Rama University, Uttar Pradesh, Kanpur-209217

EVALUATION SCHEME

&

SYLLABUS

FOR

M.Sc. (Ag)

Genetics and Plant Breeding
2024-25

Faculty of Agricultural Sciences & Allied Industries,

Rama University, Kanpur-209217

Faculty of Agricultural Sciences & Allied Industries
Rama University Uttar Pradesh, Kanpur
(Department of Genetics and Plant Breeding)

Report on Feedback on Genetics and Plant Breeding by Industry and Stakeholders

Genetics and plant breeding play a vital role in addressing global challenges related to food security, agricultural sustainability, and climate change resilience. As such, it's crucial to gather feedback from industry stakeholders to understand their perspectives, needs, and expectations regarding genetics and plant breeding research, technologies, and applications. This report summarizes the feedback obtained from various industry representatives and stakeholders through interviews, surveys, and consultations.

1. Demand for Improved Traits: Industry stakeholders expressed a strong demand for crop varieties with enhanced traits such as yield potential, stress tolerance (e.g., drought, heat, pests), disease resistance, and nutritional quality. There is a growing need for genetics and plant breeding solutions that address specific challenges faced by farmers, including climate variability, pest outbreaks, and soil degradation.

2. Interest in Advanced Technologies: Industry representatives emphasized the importance of adopting advanced technologies in genetics and plant breeding, including genomic selection, marker-assisted breeding, gene editing, and high-throughput phenotyping. These technologies offer opportunities to accelerate breeding progress, enhance trait introgression, and develop tailored solutions for diverse agricultural environments.

3. Focus on Sustainability and Resilience: Stakeholders highlighted the importance of sustainability and resilience in crop breeding programs. There is a growing emphasis on developing environmentally friendly and resource-efficient crop varieties that minimize chemical inputs, conserve water, and promote soil health. Additionally, there is interest in breeding resilient crops capable of withstanding extreme weather events and adapting to changing climatic conditions.

4. Collaboration and Knowledge Exchange: Collaboration between academia, industry, and government agencies was identified as crucial for advancing genetics and plant breeding research

and innovation. Industry stakeholders expressed interest in establishing partnerships with research institutions and breeding organizations to access cutting-edge technologies, genetic resources, and expertise. There is also a need for greater knowledge exchange and technology transfer initiatives to facilitate the adoption of research findings and best practices by breeders and growers.

5. Regulatory and Market Considerations: Industry representatives highlighted the importance of navigating regulatory frameworks and market dynamics in genetics and plant breeding. There is a need for clear and transparent regulations governing the use of genetic technologies, including gene editing, to ensure safety, consumer acceptance, and market access. Additionally, there is interest in understanding consumer preferences, market trends, and value chain considerations to guide breeding priorities and product development efforts.

Conclusion:

The feedback obtained from industry stakeholders underscores the importance of genetics and plant breeding in addressing current and future challenges in agriculture. There is a strong demand for innovative breeding solutions that enhance crop performance, sustainability, and resilience while addressing regulatory, market, and societal considerations. Collaboration, technology adoption, and knowledge exchange will be critical for driving advancements in genetics and plant breeding that benefit farmers, consumers, and the environment.

BoS Chairman

Dean

Faculty of Agricultural Sciences & Allied Industries
Rama University Uttar Pradesh, Kanpur
(Department of Genetics and Plant Breeding)

Action Taken Report based on Feedback at BoS held on 11.05.2024

- Invited resource persons from industries were made to address the students.
- Visits and interaction with progressive farmers, Seed industries, Agribusiness personals, ICAR research stations to learn about the latest technologies.
- Students are conducting their trails in the campus for the research associated with the genetics and plant breeding.

BoS Chairman

Dean

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

A meeting of the Board of Studies of the Ph.D. Genetics and Plant Breeding, Faculty of Agricultural Sciences & Allied Industries, Rama University Uttar Pradesh, Kanpur was held on 11th May 2024, 10:00 am. The following members were present:

1.	Dr. Aneeta Yadav	Convener
2.	Mr. Syed Mohd Quatadah	Member
3.	Dr. Kartikay Bisen	Member
4.	Dr. Yogesh Kumar	External Member
5.	Dr. Shweta Singh	External Member

The quorum of the meeting was complete.

Agenda of the meeting:

1. Assessment Criteria
2. Question Paper Format
3. Syllabus

The meeting resolved unanimously that attached Assessment Criteria, Question Paper Format and Syllabus are justified and approved.

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members

Signature: 1..... 2.....
Name: Mr. Syed Mohd Quatadah Dr. Kartikay Bisen
Date:

External Members

Signature: 1..... 2.....
Name: Dr. Yogesh Kumar Dr. Shweta Singh
Date:

Faculty of Agricultural Sciences & Allied Industries

Rama University Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc.(Ag.) GENETICS & PLANT BREEDING FIRST YEAR (SEMESTER-I)

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit Hours
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	MSG-101	Principles of Genetics	2	0	0	20	20	60	100	2
2	MSG-102	Principles of Cytogenetics	2	0	0	20	20	60	100	2
3	MSBT- 103	*Principles of Biotechnology	2	0	0	20	20	60	100	2
Practicals / Project										
4	MSG -151	Principles of Genetics	0	0	1	30	20	50	100	1
5	MSG – 152	Principles of Cytogenetics	0	0	1	30	20	50	100	1
6	MSBT -153	Principles of Biotechnology	0	0	1	30	20	50	100	1
Total			**6**	0	**3**	**150**	**120**	**330**	**600**	**9**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

First Mid Term Examination: 10 marks

a. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks
*Denotes minor subjects
** Denotes basic supporting subjects

