GURU KASHI UNIVERSITY									
University College of Agriculture(Code:5)									
Ph.D (Genetics and Plant breeding) (Code: 588)			Batch: 2022-23						
Course Work									
Study Scheme									
Sr. No.	**Subject Code**	**Subject Name**	**Type of Subject T/P**	**(Hours Per Week)**			**No. of Credits**	**Internal Marks**	**External Marks**	**Total Marks**
				L	**T**	**P**				
1	588101	Research Methodology	T	4	0	0	4	50	50	100
2	180102	Computer Applications in Research	T/P	1	0	2	2	100	NA	100
3	180104	Research and Publication Ethics	T/P	1	0	2	2	50	50	100
3	588102	Genomics in Plant Breeding, Advances in Plant Breeding Systems, Crop Evolution, Molecular Basis of Host-Pathogen Interaction	T	4	0	0	4	50	50	100
4	588103	Seminar	NA	NA	NA	NA	2	100	NA	100
Total No. of Credits							14			

Date:10/12/2021

Batch-2022

Guru Kashi University

University College of Agriculture (Code:5)

Ph.D. Genetics and Plant Breeding (Code:588)

Research Methodology (588101)

Credits: 4 **L T P**
4 0 0

UNIT I

Basic principles of design of experiments: randomization, replication and local control. Uniformity trials: size and shape of plots and blocks. Elements of linear estimation.Analysis of variance and covariance.

UNIT II

Completely randomized design (CRD), Randomized complete block design (RCBD) and Latin square design (LSD). Mutually orthogonal latin squares. Graeco Latin squares. Missing plot techniques.

Unit III

General Gauss Markoff set up, Gauss-Markoff 's theorem, Aitken's transformation. Theory of linear estimation, test of hypothesis in linear models.Analysis of variance, partitioning of degrees of freedom.Restricted least squares.Special cases of one and two way classifications (including disproportionate cell frequencies and interaction, cross and nested classifications).

Suggested Readings

- Cochran, W.G. and Cox, G.M. 1957. *Experimental Designs*. John Wiley.
- Das, M.N. and Giri, N.C. 1986. *Design and Analysis of Experiments*. New Age.
- Dean, A.M. and Voss, D. 1999. *Design and Analysis of Experiments*. Springer.
- Dey, A. 1986. *Theory of Block Designs*. Wiley Eastern Ltd.
- Federer, W.T. 1956. *Experimental Design –Theory and Application*.
- Macmillan. Federer, W.T. 1985. *Experimental Designs*. MacMillan.
- Fisher, R.A. 1953. *Design and Analysis of Experiments*. Oliver and Boyd.
- Bapat, R.B. 1993. *Linear Algebra and Linear Models*. Springer-Verlag.
- Rao, C. R. 2001. *Linear Inference and its Application*. Wiley Eastern.
- Searle, S. R. 1998. *Variance Components*. John Wiley.

Batch-2022

Guru Kashi University

University College of Agriculture (Code:5)

Ph.D. Genetics and Plant Breeding (Code:588)

Computer Applications in Research (180102)

Credit: 2 **L T P**
1 0 2

Common for all branches except Hindi, Punjabi, English, History and Religious Study.

Unit 1

Generating Charts/Graphs in Microsoft Excel, Power Point Presentation, Web search,

Use of Internet and www. Using search like Google etc.

Unit 2:

SPSS concepts and its use for Statistical Analysis.

Unit 3:

MatLab and its use for Statistical Analysis.

Unit 4:

Introduction to the use of LaTeX, Mendeley, Anti-Plagiarism Softwares .

References:-

- Office 2007 in Simple Steps, Kogent Solutions, (Wiley Publishers).
- MS-Office 2007 Training Guide, S. Jain (BPB Publications).
- Bansal , R. K. and others 'MATLAB and its applications in Engg. Second Edition , Pearson Education, Delhi.
- Sabine handan & Brian S. Everitt, " A Handbook of Statistical Analysis using SPSS'',Chapman & Hall / CRC Publication, USA.

Batch-2022

Guru Kashi University

University College of Agriculture (Code:5)

Ph.D. Genetics and Plant Breeding (Code:588)

Research and Publication Ethics (180104)

Credit: 2

L	T	P
2	0	0

THEORY

- **RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

- **RPE 02: SCIENTIFICCONDUCT (5hrs.)**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

- **RPE 03: PUBLICATION ETHICS (7 hrs.)**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

- **RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)**

1. Open access publications and initiatives
2. SHERPA/ROMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Guru Kashi University

University College of Agriculture (Code:5)

Ph.D. Genetics and Plant Breeding (Code:588)

- **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**

A. Databases (4 hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus,etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g-index, i10 index, altmetrics

Batch-2022

Guru Kashi University

University College of Agriculture (Code:5)
Ph.D. Genetics and Plant Breeding (Code:588)

Genomics in Plant Breeding, Advances in Plant Breeding Systems, Crop Evolution, Molecular Basis of Host-Pathogen Interaction (588102)

Credits: 4 **L T P**
4 0 0

GENOMICS IN PLANT BREEDING

Objective

To impart practical skills in advanced molecular techniques in genome mapping structural/functional genomics and development of transgenic crops.

