Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and

Choice-Based Credit System (CBCS)

In

M Sc (Agri) in Genetics & Plant Breeding

2 Year Degree Program

Revised as on 01 August 2023 Applicable w.e.f. Academic Session 2023-24



AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Agriculture Science and Technology

Department of Genetics & Plant Breeding

ATT

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A K S University Faculty of Agriculture Science and Technology Department of Genetics and Plant Breeding Curriculum & Syllabus of M.Sc. (Ag) in Genetics and Plant Breeding (GPB) program (Revised as on 01 August 2023)

CONTENTS

Sl. No	Item					
1	Forwarding	ii				
2	Vice Chancellor Massage	iii				
3	Preface	iv				
4	Introduction	1				
5	Vision & Mission of the Department of Genetics & Plant Breeding	1				
6	Program Educational Objectives (POE)	2				
7	Program Outcome (POs)	2				
9	Component of Curriculum	3				
10	General Course Structure and & Theme	3				
11	General Course Structure and Credit Distribution	5				
12	Category-wise Courses	6				
13	Semester wise Brief of total Cerits and Teaching Hours	8				
14	Semester wise Curriculum Structure	9				
15	Detailed Syllabus Semester-I	11				
16	Detailed Syllabus Semester-II	104				
17	Detailed Syllabus Semester-III	188				
18	Detailed Syllabus Semester-IV	241				

AKS University

Faculty of Agriculture Science and Technology Department of Genetics and Plant Breeding Curriculum of M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Program (Revised as on 01 August 2023)

Forwarding

I am thrilled to observe the updated curriculum of the Genetics and Plant Breeding (GPB) Department for M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Program, which seamlessly integrates the most recent genetically plant advancements and adheres to the guidelines set forth by National Core Group and BSMA Committees appointed by ICAR. The revised curriculum also thoughtfully incorporates the directives of NEP-2020 and the Sustainable Development Goals.

The alignment of course outcomes (COs), Programme Outcome (POs) and Programme specific outcomes (PSOs) has been intricately executed, aligning perfectly with the requisites of NEP-2020 and NAAC standards. I hold the belief that this revised syllabus will significantly enhance the skills and employability of our students.

With immense satisfaction, I hereby present the revised curriculum for the M. Sc. (Ag) in Genetics and Plant Breeding (GPB) program for implementation in the upcoming session.

Er. Anant Soni Pro Chancellor & Chairman AKSUniversity, Satna

01 August 2023

AKS University Faculty of Agriculture Science and Technology Department of Genetics and Plant Breeding Curriculum of M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Program (Revised as on 01 August 2023)

From the Desk of the Vice-Chancellor

AKS University is currently undergoing a process to revamp its curriculum into an outcome-based approach, with the aim of enhancing the teaching and learning process. The foundation of quality of quality education lies in the implementation of a curriculum that aligns with both societal and industrial needs, focusing on relevant outcomes. This entails dedicated and inspired faculty members, as well as impactful industry internships. Hence, it is of utmost importance to begin this endeavor by crafting an outcome-based curriculum in collaboration with academia and industry experts. This curriculum design should be informed by the latest technological advancements, market demands, the guidelines outlined in the National Education Policy (NEP) of 2020, National Core Group and BSMA Committees appointed by ICAR, and sustainable goals. I'm delighted to learn that the revised curriculum has been meticulously crafted by the Genetics and Plant Breeding Department, in consultation with an array of experts from the Seed industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines, National Core Group and BSMA Committees appointed by ICAR, as well as sustainable goals. It also adeptly incorporates the latest advancements in development of new varieties and seed production technology. To enhance students' skills, the curriculum integrates Hands on Training, industrial visits, and Training experiences, research and progress. This well-rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the seed industry. I am confident that the updated curriculum for Genetics and Plant Breeding will not only enhance students' technical skills but also contribute significantly to their employability. During the process of revising the curriculum, I am pleased to observe that the Genetics and Plant Breeding department has diligently adhered to the guidelines provided by the National Core Group and BSMA Committees appointed by ICAR. Additionally, they have maintained a total credit requirement of 75 for M. Sc. (Ag) in Genetics and Plant Breeding (GPB) program. It's worth noting that curriculum revision is an ongoing and dynamic process, designed to address the continuous evolution of technological advancements and both local and global concerns. This ensures that the curriculum remains responsive and attuned to the changing landscape of education and industry.

AKS University warmly invites input and suggestions from government agriculture departments farmers, entrepreneurs, industry experts and technocrats and Alumni students to enhance the curriculum and make it more student-centered. Your valuable insights will greatly contribute to shaping an education that best serves the needs and aspirations of our students.

Professor B. A. Chopade Vice Chancellor AKS University, Satna

01 August

AKS University Faculty of Agriculture Science and Technology Department of Genetics and Plant Breeding Curriculum of M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Program (Revised as on 01 August 2023)

Preface

As part of our commitment to ongoing enhancement, the Department of Genetics and Plant Breeding consistently reviews and updates its M. Sc. (Ag) in Genetics and Plant Breeding (GPB) program curriculum as per recommendation and need of ICAR. Through this process, we ensure that the curriculum remains aligned with the latest technological advancements, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the **M. Sc. (Ag) in Genetics and Plant Breeding** (**GPB**) Program undergoes evaluation by a panel of technocrats, industry specialists, and academics. Following meticulous scrutiny, the revised curriculum has been formulated and is set to be implemented starting from August 01, 2023. This implementation is contingent upon the endorsement of the curriculum by the University's Board of Studies and Governing Body.

This curriculum closely adheres to the National Core Group and BSMA Committees appointed by ICAR, syllabus distributed in August 2021. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP2020, as well as the principles of Sustainable Development Goals. In order to foster the holistic skill development of students, a range of practical activities, including Hands-On Training, Industrial Visits, Project planning and execution, Report Writing, Seminars, and Industrial Training, have been incorporated.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Programme Specific Outcomes has been undertaken. As the course syllabus is being meticulously developed, various elements such as session outcomes, laboratory instruction, classroom instruction, self-learning activities, assignments, and mini projects are meticulously outlined.