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members
Signature: 1..... 2.....
Name: Mr. Syed Mohd Quatadah Dr. Kartikay Bisen
Date:

External Member
Signature: 1..... 2.....
Name: Dr. Yogesh Kumar Dr. Shweta Singh
Date:

Course Learning Outcomes (CLO)

- Identify the area of research in field of Genetics and Plant Breeding.
- Develop a research problem and plan for further investigation.
- Propose research topic and objective of research work planned.
- Quote the available literature during development of research plan.
- Collect suitable review of literatures related to the planned work

Faculty of Agricultural Sciences & Allied Industries

Rama University Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc.(Ag.) GENETICS & PLANT BREEDING FIRST YEAR (SEMESTER-II)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	MSG-201	Principles of Plant Breeding	2	0	0	20	20	60	100	2
2	MSG-202	Principles of Quantitative Genetics	2	0	0	20	20	60	100	2
3	MSBT-203	*Biotechnology for Crop Improvement	2	0	0	20	20	60	100	2
4	MSG-204	**Basic Design of Experiments	2	0	0	20	20	60	100	2
Practical / Project										
5	MSG-251	Principles of Plant Breeding	0	0	1	30	20	50	100	1
6	MSG-252	Principles of Quantitative Genetics	0	0	1	30	20	50	100	1
7	MSBT-253	Biotechnology for Crop Improvement	0	0	1	30	20	50	100	1
8	MSG-254	Basic Design of ExperimentsLab	0	0	1	30	20	50	100	1
9	MSG- 255	Master Seminar	0	0	1	0	0	100	100	1
	MSG- 256	Master Research Synopsis	0	0	1	Satisfactory/ non-satisfactory				1
10	PGS 202	**Library and Information Services	0	0	1	30	20	50	100	1
Total			**8**	**0**	**6**	**200**	**160**	**430**	**800**	**15**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

3 Attendance: 5 Marks
4 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks
*Denotes minor subjects
**Denotes basic supporting subjects

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members
Signature: 1..... 2.....
Name: Mr. Syed Mohd Quatadah Dr. Kartikay Bisen
Date:

External Member
Signature: 1..... 2.....
Name: Dr. Yogesh Kumar Dr. Shweta Singh
Date:

Course Learning Outcomes (CLO)

- Identify the area of research in field of Genetics and Plant Breeding.
- Develop a research problem and plan for further investigation.
- Propose research topic and objective of research work planned.
- Quote the available literature during development of research plan.
- Collect suitable review of literatures related to the planned work

Faculty of Agricultural Sciences & Allied Industries

Rama University Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)

M.Sc.(Ag.) GENETICS & PLANT BREEDING SECOND YEAR (SEMESTER-III)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory Subjects										
1	MSG- 301	*Cell Biology & Molecular Genetics	2	0	0	20	20	60	100	2
2	MSG- 302	Breeding for Biotic and Abiotic Stress Resistance	2	0	0	20	20	60	100	2
3	SST- 303	Principles and Practices of Seed Production	2	0	0	20	20	60	100	2
4	PPA- 301	Diseases of Field Crops	2	0	0	20	20	60	100	2
5	PGS- 301	History of Agriculture	1	0	0	20	20	60	100	1
Practicals / Project										
6	MSG- 351	Cell Biology & Molecular Genetics	0	0	1	30	20	50	100	1
7	MSG- 352	Breeding for Biotic and Abiotic Stress Resistance	0	0	1	30	20	50	100	1
8	MSG- 353	Principles and Practices of Seed Production	0	0	1	30	20	50	100	1
9	PPA- 351	Diseases of Field Crops	0	0	1	30	20	50	100	1
Total			**9**	**0**	**4**	**240**	**180**	**500**	**900**	**13**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

5 Attendance: 5 Marks

6 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks
  a. First Mid Term Examination: 10 marks
  b. Second Mid Term Examination: 10 marks
ETE - End Term Examination: 50 Marks
  *Denotes minor subjects
  ** Denotes basic supporting subjects

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members
Signature: 1..... 2.....
Name: Mr. Syed Mohd Quatadah Dr. Kartikay Bisen
Date:

External Member
Signature: 1..... 2.....
Name: Dr. Yogesh Kumar Dr. Shweta Singh
Date:

Course Learning Outcomes (CLO)

- Identify the area of research in field of Genetics and Plant Breeding.
- Develop a research problem and plan for further investigation.
- Propose research topic and objective of research work planned.
- Quote the available literature during development of research plan.
- Collect suitable review of literatures related to the planned work

Faculty of Agricultural Sciences & Allied Industries
Rama University Uttar Pradesh, Kanpur
Course Detail and Evaluation Scheme
(Effective from the Session 2024-25)
M.Sc.(Ag.) Genetics & Plant Breeding Second Year (SEMESTER-IV)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory Subjects										
1	MSG-600	Master's Research (Research Work & Thesis)	0	0	2	Satisfactory/ non-satisfactory				20
Total			0	**0**	2					**20**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

7 Attendance: 5 Marks

8 Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

Convener
Signature: .....
Name : Dr. Aneeta Yadav
Date :

Internal Members
Signature: 1..... 2.....
Name: Mr. Syed Mohd Quatadah Dr. Kartikay Bisen
Date:

External Member
Signature: 1..... 2.....
Name: Dr. Yogesh Kumar Dr. Shweta Singh
Date:

Course Learning Outcomes (CLO)

- Identify the area of research in field of Genetics and Plant Breeding.
- Develop a research problem and plan for further investigation.
- Propose research topic and objective of research work planned.
- Quote the available literature during development of research plan.
- Collect suitable review of literatures related to the planned work

Genetics and Plant Breeding

MSG-101 **PRINCIPLES OF GENETICS** **(2L+1P)**

L	T	P	CR
2	0	1	3

Course objective:

-

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

Theory

Detail Contents

Unit 1:	**25%**
Unit 2:	**15%**
Unit 3:	**15%**
Unit 4:	**25%**
Unit 5:	**20%**

UNIT-1

History of Genetics; Mitosis & Meiosis, Pre-Mendelian concepts of inheritance, Mendel's laws; Discussion of Mendel's paper; Probability, Chromosomal theory of inheritance. Multiple alleles, Sex-linkage, Two point and three point cross, Linkage Detection, Linkage estimation by various methods in test crosses, intercrosses; recombination and genetic mapping in eukaryotes -classical to modern, Somatic cell genetics.

