MATA GUJRI COLLEGE

FATEHGARH SAHIB

(AN AUTONOMOUS COLLEGE)

RE-ACCEREDITED BY NAAC WITH "A" GRADE

"COLLEGE WITH POTENTIAL FOR EXCELLENCE" STATUS BY UGC"

SYLLABI

SESSION: (2018-19, 2019-20)

FACULTY OF LIFE SCIENCE

DEPPARTMENT OF AGRICULTURE

COURSE: MASTER OF SCIENCE AGRICULTURE

Genetics and Plant Breeding

Outline of the Syllabus for semester-III

M.Sc. Agriculture (Genetics and Plant Breeding)

Semester-III

Paper Code	Subject	Credit hrs.		Marks		External Assessment		Internal Assessment		Grand Total
		Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	
GPB- 508	BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE	**3**	**1**	**75**	**25**	**45**	**25**	**30**	**00**	**100**
GPB 510	HETEROSIS BREEDING	**3**	**1**	**75**	**25**	**45**	**25**	**30**	**00**	**100**
SST-501	PRINCIPLES OF SEED PRODUCTION	**3**	**1**	**75**	**25**	**45**	**25**	**30**	**00**	**100**
GPB-507	BIOTECHNOLOGY FOR CROP IMPROVEMENT	**3**	**1**	**75**	**25**	**45**	**25**	**30**	**00**	**100**
GPB-599	Master's research	**0**	**10**	**00**	**100**	**00**	**100**	**00**	**00**	**100**
TOTAL		**12**	**14**	**300**	**200**	**180**	**200**	**120**	**00**	**500**

*One credit hour of Practical= 2 hours
*One credit hour of Theory= 1 hour
*One credit hour of Master Research= 1 hour

Outline of the Syllabus for Semester-IV

M.Sc. Agriculture (Genetics and Plant Breeding)

Semester-IV

Paper Code	Subject	Credit hrs		Marks		External Assessment		Internal Assessment		Grand Total
		Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	
GPB 511	MAINTENANCE BREEDING AND CONCEPTS OF RELEASE VARIETIES	3	1	75	25	45	25	30	00	100
GPB-513	BREEDING FOR QUALITY TRAITS	3	1	75	25	45	25	30	00	100
GPB-591	Master's seminar	1	0	100	00	00	00	100	00	100
GPB-599	Master's research	0	10	00	100	00	100	00	00	100
TOTAL		07	12	250	150	90	150	160	00	400

*One credit hour of Practical= 2 hours
*One credit hour of Theory= 1 hour
*One credit hour of Master Research= 1 hour

GPB 508 BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE

Time: 3 Hours **Max. Marks: 100**

Periods per Week 3+2 **Theory: 75**

Theory Internal assessment: 30

Theory external assessment: 45

Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section- B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section- C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress resistant varieties.

Theory

UNIT-I

Importance of plant breeding with related to biotic and abiotic stress. Classification of biotic stresses– major pests and diseases of economically important crops. Concepts in insect and pathogen resistance; analysis and inheritance of resistance variation. Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Phenotypic screening methods for major insects and pests; recording of observations. Types and genetic mechanisms of resistance to biotic stresses– horizontal and vertical resistance. Quantitative resistance/Adult plant resistance and Slow rusting resistance.

UNIT-II

Classification of abiotic stresses- Stress inducing factors –moisture stress/drought and water logging and submergence; acidity, salinity/alkalinity/sodicity; high/low temperature, wind, etc. Stress due to soil factors and mineral toxicity; Physiological and Phenological responses. Genetics of abiotic stress resistance. Exploitation of wild relatives as a source of resistance to biotic and abiotic stresses in major field crops. Mapping and magic population.

List of Practical's

1. Phenotypic screening techniques for sucking pests and chewing pests – traits to be observed at plant and insect level

2. Phenotypic screening techniques for nematodes and borers ; ways of combating
3. Breeding strategies
4. Evaluating the available populations like RIL, NIL etc. for pest resistance
5. Screening crops for drought and flood resistance;
6. factors to be considered and breeding strategies
7. Screening procedure of genotypes varieties of major crops for acidity and alkalinity; their effects and breeding strategies

