Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	B050301T/ BS264	**Title of the Course**	Molecular Biology, Bioinstrumentation & Biotechniques	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**4**	**2**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to enable students to understand the concept of different types of genes, DNA replication, Transcription, Translation, regulation of Gene expression in prokaryotes and eukaryotes. The course will also develop the understanding of basic principles, working and application of commonly used biophysical techniques like Chromatography, Centrifugation, Electrophoresis, Microscopy etc.						

Course Outcomes	
CO1	The students will be able to critically analyse the process of DNA replication and transcription of prokaryotes and eukaryotes.
CO2	The students will be able to compare and contrast the mechanisms of translation in prokaryotes and eukaryotes.
CO3	The students will be able to predict the consequences of mutations and other environmental factors on the gene expression.
CO4	The students will be able to criticise on the principle and application of Microscopy and centrifugation
CO5	The students will be able to compare and contrast the between the principles, working, types and applications of Electrophoresis and Chromatography

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Process of DNA Replication**	Central Dogma, Definition of gene, concept of intron and exon. DNA as genetic material. Semiconservative mode of replication. Mechanism of Replication in prokaryotes and eukaryotes. Enzymes and proteins involved in replication.	**8**	**CO1**
2	**Process of Transcription**	Properties of prokaryotic and eukaryotic promoters. RNA polymerases, transcription factors. Mechanism of transcription in prokaryotes and eukaryotes (Formation of initiation complex, elongation and termination of transcription)	**7**	**CO2**
3	**Process of Translation**	The Genetic code, adaptor role of t-RNA, Wobble hypothesis. Aminoacylation of tRNA Mechanism of translation in prokaryotes and eukaryotes (Factors involved in translation, Initiation, elongation and termination of translation)	**7**	**CO3**
4	**Regulation of Gene expression**	Post-transcriptional modifications of eukaryotic mRNA (capping, splicing, polyadenylation). Post- translational modifications. Operon concept (Lac operon), transcriptional activation, galactose metabolism in yeast. Role of chromatin in gene expression.	**8**	**CO3**
5	**Microscopy**	Principle, working and application of Brightfield and Darkfield microscopy, Phase contrast Microscopy, Fluorescence Microscopy, Electron Microscopy (TEM and SEM)	**6**	**CO4**
6	**Centrifugation**	Principle, working and applications of centrifugation, types of rotors, Desk top, High speed & Ultracentrifuges, Differential centrifugation, Density Gradient Centrifugation	**8**	**CO4**
7	**Electrophoresis**	Principle, working and applications of electrophoresis, Zone electrophoresis (Paper electrophoresis and gel electrophoresis), Moving boundary electrophoresis (capillary electrophoresis, Immunoelectrophoresis).	**8**	**CO5**
8	**Chromatography**	Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, Rf values, factors affecting Rf values. Paper Chromatography, Thin layer Chromatography (TLC), ion exchange chromatography, HPLC	**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.
2. Keith Wilson & John Walker: Principles and Techniques of Biochemistry and Molecular Biology.
3. Upadhyay, Upadhyay and Nath: Biophysical Chemistry: Principle and Techniques.
4. David Sheehan: Physical Biochemistry Principle and Applications.
5. Sabari Ghosal & A. K. Srivastava: Fundamentals of Bioanalytical techniques and Instrumentation.

e-Learning Source:

https://www.youtube.com/watch?v=S17uszRHofU&list=PLYcLrRDaR8_cpMqa1bbUwD2T39RJA6_o3

https://www.youtube.com/watch?v=tVcEEw6qbBQ

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

CO3	3	1	1				1	3			3	
CO4	3	1	1				1	3			3	
CO5	3	1	1				1	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: 2025-26							
Course Code	B050302P/ BS265	**Title of the Course**	Bioinstrumentation & Molecular Biology Lab	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to enable students to understand the basic working principles of bioinstruments and molecular biology techniques.						