UNIT-2

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Epigenetics. Genetic code; Protein biosynthesis,Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Gene families and clusters.

UNIT-3 **III**

Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Gene expression & regulation in eukaryotes.

UNIT-4 **IV**

DNA sequencing Gene cloning, genomic and cDNA libraries, PCR-based cloning, Nucleic acid hybridization and immuno-chemical detection; DNA restriction and modification, Anti-sense RNA, Gene silencing and ribozymes; Micro-RNAs (miRNAs). Genomics: Functional, structural & comparative, proteomics, metagenomics

UNIT-5 **V**

Methods of studying polymorphism; Transgenic bacteria and bioethics; genetics of mitochondria and chloroplasts, Extra chromosomal inheritance. Eugenics, Genetic Disorders and Behavioural Genetics,Euphenics.

Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium.

Practical's

Laboratory exercises in probability and chi-square; Demonstration of genetic principles using laboratory organisms; Gene mapping using three point test cross; Tetrad analysis; Induction and detection of mutations, complementation. Study of chromosome aberrations, (deletions, inversion, translocations); DNA extraction and PCR amplification - Electrophoresis – basic principles separation of DNA.

Course Learning Outcomes (CLO)

CO-1: Comprehensive, detailed understanding of the chemical basis of heredity specially in crop plants, to improve and develop the new varieties of plants.

CO-2: Understanding of how genetic concepts affect broad societal issues including health and diseases, food and natural resources, environmental sustainability, etc.

CO-3: The knowledge required to to design, execute, and analyze the results of genetic experimentation in plant systems.

CO-4: Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings.

CO-5: Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	2	1
CO2	1	1	1	1	-	1	1	1
CO3	1	1	1	1	1	1	1	1
CO4	3	2	2	1	2	1	2	1
CO5	1	1	2	3	2	2	3	1
Average	1.8	1.2	1.4	1.4	1.5	1.6	1.8	1

Text books: -

- Gardner, E.J. and Snustad, D.P. 1991. Principles of Genetics. John Wiley & Sons.
- Klug, W.S. and Cummings, M.R. 2003. Concepts of Genetics. Peterson Education.
- Lewin, B. 2008. Genes IX. Jones & Bartlett Publ.
- Russell, P.J. 1998. Genetics. The Benjamin/Cummings Publ. Co.
- Strickberger, M.W. 2008. Genetics. Pearson Education.
- Tamarin, R.H. 1999. Principles of Genetics. Wm. C. Brown Publs.
- Snustad, D.P. and Simmons, M.J. 2006. Genetics, 4th Ed. John Wiley & Sons

Reference books: -

- B. D. Singh. Principles of Genetics. Kalyani Publishers.
- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- P. Singh. Elements of Genetics. Kalyani Publishers.
- 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.

Signature: -

1. .....

2. .....

3. .....

4. .....

5.....

MSG 102 **PRINCIPLES OF CYTOGENETICS** **(2L+1P)**

L	T	P	CR
2	0	1	3

Course objective:-

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

Theory

Detail Contents

Unit 1:	**10%**
Unit 2:	**30%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**20%**

UNIT-1

Chromosome architecture in prokaryotes and eukaryotes; Eukaryotic chromosome structure & organization, Artificial chromosomes- BACS, YACs, construction and its uses; Special types of chromosomes .

UNIT-2

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 – karyotyping techniques; Chromosome banding and painting - *in situ* hybridization and its applications, GISH, FISH.

UNIT-3

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 complexe

UNIT-4

Inter-varietal chromosome substitutions, Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of autopolyploidsvs 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 disadvantage.

UNIT-5

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;

Practicals

Preparation of tissues for cytogenetical analyses (Fixatives, fixation, dehydration, embedding, staining, cleaning etc.) - Microscopy: various types of microscopes, Mitosis in wheat, pearl millet,onion, *Aloe vera,* oilseeds, forage crops and pulses, Measuring pollen grain size in various crops with micrometer, Methods of preparing permanent slides, Pollen germination *in vivo* and *in vitro,* Identification of polyploids in different crops, Morphological observations on autopolyploids and alloployploids - Morphological observations on aneuploids, Cytogenetic analysis of interspecific and intergeneric crosses, Fluorescent in situ hybridization (FISH), Genome in situ hybridization GISH.

Course Learning Outcomes (CLO)

CO-1: Comprehensive, detailed understanding of the structure and functions of chromosomes.

CO-2: Understanding of chromosome mapping, polyploidy and.