Suggested Readings

1. Blumm A. 1988. *Plant Breeding for Stress Environments*. CRC Press.
2. Christiansen MN & Lewis CF. 1982. *Breeding Plants for Less Favourable Environments*. Wiley International.
3. Fritz RS & Simms EL. (Eds.). 1992. *Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics*. The University of Chicago Press.
4. Li PH & Sakai A. 1987. *Plant Cold Hardiness*. Liss, New York
5. Luginpill P. 1969. *Developing Resistant Plants - The Ideal Method of Controlling Insects*. USDA, ARS, Washington DC.
6. Maxwell FG & Jennings PR. (Eds.). 1980. *Breeding Plants Resistant to Insects*. John Wiley & Sons.
7. Painter RH. 1951. *Insect Resistance in Crop Plants*. MacMillan, New York.
8. Russel GE. 1978. *Plant Breeding for Pest and Disease Resistance*. Butterworths.
9. Sakai A & Larcher W. 1987. *Frost Survival in Plants*. Springer-Verlag.
10. Turener NC & Kramer PJ. 1980. *Adaptation of Plants to Water and High Temperature Stress*. John Wiley & Sons.
11. Van der Plank JE. 1982. *Host-Pathogen Interactions in Plant Disease*. Academic Press.

GPB-510 HETEROSIS BREEDING

Time: 3 Hours **Max. Marks: 100**
Periods per Week 3+2 **Theory: 75**
Theory Internal assessment: 30
Theory external assessment: 45
Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section-B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section - C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

To provide understanding about mechanisms of heterosis and its exploitation for yield improvement through conventional and biotechnological approaches.

Theory

UNIT-I

Historical aspect of heterosis- Nomenclature and definitions of heterosis. Heterosis in natural population; Evolutionary aspects– Genetic consequences of selfing and crossing in self-and cross-pollinated and asexually propagated crops. Pre Mendelian and Post Mendelian ideas. Genetic theories of heterosis– Physiological, Biochemical and molecular factors underlining heterosis; theories and their estimation; Evolutionary concepts of heterosis. Prediction of heterosis from various crosses- Inbreeding depression, frequency of inbreeding and residual heterosis in F_2 and segregating populations, importance of inbreeding in exploitation of heterosis. Relationship between genetic distance and expression of heterosis. Development of heterotic pools in germplasm/genetic stocks and inbreds, their improvement for increasing heterosis.

UNIT-II

Hybrid seed production system: 3-line, 2-line and 1-line system, Development of inbreds and parental lines- A, B and R lines. Commercial exploitation of heterosis-maintenance breeding of parental lines in hybrids. Heterosis breeding in wheat, rice, cotton, maize, pearl millet, sorghum and oilseed crops. Fixation of heterosis, Male sterile line creation and diversification in self-pollinated, cross pollinated and asexually propagated crops– problems and prospects, Apomixes in fixing heterosis- concept of

single line hybrid. Creation of male sterility through genetic engineering and its exploitation in heterosis.

List of practical's

1. Male sterile line characterization in millets; using morphological descriptors; restorer line identification and diversification of male sterile sources
2. Male sterile line creation in dicots comprising oilseeds, pulses and cotton
3. Creation of CGMS system
4. Male sterile line creation, diversification and restoration in forage crops; understanding the difficulties in breeding apomicts
5. Estimation of heterotic parameters in self, cross and asexually propagated crops- Estimation from the various models for heterosis parameters
6. Hybrid seed production in field crops – an account on the released hybrids; their potential; problems and ways of overcoming it
7. Hybrid breeding at National and International level; opportunities ahead

Suggested Readings

1. Akin E. 1979. *The Geometry of Population Genetics*. Springer-Verlag.
2. Ben Hiu Lin. 1998. *Statistical Genomics – Linkage, Mapping and QTL Analysis*. CRC Press.
3. De Joung G. 1988. *Population Genetics and Evolution*. Springer-Verlag.
4. Hartl DL. 2000. *A Primer of Population Genetics*. 3rd Ed. Sinauer Assoc.
5. Montgomery DC. 2001. *Design and Analysis of Experiments*. 5th Ed., Wiley & Sons.

SST-501 PRINCIPLES OF SEED PRODUCTION

Time: 3 Hours **Max. Marks: 100**
Periods per Week 3+2 **Theory: 75**
Theory Internal assessment: 30
Theory external assessment: 45
Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section-B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section - C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

To introduce the basic principles of quality seed production.

Theory

UNIT-I

Introduction: Seed as basic input in agriculture; seed development in cultivated plants; seed quality concept and importance of genetic purity in seed production; types of cultivars, their maintenance and factors responsible for deterioration; seed production in self and cross pollinated crops. Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, rouging etc. male sterility and self incompatibility system in hybrid seed production, role of pollinators and their management. Principles of seed production.