Course Outcomes	
CO1	Students will be able to explain the basic principles of microscopy and laboratory instruments, working of different types of microscopes
CO2	Students will be able to measure the concentration of macromolecules using spectrophotometer, separation using paper chromatography and separation of fractions using centrifuge.
CO3	Student will be able to isolate and measure DNA

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Exp-01**	To study the working principle and Simple, Compound and Binocular microscopes.	8	CO-1
2	**Exp-02**	To study the working principle of various lab equipment such as pH Meter, Electronic balance, use of glass and micropipettes, Incubator, Water bath, Centrifuge	20	CO-1
3	**Exp-03**	To separate mixture components using centrifuge	4	CO-2
4	**Exp-04**	To separate amino acids using Paper Chromatography.	4	CO-2
5	**Exp-05**	To Isolate the genomic DNA from bacteria.	6	CO-3
6	**Exp-06**	To estimate the DNA by spectrophotometry	4	CO-2
7	**Exp-07**	To estimate the DNA by Agarose gel electrophoresis	6	CO-2
8	**Exp-08**	**www.uwlax.edu** **www.labster.com** **www.onlinelabs.in** **www.powershow.in** **https://vlab.amrita.edu**	8	CO-1, 2, 3

Reference Books:

1. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
2. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd Ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Primrose. Molecular Biotechnology. Panima (2001).

e-Learning Source:

info@premiereducationaltechnologyies.com
https://li.wsu.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	PSO5
CO1	3						2	3		1	1	
CO2	3						2	3		3	1	
CO3	3						2	1		3	1	

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	B040301T/BS266	**Title of the Course**	Flowering Plants Identification & Aesthetic Characteristics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**4**	**2**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of Plant Taxonomy, their identification and aesthetic characteristics of plants.						

Course Outcomes	
CO1	Students will be able to evaluate taxonomic components and resources while studying botanical nomenclature principles. They will be able to apply critical thinking to validate classification and naming conventions.
CO2	Students will be able to evaluate phylogenetic relationships in angiosperms and modern trends in plant taxonomy to assess their impact on classification and evolutionary studies.
CO3	Students will be able to differentiate between inflorescences, flowers, fruits, and seeds and will be able to examine the role of plant modifications, floral structures and functions.
CO4	Students will be able to analyze the identification characteristics of major plant taxa and interpret key plant families for their taxonomic and evolutionary significance.
CO5	Students will be able to evaluate the aesthetic characteristics of plants and the designing principles of various garden styles.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Taxonomic resources and Nomenclature**	Components of Taxonomy (Identification, Nomenclature, Classification); Taxonomic Resources: Herbarium, Botanical Gardens, Flora. Principles and rules of Botanical Nomenclature according to IUCN (Rank and names, principle of priority, binomial system, type method, author citation, valid publication).	**9**	**CO1**
2	**Taxonomic Hierarchy**	Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary); Unique features of angiosperms; Origin and evolution of angiosperms.	**6**	**CO1**
3	**Angiosperms Taxonomy**	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)	**8**	**CO2**
4	**Modern trends in plant taxonomy**	Brief idea on Phenetics (definition, principle), Operational Taxonomic Units (OTUs), methods and procedure of numerical taxonomy and Cladistics (definition, principle), difference between phenogram and cladogram	**8**	**CO2**
5	**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	**7**	**CO3**
6	**Angiospermic families-I**	A study of following families with emphasis on morphological peculiarities and economic importance of its members (based on Bentham and Hooker's System) Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitacece.	**7**	**CO4**
7	**Angiospermic families-II**	A study of following families with emphasis on morphological peculiarities and economic importance of its members (based on Bentham and Hooker's System) Asteraceae, Solanaceae Poaceae, Liliaceae, and Orchidaceae.	**7**	**CO4**
8	**Aesthetic Characteristics of Plants**	Aesthetic Characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens, Features of a botanical garden (Garden wall, fencing, steps, hedge, edging, lawn, trees, shrubs and shrubberies, climbers and creepers, rockery, flower beds, borders, water garden). Some famous gardens of India. Conservatory, green houses, indoor garden, roof garden, Topiary and Bonsai.	**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:

https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,- Gymnospermae-and-Monocotyledonae_1000

https://www.easybiologyclass.com/topic-botany/

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

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

CO5	3	1					2	2			1	

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	B040302P/ BS267	**Title of the Course**	Plant Identification Technology	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to equip students with comprehensive knowledge and skills in plant identification, preservation techniques, and the principles of botanical nomenclature, fostering a deep understanding of plant taxonomy and its practical applications.						

