Swami Vivekanand University, Sagar (M.P.)

SYLLABUS

Master of Science in Agriculture

(As per, 5th Dean Committee of ICAR)

Faculty of Agriculture Science & Technology

Department of Agriculture Science

Study and Evaluation Scheme

of

M. Sc. (Ag.) Genetics and Plant Breeding

{*Remedial Courses: These papers are compulsory for the student who has completed his/her Graduate in Biology (10+2+3)}

(Applicable w.e.f. Academic Session 2018 to till revised)

Duration of Course: 02 year
Mode of Examination: Semester

SWAMI VIVEKANAND UNIVERSITY, SIRONJA, SAGAR, (M.P.)

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M. Sc. (Ag) Genetics and Plant Breeding
(Two Year Master Degree Programme)

REQUIREMENT OF CREDIT HOURS FOR AWARD OF THE DEGREE

S. No.	Nature of Courses	Credit
1.	Major Courses	20
2.	Minor Courses	09
3.	Supporting Courses	07
4.	Remedial Courses*	20
5.	Masters Seminar	01
6.	Masters Research	20
	Total Credits	**77**

Major Subject: The subject (Department/Discipline) in which a student takes admission.

Minor Subject: The subject closely related to a student's major subject.

Supporting Subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.

***Remedial Courses:** These papers are compulsory for the student who has completed his/her Graduate in Biology (10+2+3).

Non-Credit Compulsory Courses: Six courses are of general nature and are compulsory for Master's programme.

M.Sc. (Ag.) Genetics and Plant Breeding

SEMESTER-WISE DISTRIBUTIONS OF COURSE

First Semester

S.No.	Paper Code	Course Title	Credits
		A. Major Courses	
1.	GPB-501	Principles of Genetics	3(2+1)
2.	GPB-502	Principles of Cytogenetic	3(2+1)
3.	GPB-503	Principles of Plant Breeding	3(2+1)
4.	GPB-504	Cell Biology and Molecular Genetics	3(2+1)
		B. Minor Courses	
5.	PP-502	Mycology	3(2+1)
6.	PP-504	Detection and Diagnosis of Plant Diseases	2(0+2)
		C. Supporting	
7.	STAT-501	Statistical Methods for Applied Sciences	4(3+1)
		D. Remedial Courses*	
8.	FHR-101	Fundamentals of Horticulture*	2(1+1)
9.	FSS-103	Fundamentals of Soil Science*	3(2+1)
10.	FAG-106	Fundamentals of Agronomy*	4(3+1)
		E. Non-credit Courses	
11.	PGS-501	Basic Concept in Laboratory Techniques	N.C.
12.	PGS-502	Agricultural Research, Research Ethics and Rural Development Programmes	N.C.
		Grand Total Credits	30(19+11)

***Remedial Courses:** These papers are compulsory for the student who has completed his/her Graduate in Biology (10+2+3).

M.Sc. (Ag.) Genetics and Plant Breeding

Second Semester

S.No.	Paper Code	Course Title	Credits
A. Major Courses			
1.	**GPB-511**	Principles of Quantitative Genetics	**3(2+1)**
2.	**GPB-512**	Biotechnology for Crop Improvements	**3(2+1)**
3.	**GPB-513**	Maintenance Breeding and Concept of Variety Release and Seed Production	**2(1+1)**
B. Minor Courses			
4.	**PP-512**	Integrated Disease Management	**3(2+1)**
5.	**PP-513**	Mushroom Production Technology	**3(2+1)**
C. Supporting			
6.	**STAT-511**	Design of Experiments	**3(2+1)**
D. Remedial Courses*			
7.	**FPP-206**	Fundamentals of Plant Pathology*	**4(3+1)**
8.	**FEN-207**	Fundamentals of Entomology*	**4(3+1)**
E. Non-credit Courses			
9.	**PGS-511**	Library and Information Services	**N.C.**
10.	**PGS-512**	Intellectual Property and its Management in Agriculture	**N.C.**
		Grand Total Credits	**25(17+8)**

***Remedial Courses:** These papers are compulsory for the student who has completed his/her Graduate in Biology (10+2+3).

M.Sc. (Ag.) Genetics and Plant Breeding

Third Semester

S.No.	Paper Code	Course Title	Credits
		A. Major Courses	
1.	GPB-591	Masters Seminar	1(0+1)
2.	GPB-599	Masters Research (Under Process)	10(0+10)
		B. Remedial Courses*	
3.	FPB-302	Fundamentals of Plant Breeding*	3(2+1)
		C. Non-credit Courses	
4.	PGS-521	Technical Writing and Communication Skill	N.C.
5.	PGS-522	Disaster Management	N.C.
6.	SVN-500	Charitra Nirman Evam Samgra Vyaktitva Vikas	N.C.
		Grand Total Credits	14(2+12)

***Remedial Courses:** These papers are compulsory for the student who has completed his/her Graduate in Biology (10+2+3).