We hold the belief that this dynamic curriculum will undoubtedly enhance independent thinking, skills, and overall employability of the students.

Dr.S. S. Tomar

DEAN (FAST)

AKS University Satna

01August2023

AKS University Faculty of Agriculture Science &Technology Department of Genetics & Plant Breeding Curriculum of M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Program (Revised as on 01 August 2023)

Introduction:

Plant breeding is the science of changing the traits of plants in order to produce desired characteristics. It has been used to improve the quality of nutrition in products for humans and animals. Plant breeding can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation, to methods that make use of knowledge of genetics and chromosomes, to more complex molecular techniques (see cultigens and cultivar). Genes in plant are what determine what type of qualitative or quantitative traits it will have. Plant breeders strive to create a specific outcome of plants and potentially new plant varieties.

Plant breeding has been practiced for thousands of years, since near the beginning of human civilizations. It is practiced worldwide by individuals such as gardeners and farmers and by professional plant breeders employed by organizations such as government institutions, universities, crop-specific industry associations or research centers.

International development agencies believe that breeding new crops is important for ensuring food security by developing new varieties that are higher yielding, disease resistant, drought tolerant regionally adapted different environments and growing conditions.

Vision:

To impart quality education in field the of Genetics & Plant Breeding to UG and PG students and to develop high yielding crop Varieties with biotic, abiotic stress resistance, climate resilient and high quality.

Mission:

M 01: To impart quality teaching in Genetics and Plant Breeding related subjects in UG and PG levels.

- M 02: To guide quality research to M.Sc. and Ph.D. students in the field of Genetics & Plant breeding which will inculcate competence for higher education and societal needs?
- M 03: To impart capacity building to the students and farmers through trainings and guidance.

M 04: To collect, evaluate, maintain and characterize the genetic resources of field crops.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

- **PEO 01:** To create human resources that is knowledgeable about the most recent crop breeding practices and methodologies.
- **PEO 02:** To prepare the students with scientific knowledge about crop quality improvement using conventional and modern biotechnological tools viz, Marker Assisted Selection, Tissue culture and Transgenic approaches.
- **POE 03:** To aware the students about recent technologies of crop improvement and inspire the students for higher education and research at an advanced level in the field of genetics & plant breeding.
- **PEO 04:** To provide postgraduate students of genetics & plant breeding with the scientific training necessary to alter the genetic make-up of plants for improved resistance to biotic and abiotic challenges, while both preserving the genetic pool and discovering new genetic resources.

Program Outcomes (POs)

M. Sc. (Ag) in Genetics and Plant Breeding (GPB) Post Graduate will able to perform:

- **PO 1:** To give students a comprehensive introduction to genetics and plant breeding as they apply to various crops.
- **PO 2:** The student will be familiar with the various plant reproductive systems, genetic diversity, and breeding and selection techniques.
- **PO-3:** To disseminate information about diverse methods of cutting-edge and creative genetics and plant breeding research.
- **PO-4:** Disseminate comprehensive practical understanding of crop hybridization, indevelopment, and germplasm screening.

Program Specific Outcomes (PSOs)

On completion of M. Sc. (Ag) in Genetics and Plant Breeding (GPB) program, the students will achieve the following program specific outcomes:

- **PSO 1:** This program will provide opportunities for students to understand the major constraints of crop production and their solutions.
- **PSO 2:** The students will develop a understanding and analyzing present difficulties in local and global agriculture and how they may impact future agriculture.
- **PSO-3:** To develop scientifically trained personnel for community service, particularly in rural regions in field of agriculture
- **PSO-4:** To gain interdisciplinary understanding of genetics and breeding techniques for the cultivation of various crops growing from traditional to contemporary agriculture.

PEO	M1	M2	M3	M4
PEO-1	3	3	2	2
PEO-2	2	3	1	3
PEO-3	2	3	3	3
PEO-4	3	3	3	2

Consistency/Mapping of PEOs with Mission of the Department

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High) "-": No correlation

Components of the Curriculum M.Sc. (Ag.) in Genetics and Plant Breeding (Two Year Master Degree Programme) Requirement of Credit Hours for Award of the Degree

S. No	Nature of Courses	Credit Hours
1	Major courses	21
2	Minor Courses	11
3	Supporting Courses	7
4	Common Courses	5
5	Master Seminar	1
6	Master Research	30
	Total	75

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 students research work or necessary for building hisoverall competence.

Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree programme:

- 1. Library and Information Services
- 2. Tehnical Writing and Communications Skills
- 3. Inellectual Property and its management in Agriculture
- 4. Base Concepts in Laboratory Techniques
- 5. Agricultural Research, Research Ethics and Rural Development Programmes

GENERAL COURSE STRUCTURE & THEME

1. Definition of Credit

1Hr.Tutorial (T) per week	1 Credit
2Hours Practical (P) per week	1 Credit

2. Range of Credits:

In the light of the fact that a typical Model Two-year Post Graduate degree program in Agricultural has about 75 credits, the total number of credits proposed for the Two-year M.Sc. (Ag.) in Genetics & Plant Breeding is kept as PG Restructuring committee for ICAR 169 considering NEP-20 and NAAC guidelines.

