alpha, Beta and Gamma	8	CO1
2	Origin of Life	Theories of origin of life, Missing link, Natural selection (Example: Industrial melanism), Types of natural selection (Directional, Stabilizing, Disruptive), Sexual selection, Concept of genetic drift	8	CO2
3	Evolution	Concepts of Evolution, Theories of evolution: Lamarckism, Criticism of Lamarckism, Neo-Lamarckism, Darwinism, Theory of sexual, artificial and natural selection, Objection to Darwinism, Neo-Darwinism, Evidences of evolution	8	CO3
4	Species Concept	Speciation, Modes of speciation (Allopatric, Sympatric and Parapatric), Morphological, Genetic and Biological species concept, Monotypic and Polytypic species, Subspecies categories (Clines and Deme)	8	CO4
5	Wild life of India	Modern Concepts (IUCN categories), endangered species, Different projects launched for the preservation of animal species, Important sanctuaries, national parks of India, in-situ and ex-situ conservation of wildlife	8	CO5

Reference Books:

1. Biodiversity and Quality of Life. Sengupta. Mc Millan India Pvt. Ltd.
2. Biology: P. H. Raven& G. B. Jhonson
3. Organic Evolution by Veer Bala Rastogi
4. Evolution Paperback: by Douglas J. Futuyma, Mark Kirkpatrick 5. Evolutioary biology: Singh and Tomar

e-Learning Source:

https://drive.google.com/file/d/1NTEyuMpqKJv1opmMXy2V5UQLMlritsH/view?usp=sharing

https://drive.google.com/file/d/1z8zXrJWb6GjyUYVocfopFPAmf7TLjicN/view?usp=sharing

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO4
CO1	3	1				3	1		2	3	
CO2	3	1				1	1		2	3	
CO3	3	1				1	1		2	3	
CO4	3	1				2	1		2	3	
CO5	3	1				2	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: 2020-21							
Course Code	BS322	**Title of the Course**	Comparative anatomy and developmental biology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	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 Organizational level of Integumentary, Skeletal, Digestive, Respiratory, Circulatory, Urinogenital and Nervous System in Different Vertebrate Classes and to get an idea of the role played by evolution in their development. The students will also get an in-depth understanding of developmental processes with the help of Chick Embryo development as a model system.						

Course Outcomes	
CO1	The students will learn about the basic organization of integumentary, skeletal and digestive systems. They will also be able to learn about its various modifications and their evolutionary importance.
CO2	The students will learn about the functioning of physiological systems like Respiratory, Circulatory and Urinogenital system.
CO3	The students will get an in-depth knowledge of Nervous system in various classes of vertebrates. They will also learn about the sensory systems present in different vertebrate classes.
CO4	To provide the students an in-depth understanding of various stages involved in development of young ones from a single celled zygote.
CO5	The students will learn about the development of chick embryos as a model system of embryo development.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Integumentary System	Derivatives of integument w.r.t. glands and digital tips, Skeletal System: Evolution of visceral arches, Digestive System: Brief account of alimentary canal and digestive glands.	8	CO1
2	Respiratory System	Gills, lungs and air sacs; Circulatory System: Evolution of heart and aortic arches; Urinogenital System: Succession of kidney, Evolution of urinogenital ducts.	8	CO2
3	Nervous System	Comparative account of brain; Sense Organs: Types of receptors.	8	CO3
4	Gametogenesis,	Gametogenesis, Fertilization, Egg: structure and types. Types and patterns of cleavage structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence	8	CO4
5	Embryonic development	Process of Blastulation and Gastrulation Fate Map, Development of Chick up to formation of Primitive streak and mammal (in outline) Extra embryonic membranes of chick. Placentation and types of Placenta.	8	CO5

Reference Books:

Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.

Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.

Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House

Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

e-Learning Source:

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1		3	3	1	
CO2	3	1					1		3	3	1	
CO3	3	1					1		3	3	1	
CO4	3	1					1		3	3	1	
CO5	3	1					1		3	3	1	

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

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

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	CH224	**Title of the Course**	Inorganic and Physical Chemistry-II	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	The purpose of this course is to develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements, chemistry of Lanthanide and actinides, solid state chemistry and to gain the knowledge of basics of electrochemistry and construction of cells for the calculation of EMF/ Gibbs free energy value.						