M.Sc. (Ag.) Genetics and Plant Breeding

Fourth Semester

S.No.	Paper Code	Course Title	Credits
		A. Major Course	
1.	GPB-599	Masters Research (Accepted)	10(0+10)

GENETICS AND PLANT BREEDING
Course Contents

(FIRST SEMESTER)

Paper Code	Course Title	Credits
GPB-501	PRINCIPLES OF GENETICS	3(2+1)

OBJECTIVE

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problem solving skills from classical to molecular genetics.

THEORY

UNIT I

Beginning of genetics; Cell structure and cell division; 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.

UNIT II

Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium. Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis.

UNIT III

Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters. Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Molecular chaperones and gene expression. Gene regulation in eukaryotes, RNA editing.

UNIT IV

Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCRbased cloning, positional cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro RNAs (miRNAs), Genomics and proteomics; Functional and pharmacogenomics; Metagenomics. Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts, Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioural genetics.

PRACTICAL

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; practical demonstrations- Detection of transgenes in the exposed plant material; visit to transgenic glasshouse and learning the practical considerations.

SUGGESTED READINGS

- *Gardner EJ & Snustad DP. 1991. Principles of Genetics. John Wiley & Sons.*
- *Klug WS & Cummings MR. 2003. Concepts of Genetics. Peterson Edu.*
- *Lewin B. 2008. Genes IX. Jones & Bartlett Publ.*
- *Russell PJ. 1998. Genetics. The Benzamin/Cummings Publ. Co.*
- *Snustad DP & Simmons MJ. 2006. Genetics. 4th Ed. John Wiley & Sons.*
- *Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India*
- *Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Publs.*
- *Uppal S, Yadav R, Subhadra & Saharan RP. 2005. Practical Manual on*
- *Basic and Applied Genetics. Dept. of Genetics, CCS HAU Hisar.*

Paper Code	Course Title	Credits
GPB-502	PRINCIPLES OF CYTOGENETIC	3(2+1)

OBJECTIVE

To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution.

THEORY

UNIT I

Architecture of chromosome in prokaryotes and eukaryotes; Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; Artificial chromosome construction and its uses; Special types of chromosomes. Chromosomal theory of inheritance – Cell Cycle and cell division – mitosis and meiosis; Differences, significance and deviations – Synapsis, structure and function of synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over-mechanisms and theories of crossing over- recombination models, cytological basis,- Variation in chromosome structure: Evolutionary significance - Introduction to techniques for karyotyping; Chromosome banding and painting - *in situ* hybridization and various applications.

UNIT II

Structural and Numerical variations of chromosomes and their implications- Symbols and terminologies for chromosome numbers - euploidy - haploids, diploids and polyploids ; Utilization of aneuploids in gene location - Variation in chromosome behaviour - somatic segregation and chimeras – endomitosis and somatic reduction ; Evolutionary significance of chromosomal aberrations - balanced lethals and chromosome complexes.

UNIT III

Inter-varietal chromosome substitutions; Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of autopolyploids vs allopolyploids- Role of aneuploids in basic and applied aspects of crop breeding, their maintenance and utilization in gene mapping and gene blocks transfer– Alien addition and substitution lines– creation and utilization; Apomixis- Evolutionary and genetic problems in crops with apomixes.

UNIT IV

Reversion of autopolyploids to diploids; Genome mapping in polyploids- Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica)– Hybrids between species with same chromosome number, alien translocations- Hybrids between species with different chromosome number; Gene transfer using amphidiploids– Bridge species. Fertilization barriers in crop plants at pre-and post fertilization levels- *In-vitro* techniques to overcome the fertilization barriers in crops; Chromosome manipulations in wide hybridization; case studies- Production and use of haploids, dihaploids and doubled haploids in genetics and breeding.

PRACTICAL

Learning the cytogenetics laboratory, various chemicals to be used for fixation, dehydration, embedding, staining, cleaning etc. - Microscopy: various types of microscopes- Observing sections of specimen using Electron microscope; Preparing specimen for observation – Fixative preparation and fixing specimen for light microscopy studies in cereals - Studies on the course of mitosis in wheat, pearl millet - Studies on the course of mitosis in onion and *Aloe vera* - Studies on the course of meiosis in cereals, millets and pulses - Studies on the course of meiosis in oilseeds and forage crops - Using micrometers and studying the pollen grain size in various crops -Various methods of staining and preparation of temporary and permanent slides - Pollen germination *in vivo* and *in vitro;* Microtomy and steps in microtomy; Agents employed for the induction of various ploidy levels; Solution preparation and application at seed, seedling level- Identification of polyploids in different crops - Induction and identification of haploids; Anther culture and Ovule culture– Morphological observations on synthesized autopolyploids - Observations on C-mitosis, learning on the dynamics of spindle fibre assembly – Morphological observations on alloployploids - Morphological observations on aneuploids - Cytogenetic analysis of interspecific and intergeneric crosses - Maintenance of Cytogenetic stocks and their importance in crop breeding - Various ploidy levels due to somaclonal variation ; Polyploidy in ornamental crops. -Fluorescent *in situ* hybridization (FISH)- Genome *in-situ* hybridization GISH.