UNIT-II

Seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production– agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of Nucleus seed, production of Breeder, Foundation and Certified seed– criteria involved; life span of a variety and causes for its deterioration; certification standards for self and cross pollinated and vegetatively propagated crops. Hybrid Seed- Methods of development of hybrids; use of male sterility and self-incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed

production technology of major field crops and vegetables. Planning of seed production for different classes of seeds for self and cross pollinated crops.

List of Practical's

1. Planning of Seed Production
2. Requirements for different classes of seeds in field crops unit area and rate
3. Seed production in cross pollinated crops with special reference to land, isolation, planting ratio of male and female lines
4. Synchronization of parental lines and methods to achieve synchrony
5. Supplementary pollination, hand emasculation and pollination in Cotton
6. Detasseling in Corn
7. Identification of rogues and pollen shedders
8. Pollen collection and storage
9. Viability and stigma receptivity
10. Visits to seed production plots

Suggested Readings

1. Agarwal RL. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
2. Chhabra AK. 2006. *Practical Manual of Floral Biology of Crop Plants*. Dept. of Plant Breeding CCS HAU, Hisar.
3. Desai BB. 2004. *Seeds Handbook*. Marcel Dekker.
4. Kelly AF. 1988. *Seed Production of Agricultural Crops*. Longman.
5. McDonald MB Jr & Copeland LO. 1997. *Seed Production: Principles and Practices*.Chapman & Hall.
6. Musil AF. 1967. *Identification of Crop and Weed Seeds*. Handbook No. 219, USDA,Washington, DC, USA.
7. Poehlman JM & Sleper DA. 2006. *Breeding Field Crops*. Blackwell.
8. Singh BD. 2005. *Plant Breeding: Principles and Methods*. Kalyani.
9. Singhal NC. 2003. *Hybrid Seed Production in Field Crops*. Kalyani.

GPB 507 BIOTECHNOLOGY FOR CROP IMPROVEMENT

Time: 3 Hours **Max. Marks: 100**

Periods per Week 3+2 **Theory: 75**

Theory Internal assessment: 30

Theory external assessment: 45

Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section-B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section - C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

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

Theory

UNIT-I

Biotechnology and its roles in crop improvements, Definitions, Scope and prospectus in crop plants. Tissue culture- History, callus, suspension cultures, cloning, Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation. Genotyping; sequencing techniques; Biochemical and Molecular markers: morphological, biochemical and molecular markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc.). Molecular mapping and tagging of agronomically important traits.

UNIT -II

Marker assisted selection and its utilization in crop breeding, Recombinant DNA technology, transgenes, method of gene transformations, 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. GMOs related issues (risk and regulations). GMO; International regulations, Biosafety issues, Regulatory procedures in major countries including India, ethical, legal and social issues; Bioinformatics tools; Nanotechnology and its applications in crop improvement programmes.

List of Practical's

1. Requirements for plant tissue culture laboratory
2. Techniques in plant tissue culture
3. Media components and media preparation
4. Observations on the contaminants occurring in media – interpretations
5. Callus induction and regeneration.
6. Visit to commercial micro propagation unit
7. DNA isolation
8. Gel electrophoresis of proteins and isozymes
9. Running of PCR.

Suggested Readings

1. Chopra VL & Nasim A. 1990. *Genetic Engineering and Biotechnology: Concepts, Methods and Applications*. Oxford & IBH.
2. Gupta PK. 1997. *Elements of Biotechnology*. Rastogi Publ.
3. Hackett PB, Fuchs JA & Messing JW. 1988. *An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation.* 2nd Ed. Benjamin Publ.Co.
4. Sambrook J and Russel D. 2001. *Molecular Cloning*-a LABOTATORY Manual (III Ed) Cold Spring Harbor Lab. Press, USA.
5. Singh BD. 2005. *Biotechnology, Expanding Horizons*. Kalyani.

GPB-511 MAINTENANCE BREEDING AND CONCEPTS OF RELEASE VARIETIES

Time: 3 Hours **Max. Marks: 100**

Periods per Week 3+2 **Theory: 75**

Theory Internal assessment: 30

Theory external assessment: 45

Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section-B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section - C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

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

Theory

UNIT-I

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

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 and maize); Pulses (greengram, blackgram, pigeonpea, fieldpea, lentil); Oilseeds (groundnut, soybean, sunflower, linseed and mustard); fibres (cotton, jute) and forages (guar, forage sorghum, oats, berseem, lucerne). Seed certification procedures; Seed laws and plant variety protection regulationsin India and international systems. PPV&FR.

