Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	GPB 501	**Title of the Course**	Principles of Genetics	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	1	
Course Objectives	• Introduction to genetics and historical perspective of genetics • Detection of linkage and estimation • To aware the students about the fine structure of genes • To impart the knowledge of induction, detection and mechanism of mutation • To study about the extranuclear inheritance and polygenic inheritance						

Course Outcomes	
CO1	The students will be able to know what are the basic laws and discoveries in genetics
CO2	The students will be able to detect and estimate the linkage and recombination frequency
CO3	Students will learn about the fine structure of gene or gene concept
CO4	The students will able to know how to induce, detect and the knowledge of mechanism of mutation
CO5	The students will learn about the inheritance of cytoplasmic genes and polygenes

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Beginning of genetics, early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance; Multiple alleles, Gene interactions, Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes, Somatic cell genetics, Extra chromosomal inheritance.	4	CO1
2	**Unit-II**	Mendelian population, Random mating population, Frequencies of genes and genotypes, Causes of change: Hardy-Weinberg equilibrium.	7	CO2
3	**Unit-III**	Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis, Genetic fine structure analysis, Allelic complementation, Split genes, overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters; Regulation of gene activity in prokaryotes and eukaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Molecular chaperones and gene expression, RNA editing.	8	CO3
4	**Unit-IV**	Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCR based cloning, positional cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro-RNAs (miRNAs).	6	CO4
5	**Unit-V**	Genomics and proteomics; metagenomics; Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts. Concepts of Eugenics, Epigenetics, Genetic disorders.	5	CO5
Practicals:				
Laboratory exercises in probability and chi-square; Demonstration of genetic principles using laboratory organisms; Chromosome mapping using three-point test cross; Tetrad analysis; Induction and detection of mutations through genetic tests; DNA extraction and PCR amplification; Electrophoresis: basic principles and running of amplified DNA; Extraction of proteins and isozymes; Use of Agrobacterium mediated method and Biolistic gun; Detection of transgenes in the exposed plant material; Visit to transgenic glasshouse and learning the practical considerations.			16	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Daniel LH and Maryellen R. 2011. Genetics: "Analysis of Genes and Genomes".
- Gardner EJ and Snustad DP. 1991. Principles of Genetics. John Wiley and Sons. 8th ed. 2006
- Klug WS and Cummings MR. 2003. Concepts of Genetics. Peterson Edu. Pearson Education India; Tenth edition
- Lewin B. 2008. Genes XII. Jones and Bartlett Publ. (International Edition) Paperback, 2018
- Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co
- Singh BD. 2009. Genetics. Kalyani Publishers (2nd Revised Edition)
- Snustad DP and Simmons MJ. 2006. Genetics. 4th Ed. John Wiley and Sons. 6th Edition International Student Version edition
- Stansfield WD.1991. Genetics. Schaum Outline Series Mc Graw Hill
- Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India; 3rd ed., 2015
- Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Publs., McGraw Hill Education; 7 Edition
- Uppal S, Yadav R, Singh S and Saharan RP. 2005. Practical Manual on Basic and Applied Genetics. Dept. of Genetics, CCS HAU Hisar.

e-Learning Source:

https://www.wiley.com/en-us/Principles+of+Genetics,+7th+Edition-p-9781119142287

https://www.cliffsnotes.com/study-guides/biology/biology/classical-mendelian-genetics/principles-of-genetics

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	1		2		3		3	3	3	3			
CO2	3	3	2	3	2	1		2		2		3	3	2	3			
CO3	3	2	1	3	2	1		1		3		3	3	2	3			
CO4	3	2	2	3	3	2		2		3		3	2	3	3			
CO5	3	1	2	3	3	1		2		3		3	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: 2022-23							
Course Code	GPB 502	**Title of the Course**	Principles of Plant Breeding	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	1	
Course Objectives	• Introduction to genetics and historical perspective of genetics • Detection of linkage and estimation • To aware the students about the fine structure of genes • To impart the knowledge of induction, detection and mechanism of mutation • To study about the extranuclear inheritance and polygenic inheritance						

Course Outcomes	
CO1	The students will be able to know about the history of crop plants.
CO2	The students will be able to know the basis of breeding and types and effects of gene actions
CO3	Students had learned about the genetics of breeding
CO4	Students had learned about the different types of breeding methods
CO5	The students had learned about the different breeding methods at molecular level as well as cultivar developments

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Early Plant Breeding; Accomplishments through plant breeding; Objectives of plant breeding; Patterns of Evolution in Crop Plants: Centre of Origin, Agro-biodiversity and its significance. Pre-breeding and plant introduction and role of plant genetic resources in plant breeding.	6	CO1
2	**Unit-II**	Genetic basis of breeding: self- and cross-pollinated crops including mating systems and response to selection; Nature of variability, components of variation; Heritability and genetic advance, genotype environment interaction; General and specific combining ability; Types of gene actions and implications in plant breeding.	6	CO2
3	**Unit-III**	Pure line theory, pure line and mass selection methods; pedigree, bulk, backcross, single seed descent and multiline breeding; Population breeding in self-pollinated crops with special reference to diallel selective mating; Transgressive breeding.	5	CO3
4	**Unit-IV**	Breeding methods in cross pollinated crops; Population breeding: mass selection and ear-to-row methods; S1 and S2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and inter-population improvement and development of synthetics and composites. Hybrid breeding: genetical and physiological basis of heterosis and inbreeding, production of inbreeds, breeding approaches for improvement of inbreeds, predicting hybrid performance; seed production of hybrid and their parent varieties/ inbreeds. Self-incompatibility, male sterility and apomixes in crop plants and their commercial exploitation.	8	CO4
5	**Unit-V**	Breeding methods in asexually/ clonally propagated crops, clonal selection. Special breeding techniques: Mutation breeding, Breeding for abiotic and biotic stresses; Concept of plant ideotype and its role in crop improvement, concept of MAS, concept of polyploidy and wide hybridization, doubled haploidy. Cultivar development: testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights.	6	CO5
Practicals:				
Floral biology in self and cross pollinated species; Selfing and crossing techniques; Selection methods in segregating populations and evaluation of breeding material; Analysis of variance (ANOVA); Estimation of heritability and genetic advance; Maintenance of experimental records; Learning techniques in hybrid seed production using male-sterility in field crops; Prediction of performance of double cross hybrid.			14	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
- Chahal GS and Gossal, SS. 2002. Principles and Procedures of Plant Breeding Biotechnological and Conventional approaches. Narosa Publishing House.
- Chopra VL. 2004. Plant Breeding. Oxford & IBH.
- George A. 2012. Principles of Plant Genetics and Breeding. John Wiley & Sons.
- Gupta SK. 2005. Practical Plant Breeding. Agribios.
- Jain HK and Kharakwal MC. 2004. Plant Breeding and–Mendelian to Molecular Approach, Narosa Publications, New Delhi
- Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House.
- Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
- Sharma JP. 2010. Principles of Vegetable Breeding. Kalyani Publ, New Delhi.
- Simmonds NW.1990. Principles of Crop Improvement. English Language Book Society.
- Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
- Singh S and Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.