SUGGESTED READINGS

- *Becker K & Hardin. 2004. The World of Cell. 5th Ed. Pearson Edu.*
- *Carroll M. 1989. Organelles. The Guilford Press.*
- *Charles B. 1993. Discussions in Cytogenetics. Prentice Hall.*
- *Darlington CD & La Cour LF. 1969. The Handling of Chromosomes.*
- *Georger Allen & Unwin Ltd.*
- *Elgin SCR. 1995. Chromatin Structure and Gene Expression. IRL Press.*
- *Gray P. 1954. The Mirotomist's Formulatory Guide. The Blakiston Co.*
- *Gupta PK & Tsuchiya T. 1991. Chromosome Engineering in Plants:*
- *Genetics, Breeding and Evolution. Part A. Elsevier.*
- *Gupta PK. 2000. Cytogenetics. Rastogi Publ.*
- *Johannson DA. 1975. Plant Microtechnique. McGraw Hill.*
- *Karp G. 1996. Cell and Molecular Biology: Concepts and Experiments.*
- *John Wiley & Sons.*
- *Khush GS. 1973. Cytogenetics of Aneuploids. Academic Press.*
- *Sharma AK & Sharma A. 1988. Chromosome Techniques: Theory and*
- *Practice. Butterworth.*
- *Sumner AT. 1982. Chromosome Banding. Unwin Hyman Publ.*
- *Swanson CP. 1960. Cytology and Cytogenetics. Macmillan & Co.*

Paper Code	Course Title	Credits
GPB-503	PRINCIPLES OF PLANT BREEDING	3(2+1)

OBJECTIVE

To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

THEORY

UNIT I

History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, characteristics improved by plant breeding; Patterns of Evolution in Crop Plants- Centres of Origin-biodiversity and its significance. 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; Plant introduction and role of plant genetic resources in plant breeding.

UNIT II

Self-incompatibility and male sterility in crop plants and their commercial exploitation. Pure line theory, pure line selection and mass selection methods; Line breeding, pedigree, bulk, backcross, single seed descent and multiline method; Population breeding in self-pollinated crops (diallel selective mating approach).

UNIT III

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 interpopulation improvement and development of synthetics and composites; Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds.

UNIT IV

Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection. Self-incompatibility and male sterility in crop plants and their commercial exploitation; Concept of plant ideotype and its role in crop improvement; Transgressive breeding. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses. Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights.

PRACTICAL

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.

SUGGESTED READINGS

- *Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.*
- *Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.*
- *Chopra VL. 2004. Plant Breeding. Oxford & IBH.*
- *Gupta SK. 2005. Practical Plant Breeding. Agribios.*
- *Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH.*
- *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.*
- *Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society.*
- *Singh BD. 2006. Plant Breeding. Kalyani.*
- *Singh P. 2002. Objective Genetics and Plant Breeding. Kalyani.*
- *Singh P. 2006. Essentials of Plant Breeding. Kalyani.*
- *Singh S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding.*

Paper Code	Course Title	Credits
GPB-504	CELL BIOLOGY AND MOLECULAR GENETICS	3(2+1)

OBJECTIVE

To impart knowledge in theory and practice about cell structure, organelles and their functions, molecules like proteins and nucleic acids.

THEORY

UNIT I

Ultrastructure of the cell; Differences between eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles – nucleus, plastidschloro/ chromoplast, mitochondria endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes.

UNIT II

Bioenergetics; Ultrastructure and function of mitochondria and biological membranes; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Cell division and physiology of cell division.

UNIT III

Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation – Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes – ribosomes, t-RNAs and translational factors.

UNIT IV

Transposable elements; Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes – DNA content variation, types of DNA sequences – Unique and repetitive sequences; organelle genomes; Gene amplification and its significance; Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging.

PRACTICAL

Morphological and Gram staining of natural bacteria; Cultivation of bacteria in synthetic medium; Determination of growth rate and doubling time of bacterial cells in culture; Demonstration of bacteriophage by plaque assay method; Determination of soluble protein content in a bacterial culture. Isolation, purification and raising clonal population of a bacterium; Biological assay of bacteriophage and determination of phage population in lysate; Study of lytic cycle of bacteriophage by one step growth experiment; determination of latent period and burst size of phages per cell; Quantitative estimation of DNA, RNA and protein in an organism; Numericals: problems and assignments.

SUGGESTED READINGS

- *Bruce A.2004. Essential Cell Biology. Garland.*
- *Karp G.2004. Cell and Molecular Biology: Concepts and Experiments. John Wiley.*
- *Klug WS & Cummings MR 2003. Concepts of Genetics. Scot, Foreman & Co.*
- *Lewin B. 2008. IX Genes. John Wiley & Sons*
- *Lodish H, Berk A & Zipursky SL. 2004. Molecular Cell Biology. 5th Ed. WH Freeman.*
- *Nelson DL & Cox MM. 2005. Lehninger's Principles of Biochemistry. WH Freeman & Co.*
- *Russell PJ. 1996. Essential Genetics. Blackwell Scientific Publ.*
- *Schleif R.1986. Genetics and Molecular Biology. Addison-Wesley Publ. Co.*

Paper Code	Course Title	Credits
PP-502	MYCOLOGY	3(2+1)

OBJECTIVE

To study the nomenclature, classification and characters of fungi.