Theory

UNIT I

Introduction to the plant genome- Plant nuclear genomes and their molecular description - The chloroplast and the mitochondrial genomes in plants - Genome size and complexity.

UNIT II

Establishment of plant genome mapping projects - Genome mapping and use of molecular markers in plant breeding; Strategies for mapping genes of agronomic traits in plants- Approaches for mapping quantitative trait loci; Map based cloning of plant genes.

UNIT III

Regulation of Plant gene expression - Functional genomics – Expression Analysis using Microarrays – Transposon tagging and Insertional mutagenesis- methods and significance- Diversity Array Technology.

UNIT IV

Genome sequencing in plants–Principles and Techniques; Applications of sequence information in plant genome analyses; Comparative genomics– Genome Comparison Techniques- Classical and advanced approaches.

UNIT V

Detection of Single Nucleotide Polymorphism; TILLING and EcoTILLING; Role of transcriptomics, proteomics and metabolomics in linking genome and phenome; Importance of understanding the phenotypes for exploiting the outcome of genomic technologies- Knock out mutant studies and high throughput phenotyping.

Guru Kashi University
University College of Agriculture (Code:5)
Ph.D. Genetics and Plant Breeding (Code:588)

UNIT VI

Concept of database development, management and bioinformatics; Plant genome projects and application of bioinformatics tools in structural and functional genomics.

Suggested Readings

- Baxevanis AD & Ouellette BFF. 2001. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley Interscience.
- Brown TA. 2002. Genomes. Wiley-LISS. Caetano-Anolles G & Gresshoff PM. 1998. DNA Markers: Protocols, Applications and Overviews. Wiley-VCH.
- Cantor CR & Smith CL (2004). Genomics. Wiley, New York.
- Galas DJ & McCormack SJ. 2002. Genomic Technologies: Present and Future. Calster Academic Press.

ADVANCES IN PLANT BREEDING SYSTEMS

To impart theoretical knowledge and computation methods for non allelic interactions, mating designs and component analysis and their significance in plant breeding.

Theory

UNIT I

Facts about plant breeding before the discovery of Mendelism; Evolutionary concepts of genetics and plant breeding - Flower development and its importance; genes governing the whorls formation and various models proposed; Mating systems and their exploitation in crop breeding; Types of pollination, mechanisms promoting cross pollination.

UNIT II

Self- incompatability and sterility – Types of self incompatability: Homomorphic (sporophytic and gametophytic) and heteromorphic - Breakdown of incompatibility - Floral adaptive mechanisms - Spatial and temporal - Genetic and biochemical basis of self incompatibility; Sterility: male and female sterility – Types of male sterility: genic, cytoplasmic and cytoplasmic-genic; Exploitation in monocots and dicots, difficulties in exploiting CGMS system in dicots – Case studies and breeding strategies; Nucleocytoplasmic interactions with special reference to male sterility – Genetic , biochemical and molecular bases.

UNIT III

Guru Kashi University
University College of Agriculture (Code:5)
Ph.D. Genetics and Plant Breeding (Code:588)

Population formation by hybridization - Types of populations – Mendelian population, gene pool, composites, synthetics etc.; Principles and procedures in the formation of a complex population; Genetic basis of population improvement.

UNIT IV

Selection in self fertilizing crops; Creation of genetic variability selection methods - Selection methods: mass selection, pureline selection, pedigree method (selection in early generations vs advanced generations); Backcross, polycross and test cross.

UNIT V

Selection in cross fertilizing crops – Polycross and topcross selections, Mass and recurrent selection methods and their modifications – Mass selection: grided mass selection, ear to row selection, modified ear to row selection; Convergent selection, divergent selection; Recurrent selection: Simple recurrent selection and its modifications (restricted phenotypic selection, selfed progeny selection and full sib recurrent selection) - Recurrent selection for general combining ability (GCA) – Concepts and utilization - Recurrent selection for specific combining ability (SCA) – usefulness in hybrid breeding programmes - Reciprocal recurrent selection (Half sib reciprocal recurrent selection, Half sib reciprocal recurrent selection with inbred tester and Full sib reciprocal recurrent selection); Selection in clonally propagated crops – Assumptions and realities.