CO-3: Insight into the cytogenetic aspects of crop evolution

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	3	2	3	1	1	2	1
CO2	1	2	1	3	2	1	2	1
CO3	3	2	1	3	2	1	2	1
Average	1.66	2.33	1.33	3	1.66	1	2	1

Text books: -

- Gupta, P.K. and Tsuchiya, T. 1991. Chromosome Engineering in Plants. Part A. Elsevier.
- Gupta, P.K. 2000. Cytogenetics. Rastogi Publications
- Johannson, D.A. 1975. Plant Microtechnique. McGraw Hill Co, New York.
- Karp, G. 1996. Cell and Molecular Biology: Concepts and Experiments. John-Wiley & Sons, Inc., 773p.
- Khush, G.S. and Rick R. 1981. Cytogenetics of Aneuploids, Academic Press.
- Sharma, A.K. and Sharma, A. 1988. Chromosome techniques: Theory and practice, Butterworth, London.

Reference books:-

- B. D. Singh. Principles of Genetics. Kalyani Publishers.
- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- P. Singh. Elements of Genetics. Kalyani Publishers.
- Gupta PK. 2000. Cytogenetics. Rastogi Publ.

Signature: -

1. .....

2. .....

3. .....

4. .....

MSBT 103 **PRINCIPLES OF BIOTECHNOLOGY** **(2L+1P)**

L	T	P	CR
2	0	1	3

Course objective: - To impart knowledge and practical skills to use biotechnological tools in cropimprovement.

Theory

Detail Contents

Unit 1:	**10%**
Unit 2:	**25%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**25%**

Unit-I
History, Scope and Importance; DNA Structure, function and metabolism.

Unit-II:
DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their application

Unit-III:
Molecular Markers and their application; DNA sequencing; Applications of gene cloning in basic and applied research, QTL mapping.

Unit-IV:
Genetic engineering perception of biotechnology; and Transgenics, biosafety concerns in transgenics; Genomics, transcriptomics and proteomics.

Unit-V: General application of biotechnology in Agriculture, Medicine, Environmental remediation, Energy production, and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

Practical

i. Isolation of genomic and plasmid DNA
ii. Gel electrophoresis techniques
iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
iv. PCR and molecular marker analysis
v. Plant tissue culture, media preparation, cell and explant culture, regeneration and transformation

Course Learning Outcomes (CLO)

CO-1: Comprehensive, detailed understanding History, Scope and Importance; DNA Structure, function and metabolism.
CO-2: Understanding of recombinant DNA technology, PCR amplification.
CO-3: Insight into the General application of biotechnology in Agriculture.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	1	2	1
CO2	1	1	1	2	1	1	2	1
CO3	2	2	2	3	1	2	2	1
Average	1.33	1.33	1.33	2.33	1	1.33	2	1

Text books: -

1. Introduction to Biotechnology- C.M. Brown, I. Campbell and F.G. Priest
2. Plant Biotechnology – H.S. Chawala
3. Biotechnology – B.D. Singh
4. Element of Biotechnology – Prof. P.K. Gupta

Reference books:-

- Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.
- Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
- Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani.

Signature:-

1. .....
2. .....
3. .....
4. .....

MSBT 103 **PRINCIPLES OF PLANT BREEDING** **(2L+1P)**

L	T	P	CR
2	0	1	3

Course objective: - objectives, modes of improvement to impart theoretical knowledge and practical skills about plant breeding reproduction and genetic consequences, breeding methods forcrop

Theory Detail Content	Percent Covers
Unit-1	10%
Unit-2	20%
Unit-3	30%
Unit-4	40%
Unit-5	50%

UNIT-1 History of Plant Breeding (Pre and Post Mendelian era), Objectives of plant breeding, Characteristics improved by plant breeding. - Centres of Origin-biodiversity and its significance

UNIT-2

Genetic basis of breeding self- and cross - pollinated crops, 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. Self-incompatibility and male sterility in crop plants and their commercial exploitation, Apomixis and its role in plant breeding.

UNIT-3

Breeding self pollinated crops, Pure line theory; pure line selection and mass selection methods, line breeding, pedigree, bulk, backcross, single seed descent and multiline method. 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 inter-population improvement and development of synthetics and composites.

UNIT-4

Breeding methods in asexually/clonally propagated crops, clonal selection.Self-incompatibility and male sterility in crop plants and their commercial exploitation; concept of plant ideotype and its role in crop improvement. Special breeding techniques- Mutation breeding, polyploids. Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, maintenance of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds.

UNIT-5

Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights, DUS testing, Quality seeds-types and production.Parent selection.Combining ability and type of crosses. Biotechnology in crop improvement-An overview. Transgenic crops- current status and future prospects, integration of transgenics into breeding programmes. Molecular breeding-molecular markers (isozymes, RFLP, RAPD AFLP, SSR and SNPs), mapping populations (RILs, NILs, DH, Backross), their merits and demerits, markers assisted selection

Practicals

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.

Course Learning Outcomes (CLO)

CO-1: Establish the commercial plant breeding company to developed new superior crops varieties.

CO-2: Develop the insect and disease resistant varieties for environment friendly management of disease and insect.

CO-3: Serve the quality food in the market by developing high nutritive varieties.

CO-4: Increase the farm yield to get higher income on farm by developing higher yield crop varieties.

CO-5: start a consultant company to guide & supply the better varieties to the farmers.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	3	1	1	3
CO2	1	1	-	1	-	1	1	-
CO3	2	1	1	1	1	2	1	1
CO4	3	1	1	2	2	3	2	2
CO5	1	1	1	1	2	1	1	2
Average	1.6	1	1	1.2	2	1.6	1.2	2

Text books:-

- Allard, R.W. 1981. Principles of Plant Breeding, John Wiley & Sons.
- Chopra, V.L. 2001. Breeding Field Crops. Oxford & IBH.
- Sharma, J.R. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
- Simmonds, N.W. 1990. Principles of Crop Improvement. English Language Book Society.
- Singh, B.D. 2006. Plant Breeding. Kalyani.