Course Outcomes	
CO1	Students will be able to construct a herbarium using advanced preservation techniques and will be able to develop a systematic indexing system for documentation.
CO2	Students will be able to differentiate and classify common and major plant families based on their key identification characteristics.
CO3	Students will be able to illustrate floral structures and inflorescences, and analyze taxonomic research articles to develop insights into species classification and documentation.
CO4	Students will be able to utilize taxonomic software and digital tools for plant identification and apply proper techniques for collecting, preserving, and storing selected cryptogamic plant groups.
CO5	Students will be able to design aesthetically appealing gardens and create bonsai.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Experiment 1**	**Stepwise Practicing Herbarium techniques:** a. Collection of any 15 wild plant specimens b. Learn to handle Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label them using Standard method g. Organize them and give Index Register Number using excel	10	CO1
2	**Experiment 2**	Classify 10 plants based on Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit) according to Bentham and Hooker natural system of classification in the following families: Brassicaceae, Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Euphorbiaceae, Cucurbitaceae, Labiatae (Lamiaceae), Asteraceae, Poaceae, Liliaceae. Describe flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae.	20	CO2
3	**Experiment 3**	a. Morphological study of inflorescence. b. Demonstrate a specimen paper on basic structure of a taxonomic research published on a new species in a taxonomic journal.	10	CO3
4	**Experiment 4**	a. Plant identification using taxonomic softwares/ e-resources/ android apps. b. Collection, preservation and storage of algae/fungi/bryophytes/pteridophytes (any two)	10	CO4
5	**Experiment 5**	a. Create a Bonsai of any plant. b. Draw Layouts of various types of gardens.	10	CO5

Reference Books:

1. Practical Taxonomy of Angiosperms By: R K Sinha ISBN: 9789386768520 I.K International Publishing House Pvt. Ltd.
2. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printers and Publishers, New Delhi
3. Bendre, A.M. & Kumar A. A textbook of Practical Botany-2. Rastogi publications, Meerut.
4. Khan, M.R. (1995) Horticulture and Gardening. - Nirali Prakashan, Pune. India

e-Learning Source:

http://delta-intkey.com

https://libguides.rutgers.edu/botany/Software

	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	2	3	1	3		
CO2	3					1		3	1	2		
CO3	3					1		3	1	2	1	2

CO4	3					2	2	3	1	3		
CO5	3					2	2	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: 2025-26							
Course Code	B100305V/BS247	**Title of the Course**	Molecular Diagnostics	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**0**	**3**
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The objective of this course is to develop an understanding of the basic principles and application of molecular techniques employed in the diagnosis of diseases.						

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

Unit No.	Title of the Unit	Content of Unit	**Contact Hrs.**	**Mapped CO**
1	Introduction to Human Genome & Common Diseases	Introduction and mechanism related to the human genome, such as gene expression, replication, and genome maintenance. Consequences of mutations and polymorphisms, and impacts of genes and environment on major common diseases, such as cancer, diabetes, vascular disease, and coronary disease **Virtual Lab:** Demonstration of Extraction of DNA from Animal Sample	10	CO1
2	Infectious Diseases and History of Diagnostics	Types of infectious diseases- bacterial, viral, fungal, protozoan, and other parasites. Infection mode of transmission in infections, factors predisposing to microbial pathogenicity. Diagnosis of infectious diseases caused by bacteria, fungi, viruses, protozoa, and helminths. **Virtual Lab:** Demonstration of Gram staining to identify bacteria	10	CO2
3	Major Genetic disorders, its causes & Diagnosis.	Genetic disorders: Sickle cell anaemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis, and Sex – linked inherited disorders **Case Study:** A case study on any one of the genetic diseases. (Sickle cell anaemia, Duchene muscular Dystrophy, Retinoblastoma, Cystic Fibrosis or Sex – linked inherited disorders)	10	CO3
4	Cancer Biology and Diagnostics	Different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes, Applications of Molecular Diagnostics for Human Cancers. **Case Study:** A case study on any type of cancer	8	CO4
5	Molecular Diagnostics Tools	RT- PCR, Animal cell culture, DNA Sequencing, Microarray, Techniques of Nucleic acid Extraction, Real time PCR, Fluorescence *In Situ* Hybridization. **Virtual Lab:** Demonstration of Polymerase Chain Reaction	7	CO5

Reference Books:

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

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

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

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

e-Learning Source:

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

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

Integral University, Lucknow

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	B050401T/BS273	**Title of the Course**	Gene Technology, Immunology and Computational Biology	**L**	**T**	**P**	**C**
Year	III	**Semester**	IV	**4**	**2**	**0**	**4**
Pre-Requisite	10+2 in Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of the basic concepts of gene technology, immunology and computational biology.						