THEORY

UNIT I

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology. Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi.

UNIT II

The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

PRACTICAL

Detailed comparative study of different groups of fungi; collection, identification and preservation of specimens. Isolation and Identification of plant pathogenic fungi.

SUGGESTED READINGS

- *Ainsworth GC, Sparrow FK & Susman HS. 1973. The Fungi – An Advanced Treatise. Vol. IV (A & B). Academic Press, New York.*
- *Alexopoulos CJ, Mims CW & Blackwell M.2000. Introductory Mycology. 5th Ed. John Wiley & Sons, New York.*
- *Mehrotra RS & Arneja KR. 1990. An Introductory Mycology. Wiley Eastern, New Delhi.*
- *Sarbhoy AK. 2000. Text book of Mycology. ICAR, New Delhi.*
- *Singh RS. 1982. Plant Pathogens – The Fungi. Oxford & IBH, New Delhi.*
- *Webster J. 1980. Introduction to Fungi. 2nd Ed. Cambridge Univ. Press, Cambridge, New York.*
- *Dubey H.C. 2005. Introduction of fungi. 3rd edition, vikash publishing house, New Delhi*

Paper Code	Course Title	Credits
PP-504	DETECTION AND DIAGNOSIS OF PLANT DISEASES	2(0+2)

OBJECTIVE

To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

PRACTICAL

UNIT I

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

UNIT II

Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

SUGGESTED READINGS

- *Baudoin ABAM, Hooper GR, Mathre DE & Carroll RB. 1990. Laboratory Exercises in Plant Pathology An Instructional Kit. Scientific Publ., Jodhpur.*
- *Dhingra OD & Sinclair JB. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.*
- *Fox RTV. 1993. Principles of Diagnostic Techniques in Plant Pathology. CABI Wallington.*
- *Pathak VN. 1984. Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi.*
- *Forster D & Taylor SC. 1998. Plant Virology Protocols From Virus Isolation to Transgenic Resistance. Methods in Molecular Biology. Humana Press, Totowa, New Jersey.*
- *Matthews REF. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Florida.*
- *Trigiano RN, Windham MT & Windham AS. 2004. Plant Pathology- Concepts and Laboratory Exercises. CRC Press, Florida.*

Paper Code	Course Title	Credits
STAT-501	STATISTICAL METHODS FOR APPLIED SCIENCES	4(3+1)

OBJECTIVE

It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

THEORY

UNIT I

Classification, tabulation and graphical, representation of data. Box-plot, Descriptive statistics. Exploratory data analysis;

UNIT II

Measures of central tendancy- Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation.

UNIT III

Theory of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions. Correlation and regression

UNIT IV

Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

PRACTICAL

- Exploratory data analysis, Box-Cox plots; Fitting of distributions~Binomial, Poisson, Negative Binomial.
- Normal; Large sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F.
- Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution.
- Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis.
- Nonparametric tests.

SUGGESTED READINGS

- *Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.*
- *Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I*
- *Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.*
- *Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.*

Paper Code	Course Title	Credits
PGS-501	BASIC CONCEPT IN LABORATORY TECHNIQUE	N.C.

OBJECTIVE

To acquaint the students about the basics of commonly used techniques in laboratory.

PRACTICAL

- 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 agrochemical 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, sand bath, water bath, oil bath; 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

- *Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.*
- *Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment.*
- *Aneja, K.R. fourth edition Experiments in Microbiology, Plant pathology and Biotechnology.*

Paper Code	Course Title	Credits
PGS-502	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	N.C.

OBJECTIVE

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.

THEORY

UNIT I

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 (NA RS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR):

UNIT II

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. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

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 (lROP) 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.

SUGGESTED READINGS

- *Bhalla G. S. & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.*
- *Punia M. S. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.*
- *Rao B. S. V. 2007. Rural Development Strategies and Role of Institutions Issues, In/lovations and Initiatives. Mittal Pub.*
- *Singh K. 199H. Rural Development - Principles. Policies and Management. Sage Pub.*

GENETICS AND PLANT BREEDING
Course Contents

(SECOND SEMESTER)

Paper Code	Course Title	Credits
GPB-511	PRINCIPLES OF QUANTITATIVE GENETICS	3(2+1)

OBJECTIVE

To impart theoretical knowledge and computation skills regarding component of variation and variances, scales, mating designs and gene effects.

THEORY

UNIT I

Mendelian traits *vs* polygenic traits - nature of quantitative traits and its inheritance - Multiple factor hypothesis - analysis of continuous variation; Variations associated with polygenic traits - phenotypic, genotypic and environmental - non-allelic interactions; Nature of gene action - additive, dominance, epistatic and linkage effects.

