

**Integral University, Lucknow**  
**Integral Institute of Agricultural Science and Technology**  
**Evaluation Scheme of Post graduate program**  
**M. Sc. (Ag.) Genetics and Plant Breeding**  
**w.e.f. Session 2018-19**

**Semester – I**

Course Code	Subject	Type of Course	Periods/ Per week			Evaluation Scheme Theory Mid Sem			Evaluation Scheme Practical Mid Sem			Practical End Sem Exam	Sub Total (Theory + Practical Mid Sem Exam)	End Sem Theory Exam	Subject Total	Credit	Total Credit Points
			L	T	P	CT	TA	Total	CT	TA	Total						
APG510	Principles of Genetics	Core courses (Compulsory)	2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3
APG512	Principles of Cytogenetics		2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3
<b>Total</b>																	
APA510	Modern Concept of Crop Production	Optional Courses	3	0	0	20	10	30	-	-	-	0	0	70	100	3:0:0	3
<b>Total</b>																	*
<b>*Major Course (Core course + Optional course) should not exceed more than 9 credit</b>																	
MT519	Experimental Designs	Minor/ Related/ Supporting courses	2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3
APG515	Biotechnology for Crop Improvement		2	0	2	20	10	30	-	-	-	20	50	50	100	2:0:1	3
<b>Total</b>																	**
PGS503 (e-Course)	Intellectual Property and Its Management in Agriculture	Non Credit Course (Compulsory)	1	0	0	20	10	30	-	-	-	0	0	70	100	1:0:0	1
PGS504	Basic Concepts in Laboratory Techniques		0	0	2	0	0	0	-	25	25	75	25	-	100	0:0:1	1
PGS507	e-Agriculture		1	0	2	20	10	30	-	-	-	20	50	50	100	1:0:1	2
<b>Grand Total</b>																	***

\*+\*\*-\*\*\*Total credit should not exceed more than 18 credits in one semester

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Principles of Genetics**  
**Paper Code: APG510**  
**w.e.f. Session 2018-19**

**3(2+1)**

**Unit I**

Historical perspective on Genetics; Mendelian principles; Gene interactions; Linkage detection and estimation in various organisms (viruses, bacteria, fungi and other eukaryotes; multiple alleles) Mechanisms of sex determination;

**Unit II**

Sex-linked, sex-influenced and sex- limited traits; Intergenic and intragenic complementation and recombination, complex loci, fine structure analysis of gene; Mutations; induction, detection and mechanisms

**Unit III**

Environmental influence on gene expression; Extranuclear inheritance; Polygenic inheritance; vectors, genetic transformation and genomics introduction to other branches of Genetics.

**Practical:** Demonstration of Mendelian principles using Drosophila/plant systems; Modification of dihybrid ratios using maize as model system; Multiple alleles (ABO blood group system ); Analysis of penetrance and expressivity (PTC test ); Linkage and gene mapping using Drosophila/Neurospora; Numerical exercises related to Mendelian principles, gene interactions, Linkage and gene mapping; Induction and detection of sex-linked recessive lethals (Drosophila); Analysis of quantitative inheritance in plants (variation in seed weight).

**Suggested Readings:**

1. Gardner EJ & Snustad DP. 2018. Principles of Genetics. John Wiley & Sons (8<sup>th</sup> edition, 2018)
2. Klug WS & Cummings MR. Concepts of Genetics. Peterson Edu. (Latest edition)
3. Lewin B. Genes IX. Jones & Bartlett Publ.
4. Russell PJ. Genetics. The Benjamin/Cummings Publ. Co. (Third edition: new)
5. Principles of Genetics, (Snustad, Simmons) Binder Ready Version 6th Ed. John Wiley & Sons. (New edition)
6. Poonam Pandey (2017). Principle of genetics. Orange Books International
7. Swayam tutorials (<https://swayam.gov.in>)

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Principles of Cytogenetics**  
**Paper Code: APG512**  
**w.e.f. Session 2018-19**

**3(2+1)**

**Unit I**

History of Cytogenetics, Chromosome structure: prokaryotes and eukaryotes, function and replication. Karyotype analysis, chromosome banding pattern and fine structure: Different forms of chromosomes and their functions, significance.

**Unit II**

Lampbrush chromosomes, Polytene chromosomes, B chromosomes, Sex- chromosomes, Artificial chromosomes. Structural variation in chromosomes: their cytological consequences, gene mapping and other uses deficiencies.

**Unit III**

Duplication, inversions and interchanges. Numerical variation in chromosomes: Sources and consequences; euploidy and aneuploidy-classification, cytogenetics, segregation. Evolutionary significance and use in basic and applied research.

**Unit IV**

Synthesis of natural and new polyploids, haplontic-diplontic barriers and means to overcome them, chromosomes in evolution.

**Practical:** Preparation of important stains, Microscopy. Preparation of slides. Fixing of the materials for mitotic and meiotic analyses. Demonstration of crossing over/chiasmata. Karyotype analysis, Chromosomal aberrations, chromosomes banding, Photomicrography and image analysis.