Course Outcomes	
CO1	Students will be able to analyze the structure, function, and applications of gene cloning vectors, along with the construction of genomic DNA and cDNA libraries, and evaluate the protocols of *Immunological screening, colony hybridization, and* suitability of different cloning vectors for specific biotechnological applications.
CO2	Students will be able to evaluate the methodology for techniques such as Electrophoresis, Polymerase chain reaction (PCR), Site-directed mutagenesis (SDM), Nucleic acid sequencing: Blotting techniques and acquire the necessary skills for designing the above-mentioned techniques
CO3	The student will be able to analyze the mechanisms of innate and acquired immunity, differentiate between humoral and cell-mediated immune responses, structure and function of antigens and antibodies, and evaluate their roles in antigen-antibody reactions in mounting an immune response along with comparative analysis of immunological techniques (precipitation, immunoelectrophoresis, RIA, and ELISA)
CO4	Students will be able to evaluate and analyze the role of MHC Class I, II, and III molecules in antigen presentation, differentiate between classical and alternate pathways of complement activation, and evaluate their roles in immune defense and their dysregulation in autoimmune diseases.
CO5	Students will critically analyze the sequence alignment tools and database search such as Gene Banks, EMBL, DDBJ, Swissprot, PIR/NBRF, IG, GCG, FAST and will be able to develop computational models for gene and protein function prediction.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	DNA manipulative enzymes	Restriction enzymes and DNA ligases, Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmid	8	CO-1
2	Screening and selection of recombinant host cells	Immunological screening and colony hybridization, Gene Libraries: Genomic DNA and cDNA cloning techniques, Expression of cloned DNA in *E. coli*.	8	CO-1
3	Techniques	Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Sanger's method, Blotting techniques: Southern, Western and Northern blotting	8	CO-2
4	Introduction to Immunology	Types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity, Cell and organs of immune responses and their functions	8	CO-3
5	Antigens and Antibodies	Antigens, Antibodies, Clonal selection theory, Antigen Antibody reaction: Precipitation, Immunoelectrophoresis, RIA and ELISA	6	CO-3
6	Histocompatibility	MHC class I, II & III, MHC restriction; Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity.	8	CO-4
7	Introduction to Bioinformatics	Bioinformatics an introduction, Biological database types, sequence databases - nucleotide and protein sequence databases	8	CO-5
8	Sequence Formats,	Gene Bank, EMBL, DDBJ, Swissprot, PIR/NBRF, IG, GCG	6	CO-5

Reference Books:

1. Glick, B.R & Pasternak J.J (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
3. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
4. Stephen A., David K, Womble D; Introduction to Bioinformatics: A Theoretical and Practical Approach, 2003, Humana Press, ISBN-13: 978-1588292414.
5. Andrew Leach; Molecular Modelling: Principles and Applications (2nd Edition), Prentice Hall, 2001, ISBN 13: 9780582382107.

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		2		3	1	3	2	3		
CO2	3	3		3	3	3	3	3	3		

CO3	3	3	3	2	3	2	2	3	2		
CO4	3	3	3	2	3	2	2	3	2		
CO5	3	3	3	3	3	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: 2025-26							
Course Code	B050402P/BS274	**Title of the Course**	Genetic Engineering and Counselling Lab	L	T	P	C
Year	II	**Semester**	IV	0	0	4	2
Pre-Requisite	10+2	**Co-requisite**					
Course Objectives	The course is designed to train the students with hands-on experiments of genetic engineering, create awareness and build concepts of biology, computer science and mathematics in computer modelling.						