3. Structure of PG Program in Genetics & Plant Breeding:

The structure of PG program in Genetics & Plant Breeding shall have essentially the following categories of courses with the breakup of credits as given:

Sl No	Course Component	% of total number of	Total number of
		credits of the Program	Credits
1	Basic Sciences (BSC)	14.20	24
2	Genetics & Plant Breeding (GPB)	14.70	21
3	Humanities and Social Sciences (HMSC)	7.10	12
4	Program Core (PCC)	39.05	66
5	Program Electives (PEC)	5.33	9
6	Open Electives (OEC)	5.33	9
7	Project(s)(PRC)/On job Plant Training (OJT)	10.06	17
9	Seminar (PSC)	1.78	3
10	Indian Knowledge System	1.18	2
11	Sustainable Development Goal	1.18	2
	Total	100.00	72

(Program curriculum grouping based on course components)

General Course Structure and Credit Distribution Curriculum of M.Sc. (Ag.) in Genetics & Plant Breeding

Semester-I		Semester-II			
Course Title	Credit	Course Title	Credit		
1. Principles of Plant Breeding	2:0:1 =3	1. Principles of Cytogenetics	2:0:1 =3		
2. Fundamentals of Quantitative Genetics	2:0:1 =3	2. Molecular Breeding and Bioinformatics	2:0:1=3		
3. Seed Production and Certification	1:0:1 =2	3. MUTAGENESIS AND MUTATION BREEDING	2:0:1=3		
4. Crop Breeding I (Kharif Crops)	2:0:1 =3	4. CROP BREEDING-II (RABI CROPS)	2:0:1 =3		
5. Statistical Methods for Applied Science	3:0:1 =4	5. Experimental Design	2:0:1 =3		
6. Library and Information Services	0:0:1 =1	6. Intellectual Property and Its Management in Agriculture	1:0:0 =1		
7. Technical Writing and Communication Skills	0:0:1 =1	7. Basic Concepts in Laboratory Techniques	0:0:1 =1		
Total Credit	17	Total Credit	17		
Semester-III		Semester- IV	1		
Course Title	Credit	Course Title	Credit		
1. Breeding for Quality and Special Traits	2:0:1 =3	1. Thesis/Research	0:0:20 = 20		
2. Breeding for Stress Resistance and Climate Change	2:0:1 =3				
 Agricultural Research, Research Ethics and Rural Development Programs 	1:0:0 =1				
4. Seminar	0:0:1 =1				
5. Thesis/Research	0:0:10 =10				
Total Credit	18	Total Credit	20		

Category-wise Courses

COMMON COURSE

(2compulsory + 2 others)

(i) Common Course: 5, Credits: 5

Sl.	Code No.	Subject	Semester	Credits
1	PGS 501	Library and Information Services	1	0:0:1 =1
2	PGS 502	Technical Writing and Communication Skills	1	0:0:1 =1
3	PGS 503	Intellectual Property and Its Management in Agriculture	2	1:0:0 =1
4	PGS 504	Basic Concepts in Laboratory Techniques	2	0:0:1 =1
5	PGS 505	Agricultural Research, Research Ethics and Rural Development Programs	3	1:0:0 =1
		То	tal Credits:	05

Basic Supporting Courses (BSC) (TOTAL 2)

Sl.	Code No.	Subject	Semester	Credits
1	STAT-502	Statistical Methods for Applied Science	1	3:0:1 =4
2	STAT-511	Experimental Design	2	2:0:1 =3
		T	otal Credits:	07

Sl.	Code No.	Subject	Semester	Credits	
1	GPB 501*	Principles of Genetics	1	2:0:1 =3	
2	GPB 502*	Principles of Plant Breeding	1	2:0:1 =3	
3	GPB503*	Fundamentals of Quantitative Genetics	1	2:0:1 =3	
4	GPB 505	Principles of Cytogenetics	2	2:0:1 =3	
5	GPB 506	Molecular Breeding and Bioinformatics	2	2:0:1 =3	
6	GPB 507	Breeding for Quality and Special Traits	3	2:0:1 =3	
7	GPB 516	Breeding for Stress Resistance and Climate Change	3	2:0:1 =3	
	Total Credits:				

PROFESSIONAL MAJOR CORE COURSES [PMCC] (Total 7)

PROFESSIONAL MINOR CORE COURSES [PMCC] (Total 4)

Sl.	Code No.	Subject Semester		Credits
1	GPB 510	Seed Production and Certification	1	1:0:1 =2
2	GPB 510	Crop Breeding-I (Kharif Crops)	1	2:0:1 =3
3	GPB 508	Mutagenesis and Mutation Breeding	2	2:0:1 =3
4	4GPB 512Crop Breeding-II (Rabi Crops)2		2:0:1 =3	
		Te	otal Credits:	11

MASTER RESEARCH / SEMINAR

Sl.	Code No.	Subject	Semester	Credits
1	GPB 591	Seminar	3	0:0:1 =1
2	GPB 599	Thesis/Research	3	0:0:10 =10
3	GPB 599	Thesis/Research	4	0:0:20 = 20
		Το	tal Credits:	31

Induction Program

Induction program for student has to be offered right at the start of the first year. It is mandatory. AKS University has design an induction program for 1st year student, details are below:

Physical activity

- 1. Creative Arts
- 2. Universal Human Values
- 3. Literary
- 4. Proficiency Modules
- 5. Lectures by Eminent People
- 6. Visits to local Areas
- 7. Familiarization to Dept./Branch & Innovations

Evaluation Scheme:

For Theory Courses:

- 1. The weight age of Internal assessment is 50% and
- 2. End Semester Exam is 50%

The student has to obtain at least 40% marks individually both in internal assessment and end

semester exams to pass

For Practical Courses:

- 1. The weight age of Internal assessment is 50% and
- 2. End Semester Examis50%

The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

<u>Semester wise Course Structure</u> <u>Semester wise Brief of total Cerits and Teaching Hours</u>

Semester	L	Т	Р	Total Hour	Total Credit
Semester-I	7	0	10	38	17
Semester-II	6	0	11	23	17
Semester-III	3	0	15	31	18
Semester-IV	0	0	20	40	20
Total	16	0	56	132	72

Program: M.Sc. (Ag.) in Genetics and Plant Breeding 2 years Curriculum Structure Total Credit (2 year Course) 75 Semester wise Curriculum Structure (L= Lecture, T= Tutorial, P= Practical & H = Hours per week)