Course Outcomes	
CO1	Student will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and the bonding models, structures, reactivity, and applications of coordination complexes, boron hydrides, metal carbonyls, and organometallics.
CO3	Students will be able to understand about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.
CO4	Students will be able to understand about the key concepts of solid state chemistry, structure elucidation through X ray diffractions methods.
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Chemistry of elements of transition series	Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry	8	CO1
2	Coordination compounds	Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	8	CO2
3	Chemistry of elements of inner transition series	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, cerie ammonium sulphate and its analytical uses. Chemistry of Actinides: configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.	8	CO3
4	Solid states	Definition of space lattice, unit cell. X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Defects in crystals.	8	CO4
5	Electrochemistry-I	Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, variation of equivalent and specific conductance with dilution. Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law its uses and limitations	8	CO5

Reference Books:

Lee, J.D. Concise Inorganic Chemistry, Pearson Education.

Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.

Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.

Castellan, G. W. Physical Chemistry, Published by Narosa.

Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

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

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			1		3	3	2	3	1	2	2
CO2	3			1		3	3	2	3	2	2	2
CO3	3			1		3	3	2	3	3	2	2
CO4	3			1		3	3	2	3	3	2	2
CO5	3			1		3	3	2	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: 2017-18							
Course Code	CH225	**Title of the Course**	Organic and Physical Chemistry-II	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**					
Course Objectives	To develop understanding of Alkyl and Aryl Halides, Alcohols, phenols, Aldehydes and Ketones, Chemical Kinetics, Phase Equilibrium.						

Course Outcomes	
CO1	Comprehension of classification, methods of formation and chemical reactions of alkyl halides, Mechanism of nucleophilic substitution reaction of alkyl halides (SN1 and SN2 reactions) with energy profile diagrams.
CO2	To create basic knowledge of nomenclature, methods of formation, Hydrogen bonding. Acidic nature, Reactions of alcohols, Dihydric alcohols and phenols.
CO3	Able to evaluate different types of Synthesis of aliphatic aldehydes and ketones, alcohols, carboxylic acids and named reactions as Reimer-Tiemann reaction, gattermann-koch reaction and aromatic ketones by Friedel craft acylation.
CO4	Analyze and compare Theories of chemical kinetics, Molecularity and order of reaction, concept of activation energy method of integration, half-life method and isolation method, Thermodynamics aspect of transition state theory.
CO5	Understand the terms-phase, component and degree offreedom, derivation of Gibb's phase rule, one component system-water, two component system solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Alkyl and aryl halides**	Methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN^2 and SN^1 reactions with energy profile diagrams, Aryl halides - Methods of formation, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic substitutions.	8	CO1
2	**Alcohols and phenols**	Monohydric alcohols- nomenclature, methods of formation, reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols and pinacol-pinacolone rearrangement. Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Fries rearrangement, Claisen rearrangement, & Reimer-Tiemann reaction.	8	CO2
3	**Aldehydes and ketones**	Synthesis of aliphatic aldehydes and ketones with particular reference to acid chlorides, alcohols, carboxylic acids, Grignard reagent, alkenes and 1, 3-dithianes. Synthesis of aromatic aldehydes by oxidation of alkyl benzene, Reimer-Tiemann reaction, Gattermann-Koch reaction and aromatic ketones by Friedal Craft Acylation, Aldol condensation, Cannizzaro reaction, Clemmensen reduction and Wolff-Kishner reduction.	8	CO3
4	**Chemical kinetics**	Molecularity and order of reaction, concentration dependence of rates, integrated rate expression for- zero order, first order, second order, pseudo order reactions, half-life. Determination of the order of reaction: Differential method, method of integration, half-life method and isolation method. Theories of chemical kinetics: Arrhenius theory of reaction rate, effect of temperature on rateof reaction, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis).Thermodynamicsaspect of transition state theory.	8	CO4
5	**Phase equilibrium**	Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, 'CO_2' and 'S' systems. Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead.	8	CO5

Reference Books:

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.

Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.

Francis Carey Organic Chemistry, Published by McGraw-Hill Education.

Physical Chemistry, Puri Sharma & Pathania.

Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

Castellan, G. W. Physical Chemistry, Published by Narosa.

e-Learning Source:

https://study.com/learn/lesson/substitution-reaction-types-examples.html

https://byjus.com/chemistry/alcohol-phenol-ether-questions/

https://www.khanacademy.org/science/organic-chemistry/aldehydes-ketones/nomenclature-aldehyde-ketone/v/reactivity-of-aldehydes-and-ketones

https://nptel.ac.in/courses/104101128

https://www.google.com/search?q=phase+equilibrium&rlz=1C1ASVC_enIN966IN966&source=lnms&tbm=vid&sa=X&ved=2ahUKEwj6h-qdj_H7AhXsznMBHbo6CUsQ0pQJegQIBxAG&biw=1024&bih=600&dpr=1#fpstate=ive&vld=cid:b2e2d634,vid:rWbFx0CqSWo

https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Principles_of_Modern_Chemistry_(Oxtoby_et_al.)/Unit_3%3A_The_States_of_Matter/10%3A_Solids_Liquids_and_Phase_Transitions/10.4%3A_Phase_Equilibrium

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

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

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

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 purpose of this course is to develop the deep understanding of plant water relations. The understanding of nutrition in plants, morphology and physiology of plants and plant growth, plant hormones and its relation with plant growth and development.						