Reference books:-

- B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
- P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
- P. Singh. Elements of Genetics. Kalyani Publishers
- Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
- Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.
- Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH.
- Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.

Signature:-

1. .....
2. .....
3. .....
4. .....

MSG 202 PRINCIPLES OF QUANTITATIVE GENETICS (2L+1P)

L	T	P	CR
2	0	1	3

Course objective:- To impart theoretical knowledge and computation skills regarding component of variation and variances, Probability, scales, mating designs and gene effects.

Theory

Detail Contents

Unit 1: **20%**

Unit 2: **20%**

Unit 3: **20%**

Unit 4: **20%**

Unit 5: **20%**

UNIT-I
Probability and its application in genetic analyses; Random variables and Probability distributions.

UNIT-II
Genotypic and Phenotypic variation.Genetic component analyses; Partitioning of main effects and variances – ANOVA-MANOVA.

UNIT-III
General concepts of gene action – single and multigene models –genetical parameters and their estimations.

UNIT-IV

Heritability & components of gene action.Linkage & Linkage Disequilibrium.Inbreeding and covariance between relatives.

UNIT-V
Mating systems and designs; Combining ability – effects and variance; Genetic divergence. Heterosis; Populations- concepts and their improvement approaches.

Practical

Problems on multiple factors inheritance - Partitioning of variance -Estimation of heritability and genetic advance - Covariance analysis - D2 analysis - Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms - interpretation – Diallel analysis: Hayman's graphical approach and Griffings numerical 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.

Course Learning Outcomes (CLO)

CO-1: To understand Probability

CO-2: To understand gene action – single and multigene models –genetical parameters and their estimations.

CO-3: Knowledge to Linkage & Linkage Disequilibrium. Inbreeding and covariance between relatives.

CO-4: To understand Mating systems.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	1	1	1
CO2	2	1	1	1	1	2	1	1
CO3	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1
Average	1.5	1	1.25	1	1	1.25	1	1

Text books:-

- Falconer, D.S. and Mackay, J. 1998. Introduction to Quantitative Genetics. Longman.
- Mather, K. and Jinks, J.L. 1983. Introduction to Biometrical Genetics. Chapman & Hall.
- Naryanan, S.S. and Singh, P. 2007. Biometrical Techniques in Plant Breeding. Kalyani.
- Singh, P. and Narayanan, S.S. 1993. Biometrical Techniques in Plant Breeding. Kalyani.
- Singh, R.K. and Choudhary, B.D. 1987. Biometrical Methods in Quantitative Genetics. Kalyani.

Reference books:-

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers

Falconer DS & Mackay J. 1998. Introduction to Quantitative Genetics. Longman.

Singh P & Narayanan SS. 1993. Biometrical Techniques in Plant Breeding. Kalyani.

Signature:-

1. .....

2. .....

3. .....

4. .....

BIOTECHNOLOGY FOR CROP IMPROVEMENT

MSBT -203 **3 (2L+1P)**

L	T	P	CR
2	0	1	3

Course objective: - To impart knowledge and practical skills to use biotechnological tools in cropimprovement.

Detail Contents:

Unit 1: 20%

Unit 2: 20%

Unit 3: 20%

Unit 4: 20%

Unit 5: 20%

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, seed culture and embryo culture; cryopreservation.

UNIT II

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

UNIT III

Marker assisted selection and molecular breeding; Genomics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression,

UNIT IV

Recombinant DNA technology, transgenes, method of transformation, 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 V

Biotechnology applications in male sterility/hybrid breeding, molecular farming.

MOs and related issues (risk and regulations); GMO; International regulations, bio-safety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights

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; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures - Visit to commercial micro-propagation unit.

Course Learning Outcomes (CLO)

CO-1: Comprehensive, detailed understanding of Biotechnology especially for cropimprovement.
CO-2: Understanding Tissue culture, Recombinant DNA technology and Transgenes.
CO-3: Insight into the Molecular mapping, Marker assisted selection.
Mapping of course outcum with programme outcum and programe specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	3	1	1	3	1
CO2	1	1	1	2	1	1	2	1
CO3	1	1	1	3	1	1	3	1
Average	1	1	1	2.66	1	1	2.66	1

Text books:-

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

Reference books:-

B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishe

Signature:-

1. ……..

2. ……

3. ……

4. ……

MSG 204

BASIC DESIGN OF EXPERIMENTS

	L	(2L+1P) T	P	CR
L				
2	0	0	1	3

Course objective: - Design of Experiments provides the statistical tools to get maximum information from least number of resources. This course is meant to expose the students to the basic principles of design of experiments. The students would also be provided with mathematical background of various basic designs involving one-way and two way elimination of heterogeneity and their characterization properties. This course would also prepare the students in deriving the expressions for analysis of experimental data.

Theory

Detail Contents:

Unit 1:	**20%**
Unit 2:	**20%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**20%**

UNIT-I

Basic principles of design of experiments. Uniformity trials. Analysis of variance. Completely randomized design (CRD), Randomized complete block design (RCBD), Latin square design (LSD), Augmented design.

UNIT-II

Balanced incomplete block (BIB) design, Resolvable block designs and their applications: Alpha design and Lattice design-concepts. Randomization procedure, analysis and interpretation of results.

UNIT-III
Factorial experiments (symmetrical as well as asymmetrical). Confounding in factorial experiments - application in 2n and 3n factorial experiments. Factorial experiments with extra treatment(s). Split plot and Strip plot designs.

UNIT-IV
Groups of experiments. Analysis of covariance.Missing plot technique and its application to RCBD, LSD. Cross-over design.