SEMESTER-I

S.N.	Category	Code	Course Title	L	Т	Р	Total H	Credits
1	Major Courses	GPB 501*	Principles of Genetics	2	-	1	4	3
2	Major Courses	GPB 502*	Principles of Plant Breeding	2	-	1	4	3
3	Major Courses	GPB503*	Fundamentals of Quantitative Genetics	2	-	1	4	3
4	Minor Courses	GPB510	Seed Production and Certification	1	-	1	3	2
5	Minor Courses	GPB510	Crop Breeding-I (Kharif Crops)	2	-	1	4	3
6	Supporting Courses	STAT 502	Statistical Methods for Applied Sciences	3	-	1	5	4
7	Common Courses	PGS 501	Library and Information Services	-	-	1	2	1
8	Common Courses	PGS 502	Technical Writing and Communications Skills	-	-	1	2	1
	Total				-	7	28	20

SEMESTER-II

S.N.	Category	Code	Course Title	L	Т	Р	Total H	Credits
1	Major Courses	GPB 505	Principles of Cytogenetics	2	-	1	4	3
2	Major Courses	GPB 506	Molecular Breeding and Bioinformatics	2	-	1	4	3
3	Minor Courses	GPB 508	Mutagenesis and Mutation Breeding	2	-	1	4	3
4	Minor Courses	GPB 512	Crop Breeding-II (Rabi Crops)	2	-	1	4	3
5	Supporting Courses	STAT 511	Experimental Design	2	I	1	4	3
6	Common Courses	PGS 503	Intellectual Property and its Management in Agriculture	1	-	-	1	1
7	Common Courses	PGS 504	Basic Concepts in Laboratory Techniques	-	_	1	2	1
	Total					6	23	17

SEMESTER-III

S.N.	Category	Code	Course Title	L	Т	Р	Total H	Credits
1	Major Courses	GPB 507	Breeding for Quality and Special Traits	2	-	1	4	3
2	Major Courses	GPB 516	Breeding for Stress Resistance and Climate Change	2	-	1	4	3
3	Major Courses	GPB 591	Master Seminar	-	1	-	1	1
4	Major Courses	GPB 599	Master Research	-	-	10	20	10
5	Common Courses	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1	-	-	1	1
	Total				1	12	29	17

SEMESTER-IV

S.N.	Category	Code	Course Title	L	Т	Р	Total H	Credits
1	Major Courses	GPB 599	Master Research	-	-	20	1000	20
	Total				-	20	1000	20

Detailed Syllabus M.Sc. Ag. in Genetics & Plant breeding Semester- I

Course Code:	GPB 501*
Course Title:	Principle of Genetics
Pre- requisite:	Student should have basic knowledge of principles of heredity, Mendelian population, Organization of DNA and RNA and Protein biosynthesis.
Rationale:	Genes are the backbone of all crop improvement activities. Their chemical structure and physical inheritance are pivotal for any breeding program. Therefore, it has to be the core course for master's degree in Genetics and Plant Breeding. This course is aimed at understanding the basic concepts of inheritance of genetic traits, helping students to develop their analytical, quantitative and problem-solving skills from classical to molecular genetics.
0 0 1	

Course Outcomes:

GPB501.1: To understand basic principles of heredity and variation.

GPB501.2: Students will have the ability to apply the knowledge gained about Mendelian population, Random mating population and Hardy-Weinberg equilibrium.

GPB501.3: Student will be able to understand genetic material, Gene isolation, synthesis and cloning **GPB501.4:** Understanding on genomics and proteomics, mutation and gene expression

GPB501.5: Idea on DNA extraction and PCR amplification

Board of	Course	Course Title		Sche	Total			
Study	Code		CI LI SW SL		SL	Total Study Hours	Credits	
							CI+LI+SW+SL	(C)
Program Core	GPB 501*	Principle of	2	2	0	0	2+2 = 4	(2+1) = 3
(PCC)		Genetics						

Scheme of Studies:

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Boa	Cour	Course		Scheme of Assessment (Marks)						
rd	se	Title		Progress	sive Asse	ssment (PRA)		End	Total
of	Code		Class/Home	Class Test	Semina	Class	Class	Total	Semeste	Marks
Stu			Assignment	2 (2 best	r one	Activi	Attenda	Marks	r	(PRA +
dy			5 number	out of 3)		ty any	nce	(CA+CT+S	Assessm	ESA)
			3 marks	10 marks		one	(AT)	\mathbf{A} +	ent	
			each	each		(CAT)		CAT+AT)	(ESA)	
			(CA)	(CT)						
PCC	GPB 501*	Principle of	15	30	0	0	5	50	50	100
		Genetics								

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 501.1: To understand basic principles of heredity and variation.

Approximate Hours

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17
Total	1/

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction (LI)		(SL)
SO1.1. Understand Beginning of	1. To	Unit-1. Beginning of genetics,	1. Mendel's
genetics, early concepts of	study	Mendel's laws, Chromosomal	laws of
inheritance,	Laboratory	theory, Sex determination,	inheritance.
SO1.2. Understand Mendel's	exercises in	Recombination and genetic	2. Sex
laws and discussion on Mendel's	probability	mapping in eukaryotes.	determination
paper.	2. To	1.1. Beginning of genetics, early	ex-influenced
SO1.3. Understand	study chi-	concepts of inheritance.	and sex-limited
Chromosomal theory of	square.	1.2. Mendel's laws and	traits
inheritance.	3. To	discussion on Mendel's paper.	
SO1.4. Understand Multiple		1.3. Chromosomal theory of	
alleles, Gene interactions, Sex	demonstration	inheritance.	
determination, differentiation	of genetic	1.4. Multiple alleles, Gene	
and sex-linkage.	principles using	interactions, Sex	
SO1.5. Understand Sex-	laboratory	determination, differentiation	
influenced and sex-limited traits;	organisms.	and sex-linkage.	
Linkage-detection, estimation.	4. To	1.5. Sex-influenced and sex-	
SO1.6. Understand	study about	limited traits; Linkage-	
recombination and genetic	Chromosome	detection, estimation.	
mapping in eukaryotes, Somatic	mapping using	1.6. Recombination and genetic	
cell genetics and extra	three-point test	mapping in eukaryotes,	
chromosomal inheritance.	cross	Somatic cell genetics and extra	
		chromosomal inheritance.	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Concepts of inheritance, sex determination, and somatic cell genetics and extra chromosomal inheritance.

b. Mini Project:

- i. Monohybrid and Dihybrid Test cross with suitable example.
- **c.** Other Activities (Specify): Note on the gene interaction its types and different Sex determination mechanisms in different living organism.