Course Outcomes	
CO1	Students will have an understanding of movement of water and solutes in plant, asent of sap and transpiration.
CO2	Have knowledge of Essential elements, their absorption, transport and role in plants and translocation in phloem.
CO3	Know about basics of C assimilation, Photosynthesis, Photorespiration and Nitrogen metabolism specially Biological nitrogen fixation.
CO4	Inculcate basic knowledge about Enzymes and Plant growth regulators, Seed dormancy and germination.
CO5	Comprehend the response of plant to light, temperature and stress, specially Photomorphogenesis, Photoperiodism and Plant movements.

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	CO1
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	CO2
3	C and N metabolism	Photosynthesis Photosynthetic Pigments (Chl a, b); 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	CO3
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	CO4
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	CO5

Reference Books:

1. 1. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. 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	PSO5	PSO6
CO1	**3**	**1**					**1**						
CO2	**3**	**1**					**1**						
CO3	**3**	**1**				**1**	**1**						
CO4	**3**	**1**					**1**						
CO5	**3**	**1**					**1**						

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	BS272	**Title of the Course**	Cytogenetics and angiosperm taxonomy 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 have a firm foundation in cytogenetics and develop understanding of angiosperms and their economic importance.						

Course Outcomes	
CO1	Learn to measure cell size in micrometer scale with the help of a microscope, know about polytene chromosomes and Barr bodies.
CO2	Learn, understand and demonstrate mitotic and meiotic cell division in plants, and understand the structure of chromosomes and importance of karyotyping.
CO3	Learn, understand and demonstrate vegetative and floral characters of different families of angiosperm.
CO4	Understand the structure and importance of different reproductive parts of plants including flowers, fruits and seeds.
CO5	To recognize different kinds of plant based on their vegetative and floral characters.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Exp. 1**	Use of Micrometer and calibration, measurement of onion epidermal cells and yeast	3	CO1
2	**Exp. 2**	Cell division: Mitotic and meiotic studies onion root tips and flower bud	3	CO2
3	**Exp. 3**	Chromosomes: Study of polytene chromosomes by slides; Barr bodies	3	CO2
4	**Exp. 4**	Karyotype analysis – with the help of slide	3	CO2
5	**Exp. 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	3	CO3
6	**Exp. 6**	Morphology study of flower parts, inflorescence, seed, fruit types	3	CO4
7	**Exp. 7**	Mounting of a properly dried and pressed specimen of any twelve wild plants with herbarium label (to be submitted in the record book).	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				1				
CO2	3	3	1				1				
CO3	3	3	1			3	1				
CO4	3	3	1			2	1				
CO5	3	3	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: 2017-18							
Course Code	CH226	**Title of the Course**	Chemistry Practical-IV	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	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,and 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	Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol	4	CO1-5
2	Oxidation: Preparation of benzoic acid from toluence	4	CO1-5
3	Reduction: Preparation of aniline from nitrobenzene	4	CO1-5
4	To study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid.	4	CO1-5
5	To determine the pKa of acetic acid	4	CO1-5
6	Determination Critical Solution Temperature (CST) for the Phenol – Water System.	4	CO1-5
7	Inorganic Chemistry: Preparation of the following: 1. Chrome Alum, 2.Potash Alum , 3.Sodium Ferrioxalate 1. Chrome Alum 2. Potash Alum	6	CO1-5
8	Aliphatic electrophlic substitution: Preparation of iodoform from ethanol and acetone	6	CO1-5
9	To determine the strength of given acetic acid solution conductometrically by titrating against a standard solution.	4	CO1-5

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.

Practical Organic Chemistry, A.I.Vogel.

Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.

Experimental Inorganic Chemistry –W.G.Palmer.