e-Learning Source:

http://ecoursesonline.iasri.res.in/course/view.php?id=134

https://coabnau.in/uploads/1609844251_PBG3.3note.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	1		2		3		3	3	3	3			
CO2	3	3	2	3	2	1		2		2		3	3	2	3			
CO3	3	2	1	3	2	1		1		3		3	3	2	3			
CO4	3	2	2	3	3	2		2		3		3	2	3	3			
CO5	3	1	2	3	3	1		2		3		3	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: 2022-23							
Course Code	MBB 517	**Title of the Course**	Stress Biology and Genomics	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	0	
Course Objectives	• Knowledge and concept of different kind of stress • To provide advanced knowledge on genomics with reference to abiotic stress tolerance and biotic stress resistance in plants tolerance • Basic concepts of plant bioinformatics						

Course Outcomes	
CO1	The students will be able to understand the concept of different kind of biotic and a biotic stress
CO2	To impart the basic knowledge of crop biotechnology and its application
CO3	To study of morphological and physiological changes in plants
CO4	The students will be able to understand the concept of functional genomics; transfer of tolerance/resistant genes to model plants

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Unit-I**	Different kinds of stresses (biotic and abiotic) and adaptation strategies: Plant cell as a sensor of environmental changes; role of cell membranes in signal perception; Ways of signal transduction in cells and whole plants as a response to external factors. Abiotic stresses affecting plant productivity – Drought, salinity, water logging, temperature stresses, light stress and nutrient stress; Drought stress – Effects on plant growth and development; Components of drought resistance; Physiological, biochemical and molecular basis of tolerance mechanisms; Biotic stress (insect and pathogen) resistance mechanism.	9	CO1, CO2
2	**Unit-II**	Strategies to manipulate drought tolerance – Osmotic adjustment and Osmoprotectants - synthesis of proline, glycine betaine, poly amines and sugars; ROS and antioxidants; hormonal metabolism - ABA signaling; signaling components – transcription factors. Water logging stress – effects on plant growth and metabolism; adaptation to water logging, tolerance mechanisms -hormones and flooding tolerance. Strategies for improving submergence tolerance. Salinity stress – effects on physiology and metabolism of plants, SOS pathways and ion homeostasis, Strategies to improve salinity tolerance in plants. Water logging stress – effects on plant growth and metabolism; tolerance mechanisms. Physiological and biochemical changes – High & Low temperature tolerance mechanisms - molecular basis of thermo tolerance. Morphological and physiological changes in plants due to high and low light stresses - photo oxidation -plastid development. Characters of heliophytes and sciophytes – solar tracking – sieve effect and light channeling. Heavy metal stress – Al and Cd stress - effects on plant growth and development, biotech Strategies to overcome heavy metal stress Nutrient stress effects on plant growth and development. Genetic manipulation strategies to overcome the stress effects.	12	CO2, CO3
3	**Unit-III**	Genomics; transcriptomes, small RNAs and epigenomes; functional genomics; transfer of tolerance/resistant genes to model plants and validation of gene function. Different techniques for the functional validation of genes. Signaling pathway related to defense gene expression, R proteins, RNAi approach and genes from pathogens and other sources, coat protein genes, detoxification genes, transgenic and disease management. Bt proteins, resistance management strategies in transgenic crops, ecological impact of field release of transgenic crops. Bioinformatics approaches to determine gene function and network in model plants under stress.	10	CO3, CO4

Reference Books:

- Buchanan, B.B., Gruissem, W. and Jones R. 2015. Biochemistry and Molecular Biology of Plants, 2nd edition, Wiley and Blackwell Publications.
- Sarwat, M., Ahmad, A., Abdin, M.Z. 2013. Stress Signaling in Plants: Genomics and Proteomics Perspective, Volume 1, Springer.
- Heribert Hirt. 2010. Plant Stress Biology: From Genomics to Systems Biology, John Wiley.
- Pandey, G.K. 2015. Elucidation of Abiotic Stress Signaling in Plants, Stringer.

e-Learning Source:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5684647/

https://www.springer.com/journal/44154

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	3	2	3	3	3	2		2	3	3	3			
CO2	2	3	2	2	2	2	2	1	2	1		2	2	3	2			
CO3	3	3	3	3	3	3	2	2	3	1		2	3	3	2			
CO4	3	3	2	2	2	2	1	1	2	1		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: 2022-23							
Course Code	STAT 511	**Title of the Course**	Experimental Designs	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	1	
Course Objectives	• To understand the basic concept and fundamentals of experimental design and its application in agriculture.						

Course Outcomes	
CO1	Students will have basic knowledge of Experiments, designs and analysis of covariance
CO2	Students will have knowledge of Comparative experiments
CO3	The students will be able to prepare their experimental fields on the basis of designs
CO4	Students can have the knowledge of completely Randomized Design, Randomized Block Design and Latin square design and their analysis of variance
CO5	Students can analyze their results according to the designs