**Suggested Readings:**

1. Elgin SCR. Chromatin Structure and Gene Expression. IRL Press.
2. Gray P. The Microtome's Formulary Guide. The Blakiston Co.
3. Gupta PK. (Latest edition) Cytogenetics. Rastogi Publ.
4. Johansson DA. Plant Microtechnique. McGraw Hill
5. Karp G. (Latest edition) Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
6. Krishanan and Senthil 2016 Principles of genetics and cytogenetics. Kalyani Publication.
7. Mahabal Ram 2017 Plant Breeding Methods. PHIL, Private Limited
8. Swayam tutorials (<https://swayam.gov.in>)

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Modern Concept in Crop Production**  
**Paper Code: APA510**  
**w.e.f. Session 2018-19**

**3(3+0)**

**Unit-I**

Crop growth in relation to environment, agro ecological zones of India; concept of potential yield and its realization; modern concepts in tillage: zero or minimum, conservation tillage etc

**Unit-II**

Optimization of plant population and planting geometry in relation to soil fertility, solar radiation and available moisture regimes; Mitscherlich, Baule and Inverse- yield-nitrogen laws, biotic and abiotic stresses; concept of ideal plant type; crop modelling for maximizing crop yield; crop response production function

**Unit-III**

Cropping and farming systems for sustainable agriculture; organic farming crop. Residue recycling and management; crop production under protective agriculture, precision agriculture, precision agriculture; crop and growth analysis

**Suggested Readings**

1. Reena (2018) A Colour Handbook on Rainfed Kharif Crops: Protection, Constraints and Mitigation Strategies. New India Publishing Agency.
2. E. Somasundaram (2018) Agronomy: Principles and Practices. New India Publishing Agency.
3. Balasubramaniyan P & Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.
4. Fageria NK. Maximizing Crop Yields. Marcel Dekker.
5. Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed Prentice Hall.
6. Paroda R.S. 2003. Sustaining our Food Security. Konark Publ.
7. Reddy SR. Revised 2016 Ed. Principles of Crop Production. Kalyani Publ.
8. Popular Agronomy Books from Goodreads.com <https://www.goodreads.com/shelf/show/agronomy>

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Experimental Designs**  
**Paper Code: MT519**  
**w.e.f. Session 2018-19**

**3(2+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.

**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.

**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

**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.

**Practical**

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.

**Suggested Readings:**

1. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.
2. Casella, G, (2008). Statistical Design. Springer.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata.
4. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.
5. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
6. Gupta, S.C. and Kapoor, V.K. Fundamentals of Applied Statistics.

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Biotechnology for Crop Improvement**  
**Paper Code: APG515**  
**w.e.f. Session 2018-19**

**3 (2+1)**

**Unit I**

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation. Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc.), mapping populations (F<sub>2</sub>s, back crosses, RILs, NILs and DH).

**Unit II**

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding. Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding;

**Unit III**

Marker-assisted backcross breeding for rapid introgression, Generation of EDVs. 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.

**Unit IV**

Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecular farming. 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 Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

**Practical:** 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 - Plant regeneration; Standardizing the protocols for PG Syllabus, Department of Genetics & Plant Breeding [14] 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.

**Suggested Readings:**

1. Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH. 16
2. Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
3. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring

Harbor Lab. Press.

4. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Intellectual Property and Its Management in Agriculture**  
**Paper Code: PGS503**  
**w.e.f. Session 2018-19**

**1(1+0)**

**Theory**

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; 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, 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; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

**Suggested Readings**

1. Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: Basic Concepts in Laboratory Techniques**  
**Paper Code: PGS504**  
**w.e.f. Session 2018-19**

**1(0+1)**

**Practical**

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; 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

**Suggested Readings**

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

**M.Sc. (Ag.) Genetics and Plant Breeding**  
**SEMESTER-I**  
**Syllabus: e-Agriculture**  
**Paper Code: PGS507**  
**w.e.f. Session 2018-19**

**2(1+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

**UNIT-II**

ICAR- Centre for Agricultural Bioinformatics (CABin): Mandates and Thrust areas; National Agricultural Bioinformatics Grid (NABG): ASHOKA - Advanced Supercomputing Hub for OMICS Knowledge in Agriculture: features and applications; National Bio-Computing Portal: objectives, facilities provided at NBCP.

**UNIT-III**

Education – Meaning, Definition, Types – Formal Informal and Non-formal education and their Characteristics. Individual contact methods – Meaning, Objectives, Steps. Group contact methods, Mass contact Methods and Innovative Information sources, Method of training.

**UNIT-IV**

Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Types of training, RRA, PRA tools and techniques KVK, Adopter categories, MANAGE, EEI: extension education institute.

**Practicals:** Usage of Biological database and tools, Briefing about retrieval of scientific articles from PubMed database and NAL Online Catalog – AGRICOLA, PRA tools and techniques, Introduction of Geospatial Technology for generating valuable information for Agriculture, Research priorities at NABG, Softwares and Tools available at NABG, Link to available Database resources at NABG and its implications.

**Suggested Readings:**

1. Agri Informatics: An Introduction (Industry Series), by R Chakravarthy, ICFAI University Press
2. E-Agriculture: Concepts and Applications (Agriculture Series), Rahul Gupta (Author), ICFAI UNIVERSITY PRESS
3. Introduction to Bioinformatics by Teresa Attwood, David Parry-Smith 1st edition; Prentice Hall publications
4. 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.
5. Bioinformatics: Sequence, Structure, and Databanks: A Practical Approach by Des Higgins, Willie Taylor; OUP.
6. BIOS Instant Notes in Bioinformatics by Charlie Hodgman, Andrew French, David Westhead, Taylor & Francis publishing; 2 edition.