Course Outcomes	
CO1	The students will be able to analyze the data using statistical tools
CO2	The students will be able to construct the bacterial growth curve.
CO3	The students will be able to design experiments related to restriction digestion and its analysis
CO4	The students will be able to develop understanding of PAGE and calculation of molecular weight of unknown DNA and proteins..
CO5	The students will be able to critically evaluate different types of bioinformatics tools and virtual labs.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Exp-01**	Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc.	6	CO-1
2	**Exp-02**	Measure the height and weight of all students in the class and apply statistical measures.	6	CO-1
3	**Exp-03**	To perform bacterial culture and calculate generation time of bacteria.	6	CO-2
4	**Exp-04**	To study Restriction enzyme digestion and its analysis using agarose gel electrophoresis	6	CO-3
5	**Exp-05**	Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.	6	CO-4
6	**Exp-06**	To calculate molecular weight of unknown DNA and protein fragments from gel pictures	6	CO-4
7	**Exp-07**	To learn the basics of computer applications	6	CO-5
8	**Exp-08**	To learn sequence analysis using BLAST	6	CO-5
9	**Exp-09**	To learn Multiple sequence alignment using CLUSTALW	6	CO-5
10	**Exp-10**	**Virtual Labs** 1. Gel Documentation System- https://youtu.be/WPpt3-FanNE 2. PCR Part 1- https://youtu.be/CpGX1UFSl4A 3. DNA isolation Part 1- https://youtu.be/QE7Ul0JnY9A https://youtu.be/-efr_HFeHxM 4. Use softwares like NEB cutter, 5. NCBI, BLAST	6	CO-5

Reference Books:

1. Primrose &Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl& Jones. Genetics: principles &Analsysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd edn. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

e-Learning Source:

https://vlab.amrita.edu/?sub=3&brch=77

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

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

Integral University, Lucknow

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	B040401T/ BS275	**Title of the Course**	Economic Botany, Ethnomedicine and Phytochemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**4**	**2**	**0**	**4**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The objective of this course is to develop the understanding of phytochemical analysis of medicinally important plants, economic products produced by the plants, traditional medicines and herbs, and its relevance in modern times.						

Course Outcomes	
CO1	Students will design sustainable crop production strategies by integrating knowledge of plant diversity, domestication, and the cultivation of key crops. They will propose innovative solutions for crop development and introduction
CO2	tudents will develop strategies for the commercial cultivation and sustainable use of plants, focusing on economic products and hydrhydroponic nhouse methods. They will create solutions for efficient crop production, including edible oils, fibers, and biofuels.
CO3	Students will develop strategies for intellectual property protection, focusing on patents, copyrights, trademarks, and traditional knowledge. They will propose solutions for managing plant variety protection and biotechnological innovations.
CO4	Students will develop ethnobotanical research strategies, focusing on plant conservation, medicinal use, and quality evaluation. They will create solutions for integrating tribal knowledge and traditional medicine in healthcare practices
CO5	Students will develop strategies for drug preparation and evaluation, focusing on plant-based natural products. They will create methods for extracting and applying secondary metabolites like glycosides, flavonoids, and alkaloids

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Origin and domestication of cultivated plants**	Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages.	**7**	**CO1**
2	**Botany of oils, Fibers, timber yielding plants & dyes**	Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber, Dyes, Timber, biofuel crops.	**7**	**CO2**
3	**Commercial production of Flowers, Vegetables, and fruits**	Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, lily, tomato, cucumber, strawberry & Exotic leafy vegetables using Hydroponics.	**7**	**CO2**
4	**IPR & Traditional Knowledge**	IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge, Digital Library, Protection of Traditional Knowledge & Protection of Plant Varieties and Biotech inventions.	**7**	**CO3**
5	**Ethnobotany**	Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CIMAP and CARI. Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation.	**8**	**CO4**
6	**Medicinal aspects**	Study of common plants used by tribes (*Aegle marmelos, Ficus religiosa, Cynodon dactylon, Eclipta alba, Oxalis, Ocimum sanctum* and *Trichopus zeylanicus)* Ethnobotanical aspect of conservation and management of plant resources, Plants in primary health care*:* common medicinal plants*: Tinospora, Acorus, Ocimum*, *Turmeric* and *Aloe*. Indian Pharmacopeia, Quality Evaluation of crude drugs & adulteration	**8**	**CO4**
7	**Pharmacognosy**	Preparation of drugs for commercial market - Organoleptic evaluation of drugs – Microscopic and Physical evaluation of drugs - Active and inert constituents of drugs. Classification of drug plants - individual drugs - drug adulteration. Sources of crude drugs, Organoleptic study of *Adhatoda vasica, Andrographis paniculata, Azadirachta indica, Ocimum sanctum* and *Zingiber officinale.*	**8**	**CO5**
8	**Herbal Preparations & Phytochemistry**	Collection of wild herbs, Types of herbal preparations- Herbal oils - Liquid extracts or Tincture. Types of secondary metabolites. Plant natural products, general detection, extraction and characterization procedures. Glycosides and Flavonoids and therapeutic applications. Terpenes, Volatile oils, Carotenoids and Alkaloids and pharmacological activities.	**8**	**CO5**