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Experiments: Absolute Experiments, Comparative experiments, need for designing of experiments, characteristics of a good design. Treatment, experimental unit, blocks, yield, uniformity trials, size and shape of plots and blocks. Principles of design of experiment: randomization, replication and local control.	4	CO1
2	**Unit-II**	Designs of experiments: Completely Randomized Design, Randomized Block Design and Latin square design and their analysis of variance. factorial design; symmetrical and asymmetrical. Confounding in symmetrical factorial experiments, factorial experiments with control treatment, advantages and disadvantages of confounding.	6	CO2, CO3
3	**Unit-III**	Analysis of covariance for two-way classification (Randomized Block Design). Split plot design: comparison between split-plot design and factorial design, advantages and disadvantages of split plot design. Missing Plot techniques: Analysis of missing plot design (Fisher's Rule), analysis of Randomized Block Design with one missing observation, analysis of Latin Square Design with one missing observation.	5	CO1, CO4
4	**Unit-IV**	Balanced Incomplete Block Design (BIBD), parameters of BIBD, Incidence matrix, Symmetric BIBD, Analysis of BIBD, efficiency of BIBD relative to Randomized Block Design, Response Surfaces.	4	CO5
Practicals:				
Uniformity trial data analysis, formation of plots and blocks, Analysis of data obtained from Completely Randomized Design, Randomized Block Design, Latin Square Design; Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot designs; Transformation of data; Fitting of response surfaces.			22	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Cochran, W.G. and Cox, G.M. Experimental Design. Asia Publishing House.
- Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
- Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.
- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata.
- Casella, G, (2008). Statistical Design. Springer.
- Gupta, S.C. and Kapoor, V.K. Latest Revised Edition 2015. Fundamentals of Applied Statistics.

e-Learning Source:

https://iasri.icar.gov.in/

https://www.statisticshowto.com/experimental-design/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	2	2	1	1	2	2	1	2	2	2	1		
CO2	2	3	2	2	2	2	1	1	1	3	1	2	2	2	2		
CO3	2	3	2	2	2	2	1	1	2	3	1	2	2	2	1		
CO4	2	3	2	2	2	2	1	1	2	3	1	3	2	2	2		
CO5	2	3	2	2	2	2	1	1	2	3	1	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: 2024-25							
Course Code	BIOCHEM 505	**Title of the Course**	Techniques in Biochemistry	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	2	0	2	
Course Objectives	• To attain the knowledge and concept of Biomolecules. • To understand the basic concepts and principles of different biochemical techniques. • To understand the applications of different bioanalytical techniques.						

Course Outcomes	
CO1	Understand about the cells and apply the concept of centrifugation.
CO2	Knowledge of classification, principle and application of chromatography.
CO3	Knowledge of principle and application of electrophoresis and blotting techniques
CO4	Understand working principle of spectrophotometer and able to handle different spectrophotometric techniques
CO5	Understand the concept of microscopy and radiations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	General scheme for purification of biocomponents. Methods of studying cells and organelles, sub cellular fractionation and marker enzymes. Methods for lysis of plant, animal and microbial cells. Ultra-filtration, sonication, freeze drying and fractional precipitation. Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.	6	CO1
2	**Unit-II**	Basic principles, instrumentation, working and applications of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC.	5	CO2
3	**Unit-III**	Electrophoretic techniques - slab, capillary, 2-D, pulse field, polyacrylamide/agarose gel electrophoresis. Blotting techniques: Western, Southern and Northern blotting- principle and methodology.	5	CO3
4	**Unit-IV**	Fundamental principles of flourescene & phosphorescence, absorption, transmission of light, Beer – Lamberts law, Colorimeter, flame photometry. Principle, instrumentation, working and application of – UV, visible and IR spectroscopy, atomic absorption spectrometry, Nuclear Magnetic Resonance (NMR), Mass spectroscopy - GC-MS, HPLC-MS and LC-MS/MS, Matrix-assisted laser desorption/ionization- Time-of-Flight Mass spectroscopy (MALDI-TOF MS), X-ray crystallography.	6	CO4
5	**Unit-V**	Basic principles, instrumentation and applications of microscopy. Bright field, phase contrast, fluorescence and confocal microscopy. Electron microscope – scanning and transmission electron microscopy. Nature of radioactivity, decay and types of radiation. Radiation hazards and precautions taken while handling radioisotopes. Radiation detection and measurements: Geiger Muller counter, scintillation counter and pulse height analyzer. Application of radioisotopes in biological science- autoradiography.	4	CO5
Practicals:				
Methods for lysis of plant and microbial cells; Centrifugation; Verification of Beer-Lambert's law and determination of absorption coefficients; Paper chromatography – Separation of amino acids and carbohydrates in a mixture; Thin layer chromatography of fatty acids; Column chromatography – Separation of a mixture of proteins and salt using Sephadex column; Electrophoresis. Staining of bacteria – Simple staining, differential staining, staining of spores. Biosafety rules for handling of radioactive materials.			26	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Principles and Techniques of Practical Biochemistry by Keith Wilson, John Walker (eds), Cambridge University Press; 5th edition.
- Principles and Techniques of Practical Biochemistry by Wilson, K., Walker, J. (eds.), Cambridge University Press, Cambridge, 2000, 5th edition.
- Lehninger Principles of Biochemistry by David L. Nelson, Michael M. Cox, W. H. Freeman, 6th edition.

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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2	1	2	1	2	1	2	2	3	3	2	2		
CO2	3	2	1	1	2	2	1	1	1	1	3	3	3	3	1		
CO3	3	3	2	1	2	1	1	2	2	1	2	2	3	2	2		
CO4	3	2	1	2	1	1	2	1	1	1	3	3	3	2	3		
CO5	3	3	1	1	1	1	1	2	1	1	2	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: 2022-23							
Course Code	MCA 512	**Title of the Course**	Information Technology in Agriculture	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	1	0	1	
Course Objectives	• To gain basic knowledge of information technology in agriculture • The aim of improving communication and learning processes between various sectors in agriculture locally, regionally and worldwide • They gain knowledge of weather forecasting to increase the production and productivity of Agriculture • Type of education and Agricultural Journalism • Knowledge of Innovative Information sources.						

