Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	GPB 509	**Title of the Course**	Hybrid Breeding	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	0	2	3
Course Objectives	• To impart knowledge of different variety and various techniques of variety development. • To know the male sterility and use of it in hybrid seed production. • To study about different types of male sterility and its uses in hybrid seed production						

Course Outcomes	
CO1	The students will be able to know theoretical knowledge of male sterility.
CO2	The students will be able to understand the heterosis types of heterosis.
CO3	Students will have the knowledge of importance of male sterility and heterosis in breeding.
CO4	Students know heterosis mechanism and exploitation for yield improvement through conventional and biotechnological approaches.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Unit-I**	Historical aspect of heterosis, nomenclature and definitions of heterosis; Heterosis in natural population and inbred population; Evolutionary aspects – Genetic consequences of selfing, sibbing and crossing in self-and cross-pollinated and asexually propagated crops; Pre-Mendelian and Post-Mendelian ideas – Evolutionary concepts of heterosis; Genetic theories of heterosis – Physiological, Biochemical and molecular factors underlining heterosis; theories and their estimation; Biometrical basis of heterosis	8	CO1, CO2
2	**Unit-II**	Prediction of heterosis from various crosses, inbreeding depression, coefficient of inbreeding and its estimation, residual heterosis in F2 and segregating populations, importance of inbreeding in exploitation of heterosis – case studies.; Relationship between genetic distance and expression of heterosis, case studies; Divergence and genetic distance analyses, morphological and molecular genetic distance in predicting heterosis; Development of heterotic pools in germplasm/ genetic stocks and inbreeds, their improvement for increasing heterosis.	5	CO2
3	**Unit-III**	Male sterility and use in heterosis breeding; Male sterile line creation and diversification in self-pollinated, cross pollinated and asexually propagated crops; Creation of male sterility through genetic engineering and its exploitation in heterosis; Maintenance, transfer and restoration of different types of male sterility; Use of self-incompatibility in development of hybrids.	5	CO2, CO3
4	**Unit-IV**	Hybrid seed production system: 3-line, 2-line and 1-line system; Development of inbreeds and parental lines- A, B and R lines – functional male sterility; Commercial exploitation of heterosis, maintenance breeding of parental lines in hybrids; Fixation of heterosis in self, cross and often cross pollinated crops, asexually/ clonally propagated crops, problems and prospects; Apomixis in fixing heterosis-concept of single line hybrid; Organellar heterosis and complementation.	6	CO2, CO3
5	**Unit-V**	Hybrid breeding in wheat, rice, cotton, maize, pearl millet, sorghum and rapeseed-mustard, sunflower, safflower and castor oilseed crops and pigeonpea	6	CO4
Practicals:				
Characterization of male sterile lines using morphological descriptors; Restorer line identification and diversification of male sterile sources; Male sterile line creation in crop plants, problems in creation of CGMS system, ways of overcoming them; Diversification and restoration; Success stories of hybrid breeding in Maize, Rice, Pearl millet, Sorghum and Pigeon pea; Understanding the difficulties in breeding apomicts; Estimation of heterotic parameters in self, cross and asexually propagated crops; Estimation from the various models for heterosis parameters; Hybrid seed production in field crops—an account on the released hybrids, their potential, problems and ways of overcoming it; Hybrid breeding at National and International level, opportunities ahead			14	CO1, CO2, CO3, CO4

Reference Books:

- Agarwal RL. 1998. Fundamental of Plant Breeding and hybrid Seed Production. Science Publisher London.
- Akin E. 1979. The Geometry of Population Genetics. Springer-Verlag.
- Ben HL. 1998. Statistical Genomics – Linkage, Mapping and QTL Analysis. CRC Press.
- Chal GS and Gossal SS. 2002. Principles and procedures of Plant Breeding, Biotechnology and Convetional Approaches. Narosa Publishing House. New Delhi
- De JG. 1988. Population Genetics and Evolution. Springer-Verlag. 30 January 2012.
- Mettler LE and Gregg TG. 1969. Population Genetics and Evolution. Prentice-Hall. 25 April 1988
- Montgomery DC. 2001. Design and Analysis of Experiments. 5th Ed., Wiley & Sons. 2013
- Proceedings of Genetics and Exploitation of Heterosis in Crops – An International Symposium CIMMYT, 1998.
- Mukherjee BK. 1995.The Heterosis Phenomenon. Kalyani Publishers, New Delhi.
- Virmani SS. 1994. Heterosis and Hybrid Rice Breeding. Monographs of "Theoretical and Applied Genetics", Springer-Verlag.
- Srivastava S and Tyagi R. 1997. Selected Problems in Genetics. Vols. I, II. Anmol Publ.

e-Learning Source:

https://www.slideshare.net/JyotiVerma170/hybrid

https://www.britannica.com/science/plant-breeding/Hybrid-varieties

	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			

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

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	GPB 510	**Title of the Course**	Seed Production and Certification	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	1	0	2	2
Course Objectives	• The course will provide deep knowledge on seed is essence of life • The course will impart knowledge of seed chain and its importance • This will also help the students to know the seed certification procedure in different crops						

Course Outcomes	
CO1	The students will be able to know the principles of seed certification
CO2	The students will be able to know the production and maintenance of seed
CO3	Students have learned about the importance of seed chain which is useful for commercial promotion of new variety
CO4	Students know the seed process of seed certification
CO5	The students will learn about the Seed certification procedure in different crops