Reference Books:

Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.

Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi.

Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).

Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.

Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

e-Learning Source:

Integral University, Lucknow

https://egyankosh.ac.in/bitstream/123456789/83793/1/Block-1.pdf
https://nptel.ac.in/courses/102105342

	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	1	3				
CO2	3	1					1	3				
CO3	3	1					1	3				2
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: 2025-26							
Course Code	B040402P/ BS276	**Title of the Course**	Commercial Botany & Phytochemical Analysis	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 Biology	**Co-requisite**					
Course Objectives	The course aims to provide knowledge of plant-derived commercial products, cultivation practices, ethnobotany, plant chemistry, and career opportunities in cultivation, pharmacology, and quality analysis.						

Course Outcomes	
CO1	Students will design experiments to analyze the morphology and biochemistry of wheat, pea, and sugarcane. They will create advanced studies on these plants as sources of cereals, legumes, and sugars.
CO2	Students will design and evaluate hydroponic systems for floriculture and vegetable production. They will create strategies based on field visits to greenhouses and nutrient solution demonstrations.
CO3	Students will design and optimize the extraction process of essential oil from lemongrass using Clevenger's apparatus, integrating advanced techniques for efficient oil extraction..
CO4	Students will design systems for documenting traditional knowledge and mapping Geographic Indications. They will create models for studying tribal plants and folk medicines, focusing on cultivation, extraction, and medicinal use.
CO5	Students will design and conduct organoleptic and microscopic studies on plants, incorporating phytochemical tests for alkaloids, terpenoids, and glycosides. They will create methods for analyzing plant morphology and chemical properties

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Experiment 1**	i. To study a wheat plant (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests) as a source of cereal. ii. To study a legume with reference to Pea plant (habit, fruit, seed structure, micro-chemical tests). iii. To study sugarcane (habit sketch; cane juice- micro-chemical tests) as a source of sugars and starches.	**8**	**CO1**
2	**Experiment 2**	To conduct field visit to green houses for understanding floriculture & vegetables production.	**7**	**CO2**
	Experiment 3	Demonstration of hydroponics nutrient solutions & running models for cultivation of vegetable.	**7**	**CO2**
3	**Experiment 4**	To extract essential oil from Lemon grass through Clevenger's apparatus.	**7**	**CO3**
4	**Experiment 5**	i. To conduct documentation from Traditional Knowledge Digital Library and mark the Geographic Indications on Map. ii. To Understand the concept of Nakshtra Vatika, Navgrah vatika	**7**	**CO4**
5	**Experiment 6**	i. To study common plants used by tribes *Aegle marmelos*, *Ficus religiosa*, *Cynodon dactylon*. ii. To familiarize with at least 5 folk medicines and study the cultivation, extraction and its medicinal application.	**8**	**CO4**
7	**Experiment 7**	To perform organoleptic studies (morphological studies of vegetative and floral parts; microscopic preparations of root, stem and leaf; Stomatal number and stomatal index; Fibres and vessels (maceration)) of any three plants mentioned in the theory.	**8**	**CO5**
8	**Experiment 8**	To preform preliminary phytochemical tests for alkaloids, terpenoids and glycosides.	**8**	**CO5**

Reference Books:

Plant Ecology and Economic Botany by Dhankar - Sharma - Trivedi, RBD Publication

Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.

Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry, 3 Ed. Edward Arnold, London.

Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

e-Learning Source:

https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/sep/doc20229199001.pdf

https://ccari.icar.gov.in/Navrasnak.html

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

CO5	3					1	2	3		2	1	

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

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