UNIT II

Principles of Anaylis of Variance (ANOVA) - Expected variance components, random and fixed models; MANOVA, biplot analysis; Comparison of means and variances for significance. Designs for plant breeding experiments – principles and applications; Genetic diversity analysis – metroglyph, cluster and D2 analyses - Association analysis - phenotypic and genotypic correlations; Path analysis and Parent - progeny regression analysis; Discriminant function and principal component analyses; Selection indices - selection of parents; Simultaneous selection models- concepts of selection - heritability and genetic advance.

UNIT III

Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC; Concepts of combining ability and gene action; Analysis of genotype x environment interaction - adaptability and stability; Models for GxE analysis and stability parameters; AMMI analysis– principles and interpretation.

UNIT IV

QTL mapping; Strategies for QTL mapping - desired populations for QTL mapping - statistical methods in QTL mapping - QTL mapping in Genetic analysis; Marker assisted selection (MAS) - Approaches to apply MAS in Plant breeding - selection based on marker - simultaneous selection based on marker and phenotype - factors influencing MAS.

PRACTICAL

Problems on multiple factors inheritance - Partitioning of variance - Estimation of heritability and genetic advance - Covariance analysis - Metroglyph analysis - D^2 analysis - Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms - interpretation - Correlation analysis - Path analysis - Parent-progeny regression analysis - Diallel analysis: Griffing's methods I and II – Diallel analysis: Hayman's graphical approach - Diallel analysis: interpretation of results - NCD and their interpretations - Line x tester analysis and interpretation of results - Estimation of heterosis : standard, mid-parental and better-parental heterosis - Estimation of inbreeding depression - Generation mean analysis: Analytical part and Interpretation – Estimation of different types of gene actions. Partitioning of phenotypic variance and co-variance into components due to genotypes, environment and genotype x environment interactions - Construction of saturated linkage maps and QTL mapping - Strategies for QTL mapping; statistical methods in QTL mapping; Phenotype and Marker linkage studies - Working out efficiency of selection methods in different populations and interpretation, Biparental mating, Triallel analysis, Quadriallel analysis and Triple Test Cross (TTC) – use of softwares in analysis and result interpretation, Advanced biometrical models for combining ability analysis, Models in stability analysis Additive Main Effect and Multiplicative Interaction (AMMI) model – Principal Component Analysis model - Additive and multiplicative model – Shifted multiplicative model - Analysis and selection of genotypes - Methods and steps to select the best model - Selection systems - Biplots and mapping genotypes.

SUGGESTED READINGS

- *Bos I & Caligari P. 1995. Selection Methods in Plant Breeding. Chapman & Hall.*
- *Falconer DS & Mackay J. 1998. Introduction to Quantitative Genetics. Longman.*
- *Mather K & Jinks JL. 1971. Biometrical Genetics. Chapman & Hall.*
- *Mather K & Jinks JL. 1983. Introduction to Biometrical Genetics. Chapman & Hall.*
- *Nadarajan N & Gunasekaran M. 2005. Quantitative Genetics and Biometrical Techniques in Plant Breeding. Kalyani.*
- *Naryanan SS & Singh P. 2007. Biometrical Techniques in Plant Breeding. Kalyani.*
- *Singh P & Narayanan SS. 1993. Biometrical Techniques in Plant Breeding. Kalyani.*
- *Singh RK & Choudhary BD. 1987. Biometrical Methods in Quantitative Genetics. Kalyani.*
- *Weir DS. 1990. Genetic Data Analysis. Methods for Discrete Population Genetic Data. Sinauer Associates.*
- *Wricke G & Weber WE. 1986. Quantitative Genetics and Selection in Plant Breeding. Walter de Gruyter.*

Paper Code	Course Title	Credits
GPB-512	BIOTECHNOLOGY FOR CROP IMPROVEMENTS	3(2+1)

OBJECTIVE

To impart knowledge and practical skills to use biotechnological tools in crop improvement.

THEORY

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.

UNIT II

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 (F2s, back crosses, RILs, NILs and DH). 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.

UNIT III

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; 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. Commercial releases.

UNIT IV

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 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

- *Chopra V. L, & Nasim A. 1990. Genetic Engineering and Biotechnology:*
- *Concepts, Methods and Applications. Oxford & IBH.*
- *Gupta P. K. 1997. Elements of Biotechnology. Rastogi Publ.*
- *Hackett P. B., Fuchs J. A. & Messing J. W. 1988. An Introduction to*
- *Recombinant DNA Technology - Basic Experiments in Gene*
- *Manipulation. 2nd Ed. Benjamin Publ. Co.*
- *Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual.*
- *3rd Ed. Cold Spring Harbor Lab. Press.*
- *Singh B. D. 2005. Biotechnology, Expanding Horizons. Kalyani.*

Paper Code	Course Title	Credits
GPB-513	MAINTENANCE BREEDING AND CONCEPT OF VARIETY RELEASE AND SEED PRODUCTION	2(1+1)

OBJECTIVE

To apprise the students about the variety deterioration and steps to maintain the purity of varieties & hybrids and principles of seed production in self & cross pollinated crops.