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Unit-I**	Importance of seed as basic input in agriculture; Seed quality concept and importance; Generation system of seed multiplication -Varietal replacement rate, Seed multiplication ratios, Seed replacement rate, Seed renewal period and seed demand and supply; Various factors influencing seed production –Physical and Genetic purity in seed production; Factors responsible for varietal and genetic deterioration.	5	CO1, CO2
2	**Unit-II**	Nucleus seed production and its maintenance - Maintenance of parental lines of hybrids, Production of breeder, foundation and certified seed and their quality maintenance; Principles of seed production in self- and cross-pollinated crops; Hybrid seed production - system and techniques involved in Seed village concept; Organic seed production and certification.	3	CO2, CO4
3	**Unit-III**	Principles of seed production in field crops; Floral structure, pollination mechanism and seed production techniques in self- and cross-pollinated cereals and millets.	4	CO3, CO4
4	**Unit-IV**	Floral structure, pollination mechanism and methods and techniques of seed production in major pulses and oilseed crops; Varietal and hybrid seed production techniques in Pigeon pea, Mustard, Castor and Sunflower.	3	CO4, CO5
5	**Unit-V**	Floral structure, pollination mechanism and methods and techniques of seed production in major commercial fibres. Hybrid-seed production techniques in major vegetatively propagated crops.	2	CO3, C04
6	**Unit-VI**	Seed certification - history, concept, objectives; Central seed certification board Seed certification agency/ organization and staff requirement; Legal status - Phases of seed certification, formulation, revision and publication of seed certification standards; Minimum Seed Certification Standards (MSCS) for different crops - General and specific crop standards, Field and seed standards; Planning and management of seed certification programs; Eligibility of a variety for certification, area assessment, cropping history of the seed field.	3	CO5
Practicals:				
		Planting design for variety- hybrid seed production techniques, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; Identification of rogues and pollen shedders, supplementary pollination, detasseling, hand emasculation and pollination; Pollen collection and storage methods, pollen viability and stigma receptivity; Pre-harvest sanitation, maturity symptoms, harvesting techniques; Visits to seed production plots - visit to seed industries; Planning for seed production: cost benefit ratio, seed multiplication ratio and seed replacement rate; General procedure of seed certification, identification of weed and other crop seeds as per specific crops, field inspection at different stages of a crop and observations recorded on contaminants and reporting of results, inspection and sampling, harvesting/ threshing, processing and after processing for seed law enforcement; Specifications for tags and labels to be used for certification purpose.	16	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Agrawal PK and Dadlani M. 1987. Techniques in Seed Science and Technology, South Asian Publishers, Delhi
- Agrawal RL. 1997. Seed Technology, Oxford & IBH Publishing
- Anon, 1965. Field Inspection Manual and Minimum Seed Certification Standards, NSC Publication, New Delhi.
- Anon. 1999. Manual of Seed Certification procedures. Directorate of Seed Certification, Coimbatore, Tamil Nadu.
- Joshi AK and Singh BD. 2004. Seed Science and Technology, Kalyani Publishers, New Delhi.
- Kelly AF. 1988. Seed Production of Agricultural Crops. John Wiley, New York..
- Mc Donald MB and Copeland LO. 1997. Seed Science and Technology, Scientific Publisher, Jodhpur.
- Ramamoorthy K, Sivasubramaniam K and Kannan M. 2006. Seed Legislation in India. Agrobios (India), Jodhpur, Rajasthan
- Singhal NC. 2003. Hybrid Seed Production in Field Crops, Kalyani Publications, New Delhi
- Tunwar NS and Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

e-Learning Source:

www.agricoop.nic.in

www.seednet.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	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: 2018-19							
Course Code	PGS501	**Title of the Course**	Library and Information Services	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	0	0	2	1
Course Objectives	• To study about the role of library in education, research and technology • To obtain idea of Intricacies of abstracting and indexing services and to enlighten the students about the computerized library services • To give the knowledge of e resources and search engines						

Course Outcomes	
CO1	The students will gain the knowledge about the library importance in different sites
CO2	They gain knowledge of Intricacies of abstracting and indexing services
CO3	They know about the computerized library services
CO4	To provide knowledge of e resources
CO5	To give basic information about search engines

Practicals:		
	Contact Hrs.	**Mapped CO**
Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.	16	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Singh G. Information Sources, Services and Systems, 2013 Edition. Prentice Hall India Learning Private Limited
- Library Science, 2018 Edition. Ramesh Publishing House
- Subhankar Biswas, Durga Sankar Rath. Cataloguing in the New Era: Gazing through the Bodleian Catalogues to RDA, 2017 Edition. Ess Ess Publications

e-Learning Source:

https://www.youtube.com/watch?v=jQlGmtY3sUw (Role of libraries in education, research and technology transfer)

	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	PSO7
CO1	3	3	1	1	1	3	3	3	2	3			1	1	1	1			
CO2	3	3	1	3	3	3	1	3	2	3			1	1	1	1			
CO3	3	2	1	3	3	2	1	3	2	1			1	1	1	1			
CO4	3	2	1	3	3	3	1	3	2	2			1	1	1	1			
CO5	3	1	1	3	3	3	1	3	2	2			1	1	1	1			

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