GPB 501.2: Students will have the ability to apply the knowledge gained about Mendelian population, Random mating population and Hardy-Weinberg equilibrium.

Approximate Hours

				r r		
			Item	Approximate Hours		
			CI			4
			LI		0	
			SW			2
			SL		-	1
			Total		,	7
Session Outcomes (SOs)	Labor	atory	Class room Instruc	tion (CI)	S	Self-Learning
	Instru	iction				(SL)
	(L	J)				
SO2.1. Understand the Mendelian			Unit-2. Mendelia	an and	1.	Frequencies
population			Random mating pop	ulation.		of genes and
SO2.2. Understand the Random			2.1. Mendelian popula	ation,		genotypes,
mating population			2.2. Random mating p	oopulation,	2.	Hardy-
SO2.3. Understand the Frequencies			2.3. Frequencies of	genes and		Weinberg
of genes and genotypes			genotypes,			Law.
SO2.4. Understand the Causes of			2.4. Causes of change	ge: Hardy-		
change: Hardy-Weinberg			Weinberg equilibrium	1.		
equilibrium.						
CW 1 Commented Commentered Words (CV	* *					

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Frequencies of genes and genotypes.

b. Mini Project:

- 1. Causes of change: Hardy-Weinberg equilibrium.
- c. Other Activities (Specify):

GPB501.3: Student will be able to understand genetic material, Gene isolation, synthesis and cloning

Item	Approximate Hours
CI	8
LI	4
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction		(SL)
	(LI)		
SO 3.1. Understand the Nature,	•	Unit 3 Structure, replication	
structure and replication of	Tetrad	and Organization of DNA,	and Protein
the genetic material	analysis	Protein biosynthesis and	biosynthesis,
SO 3.2. Organization of DNA in		8 8	2. Molecular
chromosomes, Genetic code	Induction and	3.1. Nature, structure and	mechanisms
SO 3.3. Understand the Protein	detection of	replication of the genetic	of mutation
biosynthesis, Genetic fine	mutations	material.	
structure analysis,	through	3.2. Organization of DNA in	
SO 3.4. Understand the Allelic	genetic tests	chromosomes, Genetic code.	
complementation, Split		3.3. Protein biosynthesis, Genetic	
genes, overlapping genes,		fine structure analysis	
Pseudogenes, Oncogenes,		3. 4. Allelic complementation,	
Gene families and clusters		Split genes, overlapping genes,	
SO 3.5. Understand the Regulation		Pseudogenes, Oncogenes, Gene	
of gene activity in		families and clusters.	
prokaryotes and eukaryotes		3.5. Regulation of gene activity in	
equilibrium.		prokaryotes and eukaryotes.	
SO 3.6. Understand the Molecular		3.6. Molecular mechanisms of	
mechanisms of mutation,		mutation, repair and suppression	
repair and suppression.		3.7. Bacterial plasmids, insertion	
SO 3.7. Understand the Bacterial		(IS) and transposable (Tn)	
plasmids, insertion (IS) and		elements.	
transposable (Tn) elements		3.8. Molecular chaperones and	
SO 3.8. Understand the Molecular		gene expression, RNA editing.	
chaperones and gene			
expression, RNA editing.			

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Organization of DNA in chromosomes, Genetic code and Protein biosynthesis.

b. Mini Project:

a. DNA and RNA model.

c. Other Activities (Specify):

GPB501.4: Understanding on genomics and proteomics, mutation and gene expression

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory	Class room Instruction	Self-Learning
	Instruction (LI)	(CI)	(SL)
SO4.1. Understand the Gene	1. To study DNA	Unit 4. Gene isolation,	3.cDNA
isolation, cDNA libraries and PCR	extraction and	cDNA libraries and	libraries and
based cloning.	2. To study gene	PCR based cloning.	PCR based
SO4.2. Understand the Gene	amplification by	4.1. Gene isolation,	cloning.
isolation, synthesis and cloning.	PCR technique.	synthesis and cloning.	4.DNA
SO4.3. Understand the Genomic	3. To study	4.2. Genomic and cDNA	restriction and
and cDNA libraries.	amplification by	libraries,	modification
SO4.4. Understand the PCR based	Electrophoresis.	4.3. PCR based cloning,	Anti-sense
cloning, positional cloning.	4. To study basic	positional cloning.	RNA and
SO4.5. Understand the Nucleic	principles and	4.4. Nucleic acid	ribozymes
acid hybridization and	running of	hybridization and	
immunochemical detection; DNA	amplified DNA	immunochemical	
sequencing.		detection; DNA	
SO4.6. Micro-RNAs (miRNAs).		sequencing.	
		4.5. DNA restriction and	
		modification, Anti-sense	
		RNA and ribozymes.	
		4.6. Micro-RNAs	
		(miRNAs).	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Nucleic acid hybridization and immunochemical detection.

b. Mini Project:

- i. PCR based cloning, positional cloning.
- c. Other Activities (Specify):