Course Outcomes	
CO1	Use of Information and Communication Technology in Agriculture
CO2	Know about crop models concepts & techniques
CO3	Know about computer models for understanding plant processes.
CO4	Knowledge of education and their Characteristics and Agricultural Journalism
CO5	Knowledge of contact methods, Kissan Call center and e-Chaupal.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Introduction and Applications of e-Agriculture, Introduction to Online Agricultural resources: Consortium for e-resources in Agriculture (CeRA), e-agriculture community, Agriculture: National Portal of India. Agricultural Datasets and Databases: Agricola, Agris. Need of Biological databases in Agricultural Sciences.	4	CO1
2	**Unit-II**	Smartphone Apps in Agriculture for farm advisory, Weather forecasting, types, methods, tools & techniques, Use of ICT in Agriculture, Computer Models for understanding plant processes.	5	CO1, CO3
3	**Unit-III**	Crop models, concepts & techniques, types of crop models, spatial data and their management in GIS; Remote sensing concepts and application in agriculture, Global positioning system (GPS), components and its functions.	5	CO2, CO3
4	**Unit-IV**	Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Kisan call centers, e-chaupal, RRA, PRA tools and techniques KVK, Adopter categories, MANAGE, EEI: extension education institute.	4	CO3, CO4
Practicals:				
Uniformity trial data analysis, formation of plots and blocks, Analysis of data obtained from Completely Randomized Design, Randomized Block Design, Latin Square Design; Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot designs; Transformation of data; Fitting of response surfaces.			26	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Agri Informatics: An Introduction (Industry Series), by R Chakravarthy, ICFAI University Press.
- E-Agriculture: Concepts and Applications (Agriculture Series), Rahul Gupta (Author), ICFA University Press
- Yadav, D S, Foundations of IT, New Age, Delhi.
- Introduction to Bioinformatics by Teresa Attwood, David Parry-Smith 1st edition; Prentice Hall Publications
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette (Eds), 2nd Edition; Willey & Sons Publications
- Bioinformatics: Sequence, Structure, and Databanks: A Practical Approach by Des Higgins, Willie Taylor; OUP.
- BIOS Instant Notes in Bioinformatics by Charlie Hodgman, Andrew French, David Westhead, Taylor & Francis publishing; 2 edition

e-Learning Source:

https://iasri.icar.gov.in/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	1	3	3	1	1	2	3	3	3	3	2	2	1		
CO2	3	3	3	2	1	3	2	1	3	2	3	3	2	3	2	2		
CO3	3	3	1	2	2	2	3	1	2	3	3	3	2	3	3	1		
CO4	3	3	3	2	3	3	2	1	3	2	3	3	3	1	2	2		
CO5	3	3	2	3	1	3	1	1	2	2	3	3	3	3	2	2		

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

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	PGS 503 (e-Course)	**Title of the Course**	Intellectual Property and Its Management in Agriculture	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	1	0	0	
Course Objectives	• To understand the knowledge, concept and introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement • To understand the basics of Legislations for the protection of various types of Intellectual Properties • To know the fundamentals of patents, copyrights, geographical indications, designs and layout • To gain the basic concepts of Protection of plant varieties and farmers' rights and bio-diversity protection, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture • To study of Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement						

Course Outcomes	
CO1	Concept of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement
CO2	Knowledge of Legislations for the protection of various types of Intellectual Properties
CO3	Concepts of Protection of plant varieties and farmers' rights and bio-diversity protection, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
CO4	Knowledge of Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
CO5	Knowledge of Socio-economic impact, Research collaboration Agreement, License Agreement

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs	4	CO1
2	**Unit-II**	Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks.	5	CO2
3	**Unit-III**	Protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.	5	CO3, CO4
4	**Unit-IV**	Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement	4	CO5

Reference Books:

- Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.

e-Learning Source:

https://hau.ac.in/public/pages-pdf/1548828324.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	3	3	1	1	1	3	3	2	3	3	3	2	2	2		
CO2	2	3	2	2	1	1	1	1	2	3	1	3	2	2	2	1		
CO3	3	3	3	3	1	1	2	2	3	3	2	3	2	2	2	1		
CO4	3	3	2	2	1	1	1	1	2	3	3	3	3	2	2	2		
CO5	3	3	2	3	1	1	1	3	3	3	3	1	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: 2018-19							
Course Code	PGS 504	**Title of the Course**	Basic Concepts in Laboratory Techniques	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	0	0	1	
Course Objectives	• To understand the basic concepts of safety measures while handling instruments, chemicals, glasswares, etc. in lab • To learn the use of different instruments, chemicals, glasswares, etc. of lab • To learn the preparation of different agrochemical doses in field and pot applications • To learn the preparation of buffers of different strengths and pH values • To learn the preparation of media and methods of sterilization • To understand the seed viability testing, testing of pollen viability						

Course Outcomes	
CO1	Students will have basic knowledge of handling and safety measures of instruments, chemicals, glasswares, etc. in lab before and after use
CO2	Students will have knowledge of usage of different type of lab equipments, instruments, glasswares, plasticwares, etc.
CO3	The students will be able to prepare different agrochemical doses in field and pot applications
CO4	Students can have the knowledge to prepare media, acid and bases of different strengths and buffer solutions
CO5	Students can also perform seed and pollen viability testing

Practicals:		
	Contact Hrs.	**Mapped CO**
Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; Washing, drying and sterilization of glassware; Drying of solvents/ chemicals; Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values; Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing; Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.	32	CO1, CO2, CO3, CO4, CO5
Reference Books:		
• Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.		
• Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.		
e-Learning Source:		
https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Misc/COMMON_LABORATORY_TECHNIQUES		

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	1	2	1	2	2	2	1	3	2	2	2	2		
CO2	2	2	2	2	1	2	1	2	1	2	1	3	2	2	2	2		
CO3	3	3	3	2	1	2	1	2	2	2	1	3	2	2	2	1		
CO4	3	3	3	2	1	2	1	2	2	2	1	3	2	2	2	2		
CO5	3	3	3	2	2	2	1	2	2	2	1	3	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	PGS 510	**Title of the Course**	Biochemical and Molecular Biology Techniques	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	0	0	2	
Course Objectives	• To study about the importance of buffers in biological system and basic principle, instrumentation and applications of centrifugation techniques • To understand the extraction and quantification methods of different biomolecules • To explore the methodology and biochemical applications of electrophoresis, chromatographic and spectrophotometric techniques						

Course Outcomes	
CO1	To make the students aware about the basics of solutions and instrumentation of different types of techniques of centrifugation
CO2	The students will be able to understand the extraction and quantification methods of biomolecules
CO3	The students will acquire knowledge about the instrumentation techniques of electrophoresis and chromatography
CO4	Demonstrate skill to explain about principle, bioinstrumentation and applications of spectroscopy techniques

Practicals:		
	Contact Hrs.	**Mapped CO**
Growth curve of bacteria, Isolation of cell components via Ultra-centrifugation, Extraction and quantification of protein, Polyacrylamide Gel Electrophoresis (PAGE), Extraction and quantification of plant and plasmid DNA, molecular weight estimation of plant DNA and plasmid DNA through Agarose Gel Electrophoresis, PCR of the plant DNA and plasmid DNA, restriction digestion of isolated DNA, competent cell preparation, Analysis of biomolecules using UV/visible spectroscopy	**56**	CO1, CO2, CO3, CO4

Reference Books:

- Keith Wilson, John Walker. 2010. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press; 7th edition
- David T. Plummer. 2017. An Introduction to Practical Biochemistry. McGraw Hill Education; 3rd edition
- Jyoti Saxena, Mamta Baunthiyal & Indu Ravi. 2012. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers.