UNIT-IV
Sampling in field experiments. Transformation of data. Response surfaces. Experiments with mixtures.

Practicals
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 of Covariance, Analysis with missing data, Split plot and strip plot designs, Groups of experiments, Transformation of data, Fitting of response surfaces.

Course Learning Outcomes (CLO)
At the end of the course student will be able to know

CO1. Acquaintance with some basic concepts in statistics.
CO2. Getting knowledge about some elementary statistical methods of analysis of data viz. Measures of Central Tendency, Dispersion, Moments, Skewness, and Kurtosis and to interpret them.
CO3. Analysis of data pertaining to attributes and to interpret the results.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1	1
CO3	3	1	1	1	1	1	1	1
Average	3	1	1	1	1	1	1	1

Text books:-

- Cochran, W.G. and Cox, G.M. 1957. *Experimental Designs.* John Wiley and Sons.
- Panse, V.G. and Sukhatme, P.V. 1967. *Statistical Methods for Agricultural Workers.* ICAR

Reference books:

Chakrabarti MC. 1962. Mathematics of Design and Analysis of Experiments. Asia Publ.House.

• Cochran WG & Cox DR. 1957. Experimental Designs. 2nd Ed. John Wiley. • Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.

• Dey A 1986. Theory of Block Designs. Wiley Eastern.

• Kempthorne, O. 1976. Design and Analysis of Experiments. John Wiley.

Signature:-

1. .....

2. .....

3. .....

4. .....

PGS 202 **LIBRARY AND INFORMATION SERVICES** **(0L+1P)**

L	T	P	CR
0	0	1	1

Course objective:-To understand basic concept of Library.

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; e-resources access methods.

Textbooks:

Reference books:

Signature:-

1. .....

2. .....

3. .....

4. .....

SST-303 **(Seed Production: Principles And Practices)**

(2L+1P) III

L	T	P	CR
2	0	1	3

Course 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

Detail Contents

Unit 1: **20%**

Unit 2: **20%**

Unit 3: **20%**

Unit 4: **20%**

Unit 5: **20%**

UNIT I

Seed as a basic input in agriculture, quality concept and importance of genetic purity in seed production; life span of varieties and factors responsible for their deterioration.

UNIT II

Steps in the development, evaluation, release, notification and maintenance of varieties; classification of crop plants in relation to the mode of reproduction and its modification for hybrid seed production.

UNIT III

Principles of hybrid seed production viz. isolation, synchronization of flowering, field inspection, rogueing etc.; special agronomical practices for seed production and effect of environment before harvest on seed quality.

UNIT IV

Male sterility and self-incompatibility in hybrid seed production, role of insect pollinators and their management for hybrid seed production, ecology and dynamics of pollinators.

UNIT V

Seed quality control system and organization, suitable seed production areas, seed village concept; agencies responsible for seed production, seed industry in India, custom seed production, role of seed growers and seed producers in hybrid seed production.

Practicals

Seed production in rice and maize (varieties and hybrids), pollination in hybrid seed production plots of rice and maize, visit to Bajra and cotton seed production plots, visit to vegetable seed production field, hybrid seed production in cauliflower. Emasculation and pollination in bitter gourd and brinjal. Visit to seed production companies and certification agencies. Visit to seed processing units.

Course Learning Outcomes (CLO)

CO-1: Start a seed production program for fill full the requirement of quality seed in market and increase the income.

CO-2: Storage the pure variety seed to avoid the availability crises of pure variety seed due to adverse environmental conditions.

CO-3:To supply the disease free seed in the market to get the environment friendly cultivation of crops.

CO-4: To increase the farm income by producing high yielding disease free quality seed and decrease the cost of cultivation also.

CO-5:Production of hybrid seed of different crops to increase the farm income.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	3	1	1	3
CO2	1	1	1	1	3	1	1	1
CO3	1	1	1	1	2	1	1	2
CO4	1	1	1	1	2	1	1	2
CO5	1	1	1	1	3	1	1	3
Average	1	1	1	1	2.6	1	1	2.2

Text books:-

- Agarwal, R.L. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
- Chhabra, A.K. 2006. Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding CCS HAU, Hisar.
- Desai, B.B. 2004. *Seeds Handbook*. Marcel Dekker.
- Kelly, A.F. 1988. *Seed Production of Agricultural Crops*. Longman.
- Mc Donald, M.B. Jr and Copeland, L.O. 1997. *Seed Production: Principles and Practices*. Chapman & Hall.
- Musil, A.F. 1967. Identification of Crop and Weed Seeds. Handbook No. 219, USDA, Washington, DC, USA.
- Poehlman, J.M. and Sleper, D.A. 2006. *Breeding Field Crops*. Blackwell.
- Singh, B.D. 2005. *Plant Breeding: Principles and Methods*. Kalyani Publishers.
- Singhal, N.C. 2003. *Hybrid Seed Production in Field Crops*. Kalyani Publishers.
- Thompson, J.R. 1979. *An Introduction to Seed Technology*. Leonard Hill.
- Tunwar, N.S. and Singh, S.V. 1985. *Handbook of Cultivars*. CSCB, GOI.

Reference books:-

B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers

Signature:-

1. .....
2. .....
3. .....
4. .....

MSG- 301 CELL BIOLOGY AND MOLECULAR GENETICS 3 (2+1)

L	T	P	CR
2	0	1	3

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

Detail Contents

Unit 1: 20%
Unit 2: 20%
Unit 3: 20%
Unit 4: 20%
Unit 5: 20%

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, plastids- chloro/chromoplast, mitochondria endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes. 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 II

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

UNIT III

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.