THEORY

UNIT I

Variety Development and Maintenance; Definition- variety, cultivar,extant variety, essentially derived variety, independently derived variety, reference variety, farmers' variety, hybrid,and population; Variety testing, release and notification systems in India and abroad. DUS testing- DUS Descriptors for major crops; Genetic purity concept and maintenance breeding. Factors responsible for genetic deterioration of varieties - safeguards during seed production; Maintenance of varieties in self and cross-pollination crops-isolation distance; Principles of seed production; Methods of nucleus and breeder seed production.

UNIT II

Generation system of seed multiplication -nucleus, breeders, foundation, certified, - Quality seed production technology of self and cross-pollinated crop varieties viz. cereals & millets (wheat, barley, paddy, pearlmillet, sorghum, maize and ragi etc.); Pulses (greengram, blackgram, cowpea, pigeonpea, chickpea, fieldpea, lentil); Oilseeds (groundnut, soybean, sesame, castor, sunflower, safflower, linseed, rapeseed and mustard); fibres (cotton, jute) and forages (guar, forage sorghum, teosinte, oats, berseem, lucerne).; Seed certification procedures; Seed laws and plant variety protection regulations in India and international systems.

PRACTICAL

Identification of suitable areas/locations for seed production; Ear-to-row method and nucleus seed production - Main characteristics of released and notified varieties, hybrids and parental lines; Identification of important weeds/objectionable weeds; Determination of isolation distance and planting ratios in different crops; Seed production techniques of varieties in different crops; Hybrid seed production technology of important crops.

SUGGESTED READINGS

- *Agarwal R. L. 1997. Seed Technology. 2nd Ed. Oxford & IBH.*
- *Chhabra A. K. 2006. Practical Manual of Floral Biology of Crop Plants.*
- *Department of Plant Breeding. CCS HAU Hisar.*
- *Kelly A. F. 1988. Seed Production of Agricultural Crops. Longman.*
- *McDonald M. B. Jr & Copeland LO. 1997. Seed Production: Principles and*
- *Practices. Chapman & Hall.*
- *Musil A. F. 1967. Identification of Crop and Weed Seeds. Handbook No.*
- *219, USDA, Washington, DC.*
- *Poehlman J. M. & Borthakur D. 1969. Breeding Asian Field Crops. Oxford*
- *& IBH.*
- *Singh B. D. 2005. Plant Breeding: Principles and Methods. Kalyani.*
- *Thompson J. R. 1979. An Introduction to Seed Technology. Leonard Hill.*
- *Tunwar N. S. & Singh S. V. 1985. Handbook of Cultivars. ICAR.*

Paper Code	Course Title	Credits
PP-512	INTEGRATED DISEASE MANAGEMENT	3(2+1)

OBJECTIVE

To emphasize the importance and need of IDM in the management of diseases of important crops.

THEORY

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. Development of IDM- basic principles, biological, chemical and cultural disease management. IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed mustard, pearlmillet, *kharif* pulses, vegetable crops and fruit crops.

PRACTICAL

Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

SUGGESTED READINGS

- *Gupta VK & Sharma RC. (Eds). 1995. Integrated Disease Management and Plant Health. Scientific Publ., Jodhpur.*
- *Mayee CD, Manoharachary C, Tilak KVBR, Mukadam DS & Deshpande Jayashree (Eds.). 2004.*
- *Biotechnological Approaches for the Integrated Management of Crop Diseases. Daya Publ. House, New Delhi.*
- *Sharma RC & Sharma JN. (Eds). 1995. Integrated Plant Disease Management. Scientific Publ., Jodhpur.*

Paper Code	Course Title	Credits
PP-513	MUSHROOM PRODUCTION TECHNOLOGY	3(2+1)

OBJECTIVE

To develop mushroom cultivation skills for entrepreneurial activity. Historical development of mushroom cultivation and present status of mushroom industry in India.

THEORY

UNIT I

Historical development of mushroom cultivation and present status, taxonomy, classification, food, medicinal value, uses of mushroom, edible and poisonous mushrooms. Life cycle of cultivated mushrooms, reproduction and strain improvement, maintenance of pure culture, preparation of spawn and facilities required for establishing commercial spawn lab.

UNIT II

Preparation of substrate for mushroom cultivation, long, short and indoor composting methods, formulae for different composts and their computation, qualities and testing of compost, uses of spent mushroom compost/substrate. Facilities for setting up mushroom farm for seasonal and environmentally control cultivation, requirement and maintenance of temperature, relative humidity, CO2, ventilation in cropping rooms, cultivation technology of *Agaricus bisporus, Pleurotus* sp*., Calocybe indica, Lentinus edodes* and *Ganoderma lucidum.*

UNIT III

Insect pests, diseases and abnormalities of cultivated mushroom and their management, post harvest processing and value addition, economics of mushroom cultivation, biotechnology and mushroom cultivation.

PRACTICAL

Preparation of spawn, compost, spawning, casing, harvesting and postharvest handling of edible mushroom; identification of various pathogens, competitors of various mushroom.