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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2	2	1	3	2	2	2	2	1	2	2	1	1		
CO2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2		
CO3	2	2	1	1	1	2	3	1	1	1	1	1	1	1	2		
CO4	2	2	2	2	3	1	3	2	2	2	3	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: 2022-23							
Course Code	GPB 503	**Title of the Course**	Fundamentals of Quantitative Genetics	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	2	
Course Objectives	• To impart theoretical knowledge of variation and variances • To impart the computation skills regarding components of scales, mating designs and gene effects. • To impart the knowledge of yield and quality characters are controlled by many genes and show the quantitative. And To study about the various strategies for QTL mapping.						

Course Outcomes	
CO1	The students will be able to know theoretical knowledge of variation and variances.
CO2	The students will be able to components of scales, mating designs and gene effects.
CO3	Students will have the knowledge of yield and quality characters are controlled by many genes and show the quantitative.
CO4	Students know how different strategies for QTL mapping work.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Introduction and historical background of quantitative genetics, Multiple factor hypothesis, Qualitative and quantitative characters, Analysis of continuous variation mean, range, SD, CV; Components of variation- Phenotypic, Genotypic, Nature of gene action- additive, dominance and epistatic, linkage effect. Principles of analysis of variance and linear model, Expected variance components, Random and fixed effect model, Comparison of means and variances for significance.	8	CO1, CO2
2	**Unit-II**	Designs for plant breeding experiments- principles and applications; Variability parameters, concept of selection, simultaneous selection modes and selection of parents, MANOVA.	5	CO2
3	**Unit-III**	Association analysis- Genotypic and phenotypic correlation, Path analysis Discriminate function and principal component analysis, Genetic divergence analysis-Metroglyph and D2, Generation mean analysis, Parent progeny regression analysis.	5	CO2, CO3
4	**Unit-IV**	Mating designs- classification, Diallel, partial diallel, L × T, NCDs, and TTC; Concept of combining ability and gene action, G × E interaction-Adaptability and stability; Methods and models for stability analysis; Basic models- principles and interpretation, Bi-plot analysis.	6	CO2, CO3
5	**Unit-V**	QTL mapping, Strategies for QTL mapping- Desired population and statistical methods, QTL mapping in genetic analysis; Markers, Marker assisted selection and factors influencing the MAS, Simultaneous selection based on marker and phenotype.	6	CO4
Practicals:				
Analysis and interpretation of variability parameters; Analysis and interpretation of Index score and Metroglyph; Clustering and interpretation of D2 analysis; Genotypic and phenotypic correlation analysis and interpretation; Path coefficient analysis and interpretation; Estimation of different types of heterosis, inbreeding depression and interpretation; A, B and C Scaling test; L × T analysis and interpretation, QTL analysis; Use of computer packages; Diallel analysis; G × E interaction and stability analysis.			14	CO1, CO2, CO3, CO4

Reference Books:

- Bos I and Caligari P. 1995. Selection Methods in Plant Breeding. Chapman & Hall.
- Falconer DS and Mackay J. 1998. Introduction to Quantitative Genetics (3rd Ed.) ELBS/Longman, London.
- Mather K and Jinks JL.1985. Biometrical Genetics (3rd Ed.). Chapman and Hall, London.
- Nandarajan N and Gunasekaran M. 2008. Quantitative Genetics and Biometrical Techniques in Plant Breeding. Kalyani Publishers, New Delhi.
- Naryanan SS and Singh P. 2007. Biometrical Techniques in Plant Breeding. Kalyani Publishers, New Delhi.
- Roy D. 2000. Plant Breeding: Analysis and Exploitation of Variation. Narosa Publishing House, New Delhi.
- Sharma JR. 2006. Statistical and Biometrical Techniques in Plant Breeding. New Age International Pvt. Ltd.
- Singh P and Narayanan SS. 1993. Biometrical Techniques in Plant Breeding. Kalyani Publishers, New Delhi.
- Singh RK and Chaudhary BD. 1987. Biometrical Methods in Quantitative Genetic analysis. Kalyani Publishers, New Delhi.
- Weir DS. 1990. Genetic Data Analysis. Methods for Discrete Population Genetic Data. Sinauer Associates.
- Wricke G and Weber WE. 1986. Quantitative Genetics and Selection in Plant Breeding. Walter de Gruyter.

e-Learning Source:

https://www.studocu.com/row/document/university-of-mauritius/animal-breeding/lecture-notes-quantitative-genetics/5475869

https://si.biostat.washington.edu/sites/default/files/modules/IntroQG-seattle-2019-Lecture02_1.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	2	3	1		2		3		3	3	3	3			
CO2	2	3	2	3	2	2		2		2		3	3	2	3			
CO3	3	3	3	3	2	1		1		3		3	3	2	3			
CO4	3	2	2	3	3	2		2		3		3	2	3	3			

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

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	GPB 506	**Title of the Course**	Molecular Breeding and Bioinformatics	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	2	
Course Objectives	• The course will provide deep knowledge on genotyping. • The course will impart knowledge of different kinds of markers including biochemical and molecular, mapping populations, allele mining. • This will also add ways to perform marker-assisted selection and gene pyramiding to evolve superior varieties.						