UNIT IV

Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging. Introduction: Gene regulation-purpose; Process and mechanisms inprokaryotes and eukaryotes; Levels of gene controls.

UNIT V

Gene expression-Transposons in plant gene expression, cloning-transposon tagging; Light regulated gene expression-model systems in *Arabidopsis* and maize; Para mutations and imprinting of genes and genomes. Trans-gene expression and gene silencing mechanisms; Regulatory genes horizontal and vertical homology; Transformation-regulatory genes as visible

markers; Reporter systems to study gene expression; combinatorial gene control.

Practical

Morphological and Gram staining of natural bacteria .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.

Course Learning Outcomes (CLO)

1. The student will be able to read, understand, and critically interpret the primary biological literature in his/her area of interest.
2. The student will be able to design, conduct, analyze, and communicate (in writing and orally) biological research.
3. The student will recognize and be able to apply basic ethical principles to basic and applied biological/biomedical practice and will understand the role of biological/biomedical science, scientists, and practitioners in society.
4. The student will be able to explain ultra structure of cell.
5. The student will be able to explain the Genetic materials.
6. The student will be able to explain the importance DNA, RNA and protein in an organism; Numericals: problems and assignments.

Mapping of course outcum with programme outcum and programe specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	2	1
CO2	2	2	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1
CO4	-	-	-	1	-	-	1	-
CO5	-	-	-	1	-	-	1	-
CO6	-	-	-	1	-	-	1	-
Average	1.33	1.33	1	1.16	1.33	1	1.16	1

Text books:-

- 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.
- Lewin B. 2008. *Genes IX*. John Wiley & Sons.
- Schleif R.1986. *Genetics and Molecular Biology*. Addison-Wesley.
- Russell PJ. 1996. *Essential Genetics*. Blackwell Scientific Publ.

Reference books:-

B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers

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.
- Lewin B. 2008. Genes IX. John Wiley & Sons.
- Schleif R.1986. Genetics and Molecular Biology. Addison-Wesley.
- Russell PJ. 1996. Essential Genetics. Blackwell Scientific Publ.
- Brown TA. 2002. Genomes. Bios Scientific Publ.
- Tamarin RH. 1999. Principles of Genetics. Wm C Brown Publ.

- Griffiths AJF. 2000. An Introduction to Genetic Analysis. WH Freeman.
- Hexter W & Yost HT. 1976. The Science of Genetics. Prentice Hall.
- Singer M & Berg P.1991. Genes and Genomes. John Wiley & Sons.
- Hartl DL & Jones EW. 1998. Genetics Principles and Analysis. Jones & Barlett Publ.

Signature:-

1. .....

2. .....

3. .....

4. .....

MSG -302 BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE 2 (1+1)

L	T	P	CR
1	0	1	2

Course 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

Detail Contents

Unit 1:	**20%**
Unit 2:	**20%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit5:	**20%**

UNIT I

Importance of plant breeding with special reference to biotic and abiotic stress resistance; 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 defence responses to pathogen invasions- Biochemical and molecular mechanisms; Acquired and induced immunity and systemic acquired resistance (SAR); Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Concept of signal transduction and other host-defense mechanisms against viruses and bacteria.

UNIT II

Types and genetic mechanisms of resistance to biotic stresses –Horizontal and vertical resistance in crop plants. Quantitative resistance/Adult plant resistance and Slow rusting resistance - Classical and molecular breeding methods - Measuring plant resistance using plant fitness; Behavioural, physiological and insect gain studies.

Phenotypic screening methods for major pests and diseases; Recording of observations; Correlating the observations using marker data – Gene pyramiding methods and their implications.

UNIT III

Classification of abiotic stresses - Stress inducing factors –moisture stress/drought and water logging & submergence; Acidity, salinity/alkalinity/sodicity; High/low temperature, wind, etc. Stress due to soil factors and mineral toxicity; Physiological and Phenological responses; Emphasis of abiotic stresses in developing breeding methodologies.

UNIT IV

Genetics of abiotic stress resistance; Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing MAS procedures for identifying resistant types in important crops like rice, sorghum, wheat, cotton etc; Breeding for resistance to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment.

UNIT V

Exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops - Transgenics in management of biotic and abiotic stresses, use of toxins, protease inhibitors, lectins, chitnases and Bt for diseases and insect pest management- Achievements.

Practical

Phenotypic screening techniques for sucking pests and chewing pests – Traits to be observed at plant and insect level - Phenotypic screening techniques for nematodes and borers; Ways of combating them; Breeding strategies - Weeds – ecological, environmental impacts on the crops; Breeding for herbicide resistance - Evaluating the available populations like RIL, NIL etc. for pest resistance; Use of standard MAS procedures - Phenotypic screening methods for diseases caused by fungi and bacteria; Symptoms and data recording; use of MAS procedures - Screening forage crops for resistance to sewage water and tannery effluents; Quality parameters evaluation - Screening crops for drought and flood resistance; factors to be considered and breeding strategies - Screening varieties of major crops for acidity and alkalinity- their effects and breeding strategies; Understanding the climatological parameters and predisposal of biotic and abiotic stress factors- ways of combating them.

Course Learning Outcomes (CLO)

CO-1: In this course Students learn importance of biotic and abiotic stress.

CO-2: Learner learns Horizontal and vertical resistance in crop plants.

CO-3: Learner learns to Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing MAS procedures and applies to breed improve genotypes.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1
CO3	2	1	1	3	1	1	2	1
Average	1.33	1	1	1.66	1	1	1.33	1

Text books:-

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

van der Plank JE. 1982. *Host-Pathogen Interactions in Plant Disease*. Academic Press.