SUGGESTED READINGS

- *Frazier, Food Microbiology,1987.McGraw- Hill Education Pvt Ltd*
- *Pelzer, Food Microbiology,1998 McGraw- Hill Education Pvt Ltd*
- *Bibek Ray, 2005.Fundamentals of Food Microbiology, CRC Press*
- *Martin and Moss, 2008.Food Microbiology, RSC Publishing*

Paper Code	Course Title	Credits
STAT-511	DESIGN OF EXPERIMENTS	3(2+1)

OBJECTIVE

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

THEORY

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control. Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT II

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT III

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT IV

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

PRACTICAL

- Uniformity trial data analysis, formation of plots and blocks,
- Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD
- Analysis of factorial experiments without and with confounding; Analysis with
- missing data; Split plot and strip plot designs
- Transformation of data; Analysis of resolvable designs
- Fitting of response surfaces.

SUGGESTED READINGS

- Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.
- Federer WT. 1985. Experimental Designs. MacMillan. Fisher RA. 1953.
- Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983.
- The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.

Paper Code	Course Title	Credits
PGS-511	LIBRARY AND INFORMATION SERVICES	N.C.

OBJECTIVE

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

PRACTICAL

- 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; ere sources access methods.

Paper Code	Course Title	Credits
PGS-512	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	N.C.

OBJECTIVE

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

THEORY

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. 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 biodiversity protection

UNIT II

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

- *Erbisch FH & 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 & Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V.*
- *Technology Generation and IPR Issues. Academic Foundation. Rothschild M & 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.*
- *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

GENETICS AND PLANT BREEDING
Course Contents

(THIRD SEMESTER)

Paper Code	Course Title	Credits
PGS-521	TECHNICAL WRITING AND COMMUNICATION SKILL	N.C.

OBJECTIVE

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

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.

SUGGESTED READINGS

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

Paper Code	Course Title	Credits
PGS-522	DISASTER MANAGEMENT	N.C.

OBJECTIVES

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

THEORY

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

SUGGESTED READINGS

- *Gupta H. K. 2003. Disaster Management. Indian National Science*
- *Academy. Orient Blackswan.*
- *Hodgkinson P. E. & Stewart M. 1991. Coping with Catastrophe: A*
- *Handbook of Disaster Management. Routledge.*
- *Sharma V. K. 2001. Disaster Management. National Centre for Disaster*
- *Management, India.*

Paper Code	Course Title	Credits
SVN-500	**CHARITRA NIRMAN EVAM SAMGRA VYAKTITVA VIKAS**	**N.C.**

(As per Swami Vivekanand University Syllabus)

GENETICS AND PLANT BREEDING
Course Contents

(FOURTH SEMESTER)

Paper Code	Course Title	Credits
GPB-599	MASTERS RESEARCH (ACCEPTED)	10(0+10)

Note: To complete master research from the same campus as well from any ICAR, CSIR laboratory/ institute to fulfillment of his/her Master of Science in Agriculture.

SUGGESTED BROAD TOPICS FOR RESEARCH WORK

- ✓ Studies on introgressions, gene transfers, gene identification, location and localization with the application of technologies such as, *in situ* hybridization, chromosome identification like FISH (Fluorescent *In Situ* Hybridization), GISH (Genomic *In Situ* Hybridization), Spectral Karyotyping (SKY) and Multiplex Fluorescence *In Situ* Hybridization (M-FISH) etc.
- ✓ Studies on stay-green traits in relation to genes affecting efficiency of photosynthethesis, biotic/abiotic stress tolerance.
- ✓ MAS based mobilization of transgenes for tolerance to biotic and abiotic stresses into desirable agronomic backgrounds.
- ✓ Breeding methodologies to enhance selection efficiency.
- ✓ Component approaches and development of selection criteria for quantitiative trait improvement.
- ✓ Stability analyses and methods to estimate the G X E components in breeding materials.
- ✓ Relative efficiency analyses of genetic component estimation for reliable use in developing selection criteria in crop plants.
- ✓ Distance and divergence statistics for identification of similarity assessment among genetic stocks and parental genetic material.
- ✓ Linear and quadratic distance measures to identify relative contribution of component traits for complex traits.

- ✓ Studies on genetic and molecular bases of stress tolerance to develop molecular diagnostics for screening/identification of stress tolerant genotypes.
- ✓ Use of aneuploids for gene location and source for transfer through wild species.
- ✓ Development and trisomic and monosomic series in diploids and polyploids.
- ✓ Dependable marker systems for detection of introgression in wide crosses with minimized linkage drag.
- ✓ Analysis of Resistance Gene analogues and their use in MAS with enhanced disease resistance.
- ✓ Refinements in embryo rescue and consequent diplodization for production of double haploids.
- ✓ Use of molecular markers in phylogenetic analysis.
- ✓ Breeding through distant hybridization route for New Plant Type for breaking yield barriers.
- ✓ Genetics of durable, quantitative resistance and adult plant resistance in major crops against known pathogens.
- ✓ Development of tools and methodologies for identification of genes responsible for resistance against polyphagus insects.
- ✓ Development of alien addition lines and telocentric lines in crops.
- ✓ Microarray technique and robotics for identification of useful genes in crops.
- ✓ Characterization of germplasm through molecular and serological techniques.
- ✓ Induction of novel variation through mutagenesis tools and identify novel genes for different traits.
- ✓ Development of heterotic pools for maximized heterosis in cross and self pollinated crops where hybrid seed production tools are available.
- ✓ Genetics and traits responsible for terminal and initial heat tolerance in wheat, maize and mustard.
- ✓ Genetics of cold tolerance related traits in maize, rice and pigeonpea.
- ✓ Widening the QPM base in maize and prebreeding to add value to the genetic stocks of QPM.
- ✓ Comparison of relative efficiency of different softwares in analysis of quantitative trait loci and linkages.