GPB501.5: Idea on DNA extraction and PCR amplification

Item	Approximate Hours
CI	6
LI	10
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory	Class room Instruction	Self-Learning
	Instruction (LI)	(CI)	(SL)
SO5.1. Understand the	1. To study Extraction	Unit-5. Genomics,	1. Transgenic
Genomics and proteomics;	of proteins and	Transgenic bacteria,	bacteria and
metagenomics.	isozymes	Gene silencing, and	bioethics.
SO5.2. Transgenic bacteria			2. Genetics of
and bioethics.		5.1. Genomics and	mitochondria
SO5.3. Understand the Gene		-	and chloroplasts.
silencing.	3. To study Use of	e	
SO5.4. Understand the	0	5.2. Transgenic bacteria	
genetics of mitochondria and		and bioethics.	
1	4. To study Detection	5.3. Gene silencing.	
SO5.5. Understand the	U		
Concepts of Eugenics.	exposed plant	mitochondria and	
SO5.6. Understand the	material.	chloroplasts.	
Epigenetics, Genetic	0	5.5. Concepts of Eugenics.	
disorders.	-	5.6. Epigenetics, Genetic	
	learning the practical	disorders.	
	considerations		

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Genomics and proteomics; metagenomics.

b. Mini Project:

- ii. Concepts of Eugenics. Epigenetics, Genetic disorders.
- c. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
GPB501.1: To understand basic principles of heredity and variation.	14	2	1	17
GPB501.2: Students will have the ability to apply the knowledge gained about Mendelian population, Random mating population and Hardy-Weinberg equilibrium.	4	2	1	7
GPB501.3: Student will be able to understand genetic material, Gene isolation, synthesis and cloning	12	2	1	15
GPB501.4: Understanding on genomics and proteomics, mutation and gene expression.	14	2	1	17
GPB501.5: Idea on DNA extraction and PCR amplification.	16	2	1	19

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Ma	arks Distribu	tion	Total
	Unit Thies	R	U	Α	Marks
CO 1	Beginning of genetics, Mendel's laws, Chromosomal theory, Sex determination, Recombination and genetic mapping in eukaryotes.	3	4	3	10
CO 2	Mendelian and Random mating population.	2	4	4	10
CO 3	Structure, replication and Organization of DNA, Protein biosynthesis and Regulation of gene.	4	3	3	10
CO 4	Gene isolation, cDNA libraries and PCR based cloning.	3	2	5	10
CO 5	Genomics, Transgenic bacteria, Gene silencing, and Concepts of Eugenics.	5	3	2	10
Total		17	16	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Principle of Genetics will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Group Discussion
- 3. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 4. Brainstorming
- 5. Power point presentation
- 6. Chalk and Board

- 7. Smart board
- 8. Assignments, quiz
- 9. Group tasks, student's presentations

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Genetics: "Analysis of Genes and Genomes"	Daniel L.H. and Maryellen R.	Laxmi Publications	2011
2	Principles of Genetics.	Gardner EJ and Snustad DP.	John Wiley and Sons. 8th ed.	2006
3	Concepts of Genetics.	Klug WS and Cummings MR.	Peterson Edu. Pearson Education India; Tenth edition	2003
4	Genes XII.	Lewin B.	Jones and Bartlett Publ. (International Edition) Paperback,	2008, 2018
5	Genetics.	Russell PJ.	The Benzamin/ Cummings Publ. Co	1998
6	Genetics.	Singh BD.	Kalyani Publishers (2nd Revised Edition)	2009
7	Genetics.	Snustad DP and Simmons MJ.	4th Ed. John Wiley and Sons. 6th Edition International Student Version edition	2006
8	Genetics.	Stansfield WD.	Schaum Outline Series Mc Graw Hill	1991
9	Genetics (III Ed).	Strickberger MW.	Prentice Hall, New Delhi, India; 3rd ed.,	2005, 2015
10	Principles of Genetics.	Tamarin RH.	Wm. C. Brown Publs., McGraw Hill Education; 7 edition	1999
11		Uppal S, Yadav R, Singh S and Saharan RP.	Dept. of Genetics, CCS HAU Hisar.	2005

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Cos, POs and PSOs Mapping Course Code: GPB 501 Course Title: - Principle of Genetics

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
Outc																	0	1
omes	T	771	T	D'	T1 ·	TT1	T	T	т	T 1	T	D'	T 1 '	T 1	T	T	T	TT1
	To	The	To	Disse	This	The	To dev	To	To	The	To	Dis	Thi	The	To	To	To	The
	•	student will be			progr	stud ents	elop	gain inte	giv e	stud ent	diss	sem	S pro	stud	dev elo	gai	giv e	stud ent
		familia			am will	will	scie	rdis	stu	will	emi nate	inat e	pro	ents will		n inte	e stud	will
	compr			-	provi	deve	ntifi	cipl	den	be	info	com	gra m	dev	p scie	rdis	ents	be
	ehensi	the	about	ve	de	lop a	call	inar	ts a	fam	rma	pre	wil	elop	ntifi	cipl	a	fam
	ve	various			oppor	unde	y	y	co	iliar	tion	hen	1	a	call	inar	co	iliar
	introd		e	cal	tunitie	rstan	trai	und	mp	wit	abo	sive	pro	und	y	y	mpr	wit
		reprod	-		s for	ding	ned	erst	reh	h	ut	prac	vid	erst	trai	und	ehe	h
	to	uctive			stude	and	pers	andi	ens	the	dive	tical	e	andi	ned	erst	nsiv	the
	geneti	system	cuttin	ng of	nts to	anal	onn	ng	ive	vari	rse	und	ор	ng	pers	and	e	vari
	cs and	s,	g-edge	crop	under	yzin	el	of	intr	ous	met	erst	por	and	onn	ing	intr	ous
	plant	genetic	and	hybri	stand	g	for	gen	od	plan	hod	andi	tun	anal	el	of	odu	pla
	breedi	diversit	creativ	dizati	the	pres	com	etic	uct	t	s of	ng	itie	yzin	for	gen	ctio	nt
		•	e	on,	major	ent	mu	S	ion	repr	cutt	of	S	g	со	etic	n to	repr
	-	breedin	-	in-	constr	diffi	nity	and	to	odu	ing-	cro	for	pres	mm	S	gen	odu
	apply	g and			aints	culti	serv	bree	gen	ctiv	edg	р	stu	ent	unit	and	etic	ctiv
	to	selecti	^	line	of	es in	ice,	din	etic	e	e	hyb	den	diffi	У	bre	S .	e
	variou		breedi		crop	local	part	g	S 1	syst	and	ridi	ts	cult	serv	edi	and	syst
		techniq	U	opme	produ	and	icul	tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
	crops.	ues.	resear	nt,	ction	glob	arly	niq	pla	,	tive	on,	un	in 1	part	tech	nt	,
			ch.	and	and	al	in	ues	nt bro	gen	gen	in-	der	loca	icul	niq	bre	gen etic
				germp lasm	their soluti	agric ultur	rura	for the	bre edi	etic dive	etic s	bre d	sta nd	l and	arly in	ues for	edi	div
				screen	ons.	e	regi	cult	ng	rsit	and	line	the	glo	rura	the	ng as	ersi
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						impa	agri	ous	ly	g	g	and	ints	and	fiel	vari	to	ng
						ct	cult	cro	to	and	rese	ger	of	how	d of	ous	vari	and
						futur	ure	ps	var	sele	arch	mpl	cro	they	agri	cro	ous	sele
						e		gro	iou	ctio		asm	р	may	cult	ps	cro	ctio
						agric		win	S	n		scre	pro	imp	ure	gro	ps.	n
						ultur		g	cro	tech		enin	duc	act		win		tech
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								cont emp orar y agri cult ure.					uti ons			to con tem por ary agri cult ure.		
GPB5 01.1: To unders tand basic princi ples of heredi ty and variati on.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 01.2: Stude nts will have the ability to apply the knowl edge gained about Mend elian popul ation, Rando m matin g popul ation and Hardy - Weinb erg equili	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