List of Practical's

1. Identification of suitable areas/locations for seed production.
2. Ear-to-row method and nucleus seed production.
3. Main characteristics of released and notified varieties, hybrids and parental lines.
4. Determination of isolation distance and planting ratios in different crops
5. Seed production techniques of varieties in different crops.
6. Hybrid seed production technology of important crops.
7. DUS Testing.

Suggested Readings

1. Agarwal RL. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
2. Chhabra AK. 2006. *Practical Manual of Floral Biology of Crop Plants*. Department of Plant Breeding. CCS HAU Hisar.
3. Kelly AF. 1988. *Seed Production of Agricultural Crops*. Longman.
4. McDonald MB Jr & Copeland LO. 1997. *Seed Production: Principles and Practices*.Chapman & Hall.
5. Musil AF. 1967. *Identification of Crop and Weed Seeds*. Handbook No. 219, USDA,Washington, DC.
6. Poehlman JM & Borthakur D. 1969. *Breeding Asian Field Crops*. Oxford & IBH.
7. Singh BD. 2005. *Plant Breeding: Principles and Methods*. Kalyani.
8. Thompson JR. 1979. *An Introduction to Seed Technology*. Leonard Hill.
9. Tunwar NS & Singh SV. 1985. *Handbook of Cultivars*. ICAR.

GPB 513 BREEDING FOR QUALITY TRAITS

Time: 3 Hours **Max. Marks: 100**
Periods per Week 3+2 **Theory: 75**
Theory Internal assessment: 30
Theory external assessment: 45
Practical: 25

INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The question paper will consist of three sections A, B and C. Section-A will have four questions from unit-I of the syllabus and section-B will have four questions from unit-II of the syllabus carrying 9 marks each. Student will have to attempt two questions from each section. Section - C will consist of 9 short answer type questions which will cover the entire syllabus uniformly and will carry 1 mark for each question. All questions of section-C are compulsory.

Objective

To provide insight into recent advances in improvement of quality traits in rice, millets, legumes, oilseeds and forage crops and for physiological efficiency using conventional and modern biotechnological approaches.

Theory

UNIT-I

Nutritional improvement- A human perspective Breeding for grain quality parameters in rice and its analysis- Golden Rice and aromatic Rice breeding strategies, achievements and application in Indian context- Molecular basis of quality traits and their manipulation in Rice- Post harvest manipulation for quality improvement. Breeding for baking qualities in wheat; characters to be considered and breeding strategies- cytogenetic manipulation for quality improvement in wheat. Breeding for quality improvement in Barley and Oats.

UNIT-II

Breeding for quality improvement in Sorghum and Pearlmillet; Quality protein Maize concept and breeding strategies. Genetic resource management for sustaining nutritive quality in crops. Breeding for quality in pulses- Breeding for quality in groundnut, sesame, sunflower and minor oilseeds– Molecular basis of fat formation and manipulation to achieve more PUFA in oil crops; Genetic manipulation for quality improvement in cotton. Genetic engineering protocols for quality improvement– Achievements Made-Value Addition in crops; classification and importance- Nutritional genomics and Second generation transgenics.

List of Practical's

1. Grain quality evaluation in rice; correlating ageing and quality improvement in rice -Quality analysis in millets.
2. Quality parameters evaluation in wheat.
3. Quality parameters evaluation in pulses.
4. Quality parameters evaluation in oilseeds – Value addition in crop plants;
5. Post harvest processing of major field crops.
6. Quality improvement in crops through tissue culture techniques.

Suggested Readings

1. Chahal GS & Ghosal SS. 2002. *Principles and Procedures of Plant Breeding - Biotechnological and Conventional Approaches*. Narosa Publ.
2. Chopra VL. 1997. *Plant Breeding*. Oxford & IBH.
3. FAO 2001. *Speciality Rices of the World - Breeding, Production and Marketing*. Oxford& IBH.
4. Ghosh P. 2004. *Fibre Science and Technology*. Tata McGraw Hill.
5. Hay RK. 2006. *Physiology of Crop Yield*. 2nd Ed. Blackwell.
6. Nigam J. 1996. *Genetic Improvement of Oilseed Crops*. Oxford & IBH.
7. Singh BD. 1997. *Plant Breeding*. Kalyani.
8. Singh RK, Singh UK & Khush GS. 2000. *Aromatic Rices*. Oxford & IBH.