Course Outcomes	
CO1	The students will be able to know what are the concepts of genotyping.
CO2	The students will be able to be familiar with different kinds of markers including biochemical and molecular, mapping populations, allele mining.
CO3	Students have learned about the comparative genomics of different organisms.
CO4	Students know how to perform marker-assisted selection and gene pyramiding to evolve superior varieties
CO5	The students will learn about the computational tools used to study genetics and plant breeding.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	Genotyping; Biochemical and Molecular markers; Morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs, etc.), Functional markers; Mapping populations (F2s, back crosses, RILs, NILs and DH); Molecular mapping and tagging of agronomically important traits; Statistical tools in marker analysis.	5	CO1, CO2
2	**Unit-II**	Allele mining; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants; Marker-assisted backcross breeding for rapid introgression; Genomics- assisted breeding; Generation of EDVs; Gene pyramiding	5	CO2, CO4
3	**Unit-III**	Introduction to Comparative Genomics; Large scale genome sequencing strategies; Human genome project; Arabidopsis genome project; Rice genome project; Comparative genomics tools; Introduction to proteomics; 2D gel electrophoresis; chromatography and sequencing by Edman degradation and mass spectrometry; Endopeptidases; Nanotechnology and its applications in crop improvement.	8	CO3, CO4
4	**Unit-IV**	Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer; Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane, etc. and commercial releases; Biotechnology applications in male sterility/hybrid breeding, molecular farming; Application of Tissue culture in molecular breeding; MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights; Introduction to bioinformatics: bioinformatics tools, biological data bases (primary and secondary), implications in crop improvement	11	CO4, CO5
Practicals:				
Requirements for plant tissue culture laboratory; Techniques in plant tissue culture; Media components and media preparation; Aseptic manipulation of various explants, observations on the contaminants occurring in media, interpretations; Inoculation of explants, callus induction and plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures; Visit to commercial micropropagation unit; Transformation using Agrobacterium strains; GUS assay in transformed cells/ tissues; DNA isolation, DNA purity and quantification tests; Gel electrophoresis of proteins and isozymes, PCR-based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship; Construction of genetic linkage maps using computer software; NCBI Genomic Resources, GBFF, Swiss Prot, Blast n/ Blast p, Gene Prediction Tool, Expasy Resources, PUBMED and PMC, OMIM and OMIA, ORF finder; Comparative Genomic Resources: - Map Viewer (UCSC Browser and Ensembl); Primer designing- Primer 3/ Primer BLAST.		16	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Azuaje F and Dopazo J. 2005. Data Analysis and Visualization in Genomics and Proteomics. John Wiley and Sons.
- Brown TA. 1991. Essential Molecular Biology: a practical Approach. Oxford university press, 2002, 2nd edition
- Chawala HS. 2000. Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd.
- Chopra VL and Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.
- Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
- Hackett PB, Fuchs JA and Messing JW. 1988. An Introduction to Recombinant DNA Technology Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
- Jollès P and Jörnvall H. 2000. Proteomics in Functional Genomics: Protein Structure Analysis. Birkhäuser.
- Lewin B. 2017. Genes XII. Jones & Bartlett learning, 2017.
- Robert NT and Dennis JG. 2010. Plant Tissue Culture, Development, and Biotechnology. CRC Press.
- Sambrook J and Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. 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	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	3	1	2	2	1	3		3	3	3	3			
CO2	3	3	2	3	2	1	3	2	2	2		3	3	2	3			
CO3	3	2	1	3	2	1	1	1	3	3		3	3	2	3			
CO4	3	2	2	3	3	2	2	2	1	3		3	2	3	3			
CO5	3	1	2	3	3	1	1	2	1	3		3	3	2	3			

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

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	GPB 511	**Title of the Course**	Crop Breeding-I (Kharif Crops)	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	2	
Course Objectives	• Botanical features, reproductive systems, genetics involved in Kharif Crop. • Important breeding techniques are essential to undertake any crop improvement programme. • This course is designed for important/ major Kharif crops. • The student will know about plant breeding research in different Kharif crops.						

Course Outcomes	
CO1	The students had learned the insight into recent advances in improvement of kharif crops using conventional and modern biotechnological approaches.
CO2	The students will be able to know the origin, evolution mode of reproduction and breeding objectives of different kharif crops.
CO3	Students will be able to use the knowledge of genetics of different crops.
CO4	The student will understand about plant breeding research in different kharif crops.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Unit-I**	Rice: Origin, evolution, mode of reproduction, chromosome number; Genetics –cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement, Aerobic rice, its implications and drought resistance breeding. Maize: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement- QPM and Bt maize – strategies and implications. Small millets: Evolution and distribution of species and forms - wild relatives and germplasm; Cytogenetics and genome relationship - breeding objectives yield, quality characters, biotic and abiotic stress resistance, etc.	6	CO1, CO2, CO3, CO4
2	**Unit-II**	Pigeon pea: evolution, mode of reproduction, chromosome number; Genetics –cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement - Hybrid technology; maintenance of male sterile, fertile and restorer lines, progress made at National and International institutes. Groundnut: Origin, evolution mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship, breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, released varieties, examples of MAS used for improvement. Other pulses: Urdbean, mungbean, cowpea: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship, breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), released varieties, examples of MAS used for improvement. Interspecific crosses attempted and its implications, reasons for failure, ways of overcoming them.	6	CO1, CO2, CO3, CO4
3	**Unit-III**	Soybean: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement. Castor and Sesame: Origin, evolution mode of reproduction, chromosome number; Genetics –cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), released varieties, examples of MAS used for improvement; Hybrid breeding in castor – opportunities, constraints and achievements.	6	CO1, CO2, CO3, CO4
4	**Unit-IV**	Cotton: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement, Development and maintenance of male sterile lines – Hybrid development and seed production – Scenario of Bt cottons, evaluation procedures for Bt cotton. Jute: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement.	6	CO1, CO2, CO3, CO4
5	**Unit-V**	Sugarcane: Evolution and distribution of species and forms, wild relatives and germplasm; Cytogenetics and genome relationship – Breeding objectives- yield, quality characters, biotic	6	CO1, CO2,

		and abiotic stress resistance, etc. Forage crops: Evolution and distribution of species and forms – Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters and palatability studies; Biotic and abiotic stress resistance, etc. Seed spices: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc.; Breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement; Achievements of important spice crops.		CO3, CO4
Practicals				
Floral biology, emasculation, pollination techniques in rice, maize, pigeon pea, soybean, sesame, cotton; Study of range of variation for yield and yield components; Study of segregating populations in cereal, pulses and oilseed crops; Learning on the crosses between different species; attempting crosses between black gram and green gram; Evaluating the germplasm of cotton for yield, quality and resistance parameters, learning the procedures on development of Bt cotton; Visit to Cotton Technology Laboratory and Spinning Mills; Learning on the Standard Evaluation System (SES) and descriptors; Use of software for database management and retrieval; Practical learning on the cultivation of fodder crop species on sewage water, analysing them for yield components and palatability; Laboratory analysis of forage crops for crude protein, digestibility percent and other quality attributes; Visit to animal feed producing factories; Learning the practice of value addition; Visiting the animal husbandry unit and learning the animal experiments related with palatability and digestibility of fodder			16	CO1, CO2, CO3, CO4