brium.																		
GPB5 01.3: Stude nt will be able to unders tand geneti c materi al, Gene isolati on, synthe sis and clonin g	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1
GPB5 01.4: Under standi ng on geno mics and proteo mics, mutati on and gene expres sion	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
GPB5 01.5: Idea on DNA extrac tion and PCR amplif icatio n.	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

Legend: 1- Low,2 – Medium, 3- High

		<u>Course (</u>	Curriculum Map: Princip		
POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB501.1:Tounderstandbasicprinciplesofheredityandvariation.	SO1.1 SO1.2 SO1.3		Unit-1. Beginning of genetics, Mendel's laws, Chromosomal theory, Sex determination, Recombination and genetic mapping in eukaryotes.1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB501.2: Students will have the ability to apply the knowledge gained about Mendelian population, Random mating population and Hardy- Weinberg equilibrium.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	To study Extraction of proteins and isozymes	Mendelian and Random mating population 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB501.3: Student will be able to understand genetic material, Gene isolation, synthesis and cloning	SO3.1 SO3.2 SO3.3	To study Use of Agrobacterium mediated method	Structure, replication and Organization of DNA, Protein biosynthesis and Regulation of gene.3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB501.4: Understanding on genomics and proteomics, mutation and gene expression.	SO4.1 SO4.2	To study Use of Biolistic gun method.	Gene isolation, cDNA libraries and PCR based cloning 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB501.5: Idea on DNA extraction and PCR amplification.	SO5.1 SO5.2		Genomics, Transgenic bacteria, Gene silencing, and Concepts of Eugenics. 5.1, 5.2	As mentioned in page number

Course Curriculum Map: Principle of Genetics

Semester- I

Course Code:GPB 502*Course Title:Principles of Plant Breeding

Pre- requisite: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling. The course will also acquaint the student with importance of floral biology, mutation breeding and participatory plant breeding, etc.

Rationale: Development of plant variety is the ultimate aim of any plant breeding program. A post graduate in the subject of agriculture must know what are the different selection methods, techniques and related crop improvement strategies. Further, knowledge of genetic resources, evolution and their role in development of noble varieties is the need of the hour.

Course Outcomes:

GPB502.1: The knowledge of this course will enable the student to know Patterns of Evolution, Centre of Origin, and Agro-biodiversity with their significance.

GPB502.2: The knowledge of this course will enable the student to know Genetic basis of breeding, variability, its components and combining ability.

GPB502.3: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in self-pollinated crops.

GPB502.4: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in cross-pollinated crops.

GPB502.5: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in asexually/ clonally propagated crops

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)				Total
Study	Code		CI	LI	SW	SL	Total Study Hours	Credits
							CI+LI+SW+SL	(C)
Program	GPB	Principles of	2	2	0	0	4	(2+1) = 3
Core	502*	Plant						
(PCC)		Breeding						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Boa	Cour	Course		Scheme of Assessment (Marks)						
rd	se	Title		Progressive Assessment (PRA)					End	Total
of	Code		Class/Home	Class Test	Semina	Class	Class	Total	Semeste	Marks
Stu			Assignment	2 (2 best	r one	Activi	Attenda	Marks	r	(PRA +
dy			5 number	out of 3)		ty any	nce	(CA+CT+S	Assessm	ESA)
			3 marks	10 marks		one	(AT)	\mathbf{A} +	ent	
				each						

			each	(CT)		(CAT)		CAT+AT)	(ESA)	
			(CA)							
PCC	GPB	Principles	15	30	0	0	5	50	50	100
	502*	of Plant								
		Breeding								

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB502.1: The knowledge of this course will enable the student to know Patterns of Evolution, Centre of Origin, and Agro-biodiversity with their significance.

Approximate Hours

Item	Approximate Hours
СІ	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
 SO1.1. Students are able to explain the Early Plant Breeding. SO1.2. Students are able to explain the Accomplishments through plant breeding. SO1.3. Students are able to understand the Objectives of plant breeding. SO1.4. Students are able to explain the Patterns of Evolution in Crop Plants and Centre of Origin. SO1.5. Students are able to understand the Agro-biodiversity and its significance. SO1.6. Students are able to 		 Unit-1. Plant Breeding, introduction, objective, history and Agro- biodiversity of crop plants. 1. Early Plant Breeding. 2. Accomplishments through plant breeding. 3. Objectives of plant breeding. 4. Patterns of Evolution in Crop Plants and Centre of Origin. 5. Agro-biodiversity and its significance. 6. Pre-breeding and plant introduction. 	objectives for different self and
explain the Pre-breeding and plant introduction and role of plant genetic resources in plant breeding.			