UNIT VI

Genetic engineering technologies to create male sterility; Prospects and problems - Use of self- incompatability and sterility in plant breeding – case studies; - Fertility restoration in male sterile lines and restorer diversification programmes - Conversion of agronomically ideal genotypes into male steriles – Concepts and breeding strategies; Case studies - Generating new cytonuclear interaction system for diversification of male steriles - Stability of male sterile lines – Environmental influence on sterility– Environmentally Induced Genic Male Sterility (EGMS) – Types of EGMS; Influence on their expression, genetic studies; Photo and thermo sensitive genetic male sterility and its use in heterosis breeding - Temperature sensitive genetic male sterility and its use heterosis breeding - Apomixis and its use in heterosis breeding - Incongruity – Factors\influencing incongruity - Methods to overcome incongruity mechanisms.

Suggested Readings

- Agarwal RL. 1996. Fundamentals of Plant Breeding and Hybrid Seed Production. Oxford & IBH.
- Allard RW. 1966. Principles of Plant Breeding. John Wiley & Sons.
- Briggs FN & Knowles PF. 1967. Introduction to Plant Breeding. Reinhold.
- Fehr WR. 1987. Principles of Cultivar Development: Theory and Technique. Vol I. Macmillan.

Guru Kashi University

University College of Agriculture (Code:5)

Ph.D. Genetics and Plant Breeding (Code:588)

CROP EVOLUTION

Objective

To impart knowledge on crop evolutionary aspects and manipulation at ploidy level for crop improvement.

Theory

UNIT I

Origin and evolution of species; Centres of diversity/origin, diffused centres; Time and place of domestication; Patterns of evolution and domestication-examples and Case studies.

UNIT II

Domestication and uniformity – Characteristics of early domestication and changes – Concept of gene pools and crop evolution; Selection and Genetic drift - Consequences.

UNIT III

Speciation and domestication – The process of speciation – Reproductive isolation barriers – Genetic differentiation during speciation – Hybridization - speciation and extinction.

UNIT IV

Exploitation of natural variation – Early attempts to increase variation – Distant hybridization and introgression- Inter-specific, inter-generic hybridization, scope and limitations, techniques to overcome the limitations; Gene transfer into cultivated species, tools and techniques; Validation of transferred genes and their expression; Controlled introgressions.

UNIT V

Processes in crop evolution and stabilization of polyploids, cytogenetic and genetic stabilization; Genome organization – Transgenesis in crop evolution – Multifactorial genome – Intragenomic interaction – Intergenomic interaction – Genome introgression.

UNIT VI

Methods to study crop evolution - Contemporary Methods – Based on morphological features – Cytogenetic analysis – Allozyme variations and crop evolution – DNA markers, genome analysis and comparative genomics.

UNIT VII

Evolutionary significance of polyploidy, Evolution of crop plants through ploidy manipulations; polyploids: methods, use of autopolyploids; haploidy-method of production

and use; allopolyploids- synthesis of new crops; - Case studies – Cereals – Pulses – Oilseeds – vegetables, Fibre crops - Plantation crops – Forage crops – Tuber crops – Medicinal Plants.

Suggested Readings

- Hancock JF. 2004. Plant Evolution and the Origin of Crop Species. 2nd Ed. CABI.
- Ladizinsky G. 1999. Evolution and Domestication. Springer.
- Miller AJ. 2007. Crop Plants: Evolution. John Wiley & Sons.

MOLECULAR BASIS OF HOST PATHOGEN INTERACTION

Objective

To provide knowledge on host pathogen interaction and its application at molecular level.

Theory

UNIT I

Importance and role of biotechnological tools in Plant Pathology- Basic concepts and principles to study host pathogen relationship.

UNIT II

Molecular basis of host-pathogen interaction- fungi, bacteria and viruses; recognition system, signal transduction.

UNIT III

Induction of defense responses- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, Programmed Cell Death, Viral induced gene silencing.

UNIT IV

Molecular basis of gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

UNIT V

Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Suggested Readings

- Agrios, G.N. 1997. *Plant Pathology*. 4th Edition. Academic Press, New York.
- Huang, J. 2001. *Plant Pathogenesis and Resistance- Biochemistry and physiology of plant-microbe interactions.* Kluwer Academic Publishers, pp. 691.
- Osiewacz, H.D. 2002. *Molecular Biology of Fungal Development,* Marcel Dekker, USA, pp.607.

Guru Kashi University
University College of Agriculture (Code:5)
Ph.D. Genetics and Plant Breeding (Code:588)

- Singh, R.S., Singh, U.S., Hess, W.M. and Weber, D.J. 1988. *Experimental and Conceptual Plant Pathology*. Oxford and IBH publishing Co. Pvt. Ltd., pp. 599.