Reference books: -

B. D. Singh. Principles of Genetics. Kalyani Publishers

B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.

P. Singh. Essentials of Plant Breeding. Kalyani Publishers.

P. Singh. Elements of Genetics. Kalyani Publishers.

• Blum A. 1988. Plant Breeding for Stress Environments. CRC Press.
• Christiansen MN & Lewis CF. 1982. Breeding Plants for Less Favourable Environments. Wiley International.

• Fritz RS & Simms EL. (Eds.). 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics. The University of Chicago Press.

• Li PH & Sakai A. 1987. Plant Cold Hardiness. Liss, New York.
• Luginpill P. 1969. Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.

• Maxwell FG & Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons.

• Painter RH. 1951. Insect Resistance in Crop Plants. MacMillan, New York.
• Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.
• Sakai A & Larcher W. 1987. Frost Survival in Plants. Springer-Verlag.
• Turener NC & Kramer PJ. 1980. Adaptation of Plants to Water and High Temperature Stress. John Wiley & Sons.
• Van der Plank JE. 1982. Host-Pathogen Interactions in Plant Disease. Academic Press.

Signature:-

1. .....
2. .....
3. .....
4. .....

PPA -301 **DISEASES OF FIELD CROPS** **(2L+1P) III**

L	T	P	CR
1	0	1	2

Course objective:-To knowledge about common pathogens of different diseases, etiology, symptoms, diseases suitable management methods, Eco-friendly and economically suitable management practices may be adopted.

Theory

Detail Contents

Unit 1:	**20%**
Unit 2:	**20%**
Unit 3:	**20%**
Unit 4:	**20%**
Unit 5:	**20%**

UNIT I
Diseases of Cereal crops- wheat, barley, rice, pearl millet, sorghum and maize-economic importance, symptoms and disease cycle, epidemiology and management

UNIT II
Diseases of Pulse crops- gram, urdbean, mungbean, lentil, pigeonpea, soybean.

UNIT III
Diseases of Oilseed crops- rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor.

UNIT IV
Diseases of Cash crops- cotton, sugarcane.

UNIV V
Diseases of Fodder legume crops- berseem, oats, guar, lucerne, cowpea.

Practicals
Detailed study of symptoms and host parasite relationship of important diseases of above mentioned crops. Collection and dry preservation of diseased specimens of important crops

Course Learning Outcomes (CLO)

CO-1.Student will know the common pathogens of different diseases.
CO-2. Student acquire the knowledge about etiology, and symptoms of thesediseases which helps in diagnosis of the diseases of field and horticultural crops
CO-3. By knowing means of dispersal of these diseases suitable management methods can be applied.
CO-4. Eco-friendly and economically suitable management practices may be adopted.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1
Average	1	1	1	1	1	1	1	1

Text books:-

- Mishra, A. 2005. *Plant Pathology-Disease and Management*, Agrobios Publishers, India.
- Paul Khurana, S.M. 1998. *Pathological Problems of Economic Crop Plants and their management.* Scientific Publishers, Jodhpur, India.

Reference books:-

- Shahid, Ahmad and Udit, N. 2007. *Eco friendly Management of Plant Diseases*. Daya Publishing House, Delhi, India.
- Wang, Guo-Liang and Valent, B. 2009. *Advances in Genetics, Genomics and Control of Rice Blast Disease*, Springer Link, Netherland.

Signature:-

1. .....
2. .....
3. .....
4. .....

PGS 301 **HISTORY OF AGRICULTURE** **(1L+0P)**

L	T	P	CR
1	0	0	1

Course objective: - To knowledge about Agriculture in ancient India, Pests andir management, the Agricultural research, education and extension and how to overcome Challenges to Indian agriculture.

Detail Contents

Unit 1: **20%**

Unit 2: **20%**

Unit 3: **20%**

Unit 4: **20%**

Unit 5: **20%**

UNIT-I
Agriculture in ancient India: archaeological findings and literature.

UNIT-II
Ancient literature on: farm implements, forecast of weather and rains, types of lands, manure, irrigation, seed and sowing.

UNIT-III

Pests and their management, horticulture and arboriculture, cattle management etc.

UNIT-IV
Agricultural research, education and extension in pre-and post-independent India. Green revolution, success, associated problems, lessons learnt.

UNIT-V
Challenges to Indian agriculture: future needs and capabilities, environmental problems, international agriculture and partnership. Emerging scenario and expectations.

Course Learning Outcomes (CLO)

CO1. Ancient Agricultural Practices & Its relevant to modern agriculture practices.

CO2 Traditional Technical Knowledge.

CO3 Our Journey (Developments) in Agriculture and Vision for the Future.

Mapping of course outcome with programme outcome and programme specific outcome-

POC& PSOC / COC	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1

Text books:-

- Jain, H.K. 2010. The Green Revolution: History, Impact and Future. Studium Press LLc, Houston USA, 276 pp.
- Saxena, R.C., Choudhary, S.L. and Nene, Y.L. 2009. A Text Book on Ancient History of Indian Agriculture. Asian Agri-History Foundation, Secundarabad, 148 pp.
- Nene, Y.L. (Ed.) 2007. Glimpses of the Agricultural Heritage of India. Asian Agri-History Foundation, Secundarabad, 912 pp.

Reference books:-

B. D. Singh. Principles of Genetics. Kalyani Publishers
B. D. Singh. Plant Breeding: Principles and Methods. Kalyani Publishers.
P. Singh. Essentials of Plant Breeding. Kalyani Publishers.
P. Singh. Elements of Genetics. Kalyani Publishers.

Signature:-

1. .....
2. .....
3. .....
4. .....