- ✓ Biochemical and molecular bases of signal transduction in host-pathogen interactions.
- ✓ Metal binding proteins for identification of phytoremediators.
- ✓ Crop improvement for biomass energy and industrial use.
- ✓ Development of cytogenetic stocks through varietal/alien chromosome substitutions.

LIST OF SOME JOURNALS

- ❖ Australian Journal of Biological Sciences, Australia
- ❖ Australian Journal of Agricultural Research, Australia
- ❖ Biometrics, UK
- ❖ Bio-Techniques
- ❖ Cereal Research Communication, Hungary
- ❖ Cotton Research and Development, Hisar, India
- ❖ Crop Improvement, Ludhiana, India
- ❖ Crop Science, USA
- ❖ Current Science, Bangalore, India
- ❖ Critical Reviews in Plant Sciences
- ❖ Czech Journal of Plant Breeding Genetics, Prague,
- ❖ Electronic Journal of Biotechnology
- ❖ Euphytica, The Netherlands
- ❖ FABIS Newsletter
- ❖ Forage Research, Hisar, India
- ❖ Genetics, USA
- ❖ Genome, Canada
- ❖ Genetic resources and crop evolution, Netherlands
- ❖ Haryana Agricultural University Journal of Research, Hisar, India
- ❖ Heredity
- ❖ Hilgardia, Sweden,
- ❖ Indian Journal of Agricultural Research, New Delhi
- ❖ Indian Journal of Genetics and Plant Breeding, New Delhi
- ❖ Indian Journal of Plant Genetic Resources, New Delhi
- ❖ International Chickpea Newsletter, ICRISAT

- International Rice Research Notes, IRRI, Philippines
- Journal of Agricultural Research, U.K.
- Journal of Biochemistry and Biotechnology, New Delhi , India
- Journal of Genetics and Breeding, Italy
- Journal of Heredity
- Journal of Pulses Research, Kanpur, India
- Legume Research, Karnal, India
- MILWAI Newsletter
- Madras Agricultural Journal, Coimbatore, India
- Molecular Breeding, USA
- Mutation Research
- National Journal of Plant Sciences, Hisar, India
- Nucleic Acids Research, USA
- Oryza, Cuttack, India
- PGR Newsletter, Syria
- Plant Breeding, Germany
- Plant Molecular Biology, The Netherlands
- Rachis, Syria
- Sorghum and Millet Newsletter, ICRISAT
- Theoretical and Applied Genetics, Germany
- Wheat Research, Japan

SYLLABUS FOR REMEDIAL COURSES*

Semester-I

FHR-101	Fundamentals of Horticulture*	2(1+1)

Theory

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; Seed dormancy, Seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture. Irrigation – methods, Fertilizer application in horticultural crops.

Practical

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/ nursery bed. Practice of sexual and asexual methods of propagation including micro-propagation. Layout and planting of orchard. Training and pruning of fruit trees. Preparation of potting mixture. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

FSS-103	Fundamentals of Soil Science*	3(2+1)

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms:

macro and micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

FAG-106	Fundamentals of Agronomy*	4(3+1)

Theory

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, logging. Weeds- importance, classification, crop weed competition, concepts of weed management-principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agro-climatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, bulk density and infiltration rate, Measurement of irrigation water.

Semester-II

FPP-206	Fundamentals of Plant Pathology*	4(3+1)

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups**:** fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.

Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.

Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites.

Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (*Heterodera, Meloidogyne*, *Anguina, Radopholus* etc.)

Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants**.** Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy. Collection and preservation of disease specimen. Preparation of media, isolation and Koch's postulates.

General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites. Study of morphological features and identification of plant parasitic nematodes. Sampling and extraction of nematodes from soil and plant material, preparation of nematode mounting. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations**.**

FEN-207	Fundamentals of Entomology*	**4(3+1)**

Theory

Part – I

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Part-II

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance.

Part III

Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical control-importance, hazards and limitations. Recent methods of pest control, repellents, anti feed ants, hormones, attractants, gamma radiation. Insecticides Act 1968- Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.

Part – IV

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of

class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera:

Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae,Muscidae, Tephritidae.

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Dissection of male and female reproductive systems in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

Semester-III

FPB-302	Fundamentals of Plant Breeding*	3(2+1)

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproductionandapomixes,self-incompatibilityandmalesterility-geneticconsequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/ diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes-Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.