Reference Books:

- Agarwal RL. 1996. Identifying Characteristics of Crop Varieties. Oxford & IBH.
- Bahl PN and Salimath PM. 1996. Genetics, Cytogenetics and Breeding of Crop Plants. Vol. I. Pulses and Oilseeds. Oxford & IBH.
- Chandraratna MF. 1964. Genetics and Breeding of Rice. Longmans.
- Chopra VL and Prakash S. 2002. Evolution and Adaptation of Cereal Crops. Oxford & IBH. Gill KS. 1991. Pearl Millet and its Improvement. ICAR.
- IRRI. 1964. Rice Genetics and Cytogenetics. Elsevier.
- IRRI. 1986. Rice Genetics. Proc. International Rice Genetics Symposium. IRRI, Los Banos, Manila, Philippines.
- IRRI. 1991. Rice Genetics II. Proc. International Rice Genetics Symposium. IRRI, Los Banos, Manila, Philippines.
- IRRI. 1996. Rice Genetics III. Proc. International Rice Genetics Symposium. IRRI, Los Banos, Manila, Philippines.
- IRRI. 2000. Rice Genetics IV. Proc. International Rice Genetics Symposium. IRRI, Los Banos, Manila, Philippines.
- Jennings PR, Coffman WR and Kauffman HE. 1979. Rice Improvement. IRRI, Los Banos, Manila,

e-Learning Source:

https://coabnau.in/uploads/1610707739_GPB-5.6Theory.pdf

https://drive.google.com/file/d/1Tq_VssL0zvf3zU7gS01BKIdq3ilWhwy8/view

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	1	3	3	3	2	1	2	3		2	2	2	2			
CO2	3	2	3	2	2	2	2	3	1	3		2	2	2	2			
CO3	3	2	2	1	3	1	1	2	1	3		3	2	2	3			
CO4	3	2	3	2	1	3	1	3	1	3		3	2	3	3			

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

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	MBB 504	**Title of the Course**	Techniques in Molecular Biology I	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	6	
Course Objectives	• To get a basic overview of molecular biology techniques, good lab practices and recombinant DNA technology. • To get a hands-on training in chromatography, protein analysis, nucleic acid analysis, bacterial and phage genetics						

Course Outcomes	
CO1	able to know what are the concepts of GLPs
CO2	able to have an overview of molecular biology techniques and recombinant DNA technology
CO3	Students learned about in chromatography, protein analysis, nucleic acid analysis, bacterial and phage genetics

Practicals:	**Contact Hrs.**	**Mapped CO**
Good lab practices, preparation of buffers and reagents; Principle of centrifugation and spectrophotometry; Growth of bacterial culture and preparation of growth curve; Isolation of Genomic DNA from bacteria, Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Isolation and restriction of plant DNA (e.g. Rice / Moong / Mango / Marigold); Quantification of DNA by (a) Agarose Gel electrophoresis and (b) Spectrophotometry; PCR using isolated DNA; PAGE Gel electrophoresis; Restriction digestion of plasmid and phage DNA, ligation, Recombinant DNA construction; Transformation of E. coli and selection of transformants; Chromatographic techniques a. TLC b. Gel Filtration Chromatography, c. Ion exchange Chromatography, d. Affinity Chromatography; Dot blot analysis, Southern hybridization, Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.	44	CO1, CO2, CO3

Reference Books:

- Sambrook, J., and Russell, R.W. 2001. Molecular Cloning: A Laboratory Manual 3rd Edition, Cold spring harbor laboratory press, New York.
- Wilson, K., and Walker, J., 2018. Principles and Techniques of Biochemistry and Molecular Biology 8th edition, Cambridge University Press.
- Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA and Struhl K. 2002. Short Protocols in Molecular Biology 5th edition, Current Protocols publication.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	1	1	2	2	1	3			3	3	3	3		
CO2	2	1	2	3	3	2	3	2	1	2			3	3	2	3		
CO3	3	2	1	3	2	1	2	1	2	3			3	3	2	3		

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

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	MBB 509	**Title of the Course**	Plant Tissue culture	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	2	
Course Objectives	• To provide insight into principles of plant cell culture and genetic transformation. • To get a hands-on training in basic plant tissue culture techniques, callusing, micropropagation and analysis.						

Course Outcomes	
CO1	The students had learned different forms of plant tissue culture techniques.
CO2	The students had learned the insight into principles of plant cell culture and genetic transformations.
CO3	Students will get a hands-on training in basic plant tissue culture techniques, callusing, micropropagation and analysis.
CO4	Students will learn the commercial tissue culture: case studies and success stories.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	History of plant tissue culture, principle of Totipotency; Tissue culture media; Plant hormones and morphogenesis; Direct and indirect organogenesis; Direct and indirect somatic embryogenesis; Applications of plant tissue culture; National certification and Quality management of TC plants; Genetic Fidelity testing and Virus indexing methods – PCR, ELISA	6	CO1, CO2
2	**Unit-II**	Micropropagation of field and ornamental crops; Virus elimination by meristem culture, meristemtip culture and micrografting; Androgenesis and gynogenesis - production of androgenic and gynogenic haploids - diploidization; Protoplast culture - isolation and purification; Protoplast culture; Protoplast fusion; Somatic hybridization - Production of Somatic hybrids and Cybrids; Wide hybridization - embryo culture and embryo rescue techniques; Ovule, ovary culture and endosperm culture.	6	CO1, CO3
3	**Unit-III**	Large-scale cell suspension culture - Production of alkaloids and other secondary metabolites- techniques to enhance secondary metabolite production, Somaclonal and gametoclonal variations – causes and applications; Callus culture and in vitro screening for stress tolerance; Artificial seeds, In vitro germplasm storage and cryo-preservation. Commercial Tissue Culture: Case studies and success stories, Market assessment; project planning and preparation, economics, government policies	6	CO1, CO3, CO4
Practicals:				
		Preparation of stocks - macronutrients, micronutrients, vitamins and hormones, filter sterilization of hormones and antibiotics; Preparation of Murashige and Skoog medium; Micro-propagation of plants by nodal and shoot tip culture; Embryo culture to overcome incompatibility, Anther culture for haploid production; Callus induction in tobacco leaf discs, regeneration of shoots, root induction, role of hormones in morphogenesis; Acclimatization of tissue culture plants and establishment in greenhouse; Virus indexing in tissue culture plants (Using PCR and ELISA); Plan of a commercial tissue culture unit.	14	CO1, CO2, CO3, CO4