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			2	2	3	3	3	3	1	3	3
CO2	3			2	2	3	3	3	3	1	3	3
CO3	3			2	2	3	3	3	3	1	3	3
CO4	3			2	2	3	3	3	3	1	3	3
CO5	3			2	2	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: 2020-2021							
Course Code	BS302	**Title of the Course**	Plant Biotechnology	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	10+2 with Biology	**Co-requisite**					
Course Objectives	The course has been designed to make students aware of basic plant biotechnology techniques and their applications in plant growth and development, and large scale production of natural products from plant source						

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	The students will learn the role of techniques haploid plant production and its significance.
CO3	The students will learn about the protoplast isolation and somatic hybridization of protoplast and its application.
CO4	The students will learn about the role of plant tissue culture in agriculture, horticulture and forestry.
CO5	The students will learn about the transgenic plants and different strategies to make recombinant and its application

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Aseptic Techniques for Callus and suspension culture	Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokininis and Gibberellins). Callus and suspension	8	CO-1
2	Haploid plant production	Microspore and ovule culture, Organ Culture and their applications, Organogenesis and Somatic Embryogenesis: Techniques and applications	8	CO-2
3	Protoplast Culture	Somatic hybridization, methods of protoplast fusion chemical and electro fusion, practical application of somatic hybridization. Somaclonal variation and their significance, In vitro production of secondary metabolites: Techniques and significance	8	CO-3
4	Role of tissue culture in agriculture, horticulture and forestry, Transgenic plants, Technique of transformation	Agrobacterium-mediated and physical methods (Microprojectile bombardment and electroporation)	8	CO-4
5	Applications	Applications of transgenic plants, Edible Vaccines	8	CO-5

Reference Books:

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

e-Learning Source:

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	BS366	**Title of the Course**	PLANT ECOLOGY, PHYTOGEOGRAPHY AND ECONOMIC BOTANY	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**2**	**0**	**0**	**2**
Pre-Requisite	10+2 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	The students with be able to explain the structure and functioning of ecosystem.
CO2	The students will be able to differentiate between primary and secondary productivity as well as different types of plant succession.
CO3	The students will be able to explain the types and causes of pollution; sources of energy; depletion of plant resources and their management practices.
CO4	The students will be able to explain the concept of phytogeography and process of plant ecological adaptations.
CO5	The students will be able to discuss the economic importance of different 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	6	CO1
2	Productivity	Primary and secondary productivity and their measurements. Plant succession: causes. Process types: Hydrosere, Xerosere (Lithosere and Psammosere). Community: Structure and development	6	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	6	CO3
4	Plant adaptations	Hydrophytes, Xerophytes and Halophytes (morphological, anatomical and physiological adaptations). Phytogeography: Introduction, continuous and discontinuous distribution, Phytogeography of India, Plant indicators	6	CO4
5	Economic importance of plants	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	6	CO5

Reference Books:

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

e-Learning Source:

epgp.inflibnet.ac.in

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	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	The students will be able to explain the organization of shoot and root apex.
CO2	The students will be able to differentiate between the anatomical features of different plant organs (root, stem and leaf).
CO3	The students will be able to discuss the overall process of microsporogenesis and megasporogenesis.
CO4	The students will be able to explain the structural organization of flower and the process of pollination, fertilization and seeds dispersal.
CO5	The students will be able to explain the basics of plant embryology.

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.

3. e

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 Un[illegible], 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	BS212	**Title of the Course**	Molecular Biology	**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 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	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	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: 2023-24							
Course Code	BS376	**Title of the Course**	Horticulture Practices	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	This course is designed to enable the students to understand the importance of horticultural crops in present scenario and their role in urban and rural economy. The students will acquire knowledge about the general techniques applied in horticultural practices.						

Course Outcomes	
CO1	The students will learn about the scope and importance of horticultural practices
CO2	The students will learn about the identification and classification of ornamental plants (rose, marigold, carnations, orchids) and trees (Gulmohar, Lagerstroemia, fishtail and areca palms)
CO3	The students will learn about some fruits, vegetable crops and flowers of commercial value.
CO4	The students will learn about horticultural techniques like application of biofertilizers, biopesticides, irrigation and propagation methods of horticultural crops
CO5	The students will learn about landscaping and garden design, different types of gardens and their importance.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Horticulture	Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism. UPOV.	8	CO1
2	Ornamental Plants	Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants (rose, marigold, carnations, orchids), Ornamental flowering trees (Gulmohar, Lagerstroemia, fishtail and areca palms).	8	CO2
3	Fruits, vegetable crops and floriculture	Production, origin and distribution; Description of plants and their economic products; Identification of some fruits and vegetable varieties (citrus, banana, mango and cucurbits), Cut flowers, bonsai, Importance of flower shows and exhibitions.	8	CO3
4	Horticultural techniques	Application of biofertilizers and biopesticides; Irrigation methods (drip, surface, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual propagation	8	CO4
5	Landscaping and garden design	Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.	8	CO5

Reference Books:

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.

2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.

3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	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**