Reference Books:

- Razdan, M.K. 2003. Introduction to plant tissue culture, 2nd edition, Oxford publications group
- Butenko, R.G. 2000. Plant Cell Culture University Press of Pacific
- Herman, E.B. 2008. Media and Techniques for Growth, Regeneration and Storage, Agritech Publications, New York, USA.
- Bhojwani, S.S and Dantu P. 2013. Plant Tissue Culture – An Introductory Text. Springer Publications.
- Gamborg, O.L and G.C. Philips (eds.). 2013. Plant Cell, Tissue and Organ culture-Lab Manual. Springer Science & Business media.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	2	1	2	2	3	1	1			3	3	2	2		
CO2	3	1	2	3	2	3	2	2	1	2			3	2	2	2		
CO3	2	2	1	1	1	1	2	1	2	2			3	3	2	2		
CO4	3	3	3	3	2	2	2	1	1	1			3	3	2	2		

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	PGS 502	**Title of the Course**	Technical Writing and Communications Skills	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	2	
Course Objectives	• To give knowledge about the various forms of scientific writings • To give knowledge about the various parts of thesis, research communications • To give knowledge about writing of abstracts, summaries, citations etc • To give knowledge about research communications, illustrations, photograph, drawings • To give knowledge about pagination, scientific write ups, editing and proof reading, and writing of review article						

Course Outcomes	
CO1	The students will learn that what are the various forms of scientific writings
CO2	The students will be able to write the various parts of thesis, research communications
CO3	The students will learn how to do writing of abstracts, summaries and what are citations etc
CO4	The students will learn research communications, illustrations, photograph, drawings
CO5	The students will learn pagination, scientific write ups, editing and proof reading, and writing of review article

Title of Experiment	**Contact Hrs.**	**Mapped CO**
Practical: Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article. **Communication Skills -** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.	26	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.
- Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995. Harper Collins.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
- Richard WS. 1969. Technical Writing. Barnes & Noble.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2			2		1	1	3	3	2	2	1			
CO2	3	3	1	2		3	2				3	2	2	2	2			
CO3	3	3	1			1	2				3	3	2	2	2			
CO4	3	3	2	3		2	2				3	3	2	2	2			
CO5	3	3	2	3		3	2	1			3	3	2	2	1			

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	PGS 505 (e-Course)	**Title of the Course**	Agricultural Research, Research Ethics and Rural Development Programmes	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	1	0	0	
Course Objectives	• To know the objective and principle of extension education • To obtain idea on various development programmes in agriculture and allied area to help farmers. • To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government						

Course Outcomes	
CO1	Students capable, efficient, and self-reliant in character.
CO2	They gain knowledge to help rural families in better appreciation of SWOT in the village.
CO3	They know about to open new opportunities for developing talents and leadership of rural people.
CO4	To provide knowledge and help for better management of farms and increase incomes.
CO5	To promote better social, natural recreational intellectual and spiritual file among the people.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Unit-1**	History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.	5	CO1, CO2
2	**Unit-II**	Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.	3	CO2, CO3
3	**Unit-III**	Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.	5	CO3, CO4, CO5

Reference Books:

- Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ..

e-Learning Source:

https://sites.google.com/site/uasdpgs505/course-material-1

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	2	1	1	3	3	3	2	3	1		1	1	1			
CO2	3	3	3	1	1	3	3	3	2	3	3		2	2	2			
CO3	3	2	1	1	1	2	3	3	2	1	2		1	1	1			
CO4	3	2	2	2	1	3	3	3	2	2	3		1	2	2			
CO5	3	1	1	1	1	2	3	3	2	2	3		3	1	1			

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	PGS 508	**Title of the Course**	AI Foundation in Agricultural Sciences	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	2	0	1	**3**
Course Objectives	• Foundational understanding of AI principles • Application of AI in crop management • Hands-on experience with agricultural AI tools • Integration of ethical and sustainable practices						

Course Outcomes	
CO1	To make aware about the basics of artificial intelligence
CO2	The students will be able to know about the basics of Machine learning and natural language processing
CO3	The students also get awareness about the use of AI in remote sensing and satellite image processing & interpretation
CO4	To aware the students about satellite images in weather monitoring and forecasting and precision agriculture

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit-I**	**Introduction to artificial intelligence**: History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. **Problem solving through AI**: Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search.	8	CO1
2	**Unit-II**	**Machine Learning Basics:** Neural networks and deep learning, Supervised and unsupervised learning, Feature selection and engineering, learning from observation, knowledge in learning. **Natural Language Processing:** Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system.	8	CO2
3	**Unit-III**	**Remote Sensing in Agriculture:** Crop identification and monitoring, soil mapping and analysis, water management, crop health assessment, land use mapping, pest, and disease management. **Applications of Satellite Image Processing & Interpretation:** Identification of crop types, assessment of crop health, crop growth monitoring & development.	8	CO3
4	**Unit-IV**	**Use of GIS in Weather forecasting and monitoring:** Risks of droughts; monitoring, prediction, and prevention of drought; drought proofing and management; modern tools including remote sensing and GIS in monitoring and combating droughts. **Precision Agriculture:** Precision livestock farming, precision beekeeping, nutrient management, yield monitors, precision viticulture, impact of industry 4.0 on the agriculture industry.	8	CO4
Practicals:				
		Soil mapping and analysis; Crop health assessment; Pest and disease management; Crop growth monitoring & development using Satellite Imaging and GIS, Weather forecasting and monitoring using GPS and GIS.	12	CO1, CO2, CO3, CO4

Reference Books:

- Rajesh Singh, Anita Gehlot, Mahesh Pratap Gehlot, Bhupendra Singh 2020. Artificial Intelligence in Agriculture. New India Publishing Agency, New Delhi.
- Tofael Ahamed 2023. IoT and AI in Agriculture: Self- sufficiency in Food Production to Achieve Society 5.0 and SDG's Globally. Springer Singapore.

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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	3	3	1	3	1	1	3	3	2	3	2	3			
CO2	2	3	2	2	3	2	2	1	1	1	2	3	3	3	2			
CO3	3	2	1	1	3	1	3	2	1	2	3	3	2	2	3			
CO4	2	2	1	3	3	2	2	1	1	1	1	2	3	3	3			

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

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