SW-1 Suggested Sessional Work (SW):

d. Assignments:

ii. Important landmarks in plant breeding.

e. Mini Project:

- ii. Plant genetic resources, types and their role in crop improvement.
- f. Other Activities (Specify):

GPB502.2: The knowledge of this course will enable the student to know Genetic basis of breeding, variability, its components and combining ability.

					Approxim	ate Hours
			Item	A	Approximate Hours	
			CI		6	
			LI		12	
			SW		2	
			SL		1	
			Total		21	
Session Outcomes (SOs)	Labora	tory	Class room Instr	uction	Self-Lear	ning (SL)
	Instructio	on (LI)	(CI)			
SO2.1. Students are able to	1. Floral	biology	Unit-2. Genetic b	asis of	5. To	estimate
understand genetic basis of	in	self	breeding and	gene	genetic	variability
breeding: self and cross	pollinated	b	actions.		and	its
pollinated crops including mating	species.		1.Genetic basis	of	compone	ents.
systems and response to	2. Floral	biology	breeding: self an	d cross		
selection.	in	cross	pollinated	crops		
SO2.2. Students are able to	pollinated	b	including	mating		
evaluate nature of variability,	species.		systems and resp	onse to		
components of variation.	3. Selfing	and	selection.			
SO2.3. Students are able to	crossing		2. Nature of var	iability,		
evaluate heritability and genetic	technique	es.	components of va	riation.		
advance.	4. Analysis	of	3.Heritability and	genetic		
SO2.4. Students are able to	variance		advance.			
evaluate genotype environment	(ANOVA	A).	4. Genotype envir	onment		
interaction.	5. Estimatio	on of	interaction.			
SO2.5. Students are able to	heritabilit	ty.	5.General and	specific		
6	6. Estimatio	on of	8			
and specific combining ability.	genetic a	dvance	6.Types of gene			
SO2.6. Students are able to			and implications	in plant		
explain types of gene actions and			breeding.			
implications in plant breeding.						

SW-2 Suggested Sessional Work (SW):

a. Assignments:

2. Combining ability, its types and role in crop improvments.

b. Mini Project:

2. Evaluate the nature of variability, components of variation, heritability and genetic advance.

ci. Other Activities (Specify):

GPB502.3: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in self-pollinated crops.

Item	Approximate Hours
CI	6
LI	10
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room	Self-Learning
		Instruction (CI)	(SL)
SO3.1. Students are able to			3. Explain
understand the process of	segregating populations and		different
pure line theory, pure line	evaluation of breeding	used for self	types of
SO3.2. Students are able to	material by pedigree	pollinated crops.	mating design
understand the process of	methods.	1. Pure line theory,	used in self
mass selection methods.	2. Selection methods in	pure line and	and cross
SO3.3. Students are able to	segregating populations and	2. Mass selection	pollinated
understand the process of	evaluation of breeding	methods.	crops.
pedigree method and bulk	material by mass pedigree		
method.	methods.	and bulk method.	
SO3.4. Students are able to	3. Selection methods in	4. Backcross, single	
understand the process of	segregating populations and	seed descent and	
backcross, single seed	evaluation of breeding	multiline	
descent and multiline	material by bulk methods.	breeding.	
breeding.		5. Population	
SO3.5. Students are able to	segregating populations and	0	
understand the process of	evaluation of breeding	pollinated crops	
population breeding in self-	material by single seed decent	with special	
pollinated crops with special	methods.	reference to	
reference to diallel selective		diallel selective	
mating.	segregating populations and	U U	
SO3.6. Students are able to	evaluation of breeding	0	
understand the process of	material by back cross	breeding.	
transgressive breeding.	methods.		

SW-3 Suggested sessional work (sw):

d. Assignments:

i. Handling of segregating generations by different methods.

e. Mini project:

- ii. Process of different selection methods.
- f. Other activities (specify):

GPB502.4: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in cross-pollinated crops.

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO4.1. Students are able to understand		Unit 4. Breeding methods in	1. Hybrid
the process of population breeding: mass		cross pollinated crops.	breeding:
selection and ear-to-row methods.		1. Population breeding: mass	heterosis
SO4.2. Students are able to understand		selection and ear-to-row	and
the process of S1 and S2 progeny testing,		methods.	inbreedin
progeny selection schemes, recurrent		2. S1 and S2 progeny testing,	g,
selection schemes for intra and inter-		progeny selection schemes,	productio
population improvement and		recurrent selection schemes for	n and
development of synthetics and		intra and inter-population	uses of
composites.		improvement and development	inbreeds.
SO4.3. Students are able to understand		of synthetics and composites.	
the process of hybrid breeding: genetical		3. Hybrid breeding: genetical and	
and physiological basis of heterosis and		physiological basis of heterosis	
inbreeding, production of inbreeds.		and inbreeding, production of	
SO4.4. Students are able to understand		inbreeds.	
the process of breeding approaches for		4. Breeding approaches for	
improvement of inbreeds, predicting		improvement of inbreeds,	
hybrid performance.		predicting hybrid performance.	
SO4.5. Students are able to understand		5. Seed production of hybrid and	
the process of seed production of hybrid		their parent varieties/ inbreeds.	
and their parent varieties/ inbreeds.		6. Self-incompatibility, male	
SO4.6. Students are able to understand		sterility and apomixes in crop	
the process of self-incompatibility, male		plants and their commercial	
sterility and apomixes in crop plants and		exploitation.	
their commercial exploitation.			

SW-4 Suggested Sessional Work (SW):

d. Assignments:

ii. Improvement of plant population through population breeding methods.

e. Mini Project:

- j. Process of seed production of hybrid and their parent varieties/ inbreeds.
- f. Other Activities (Specify):

GPB502.5: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in asexually/ clonally propagated crops.

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction (LI)		Learning
			(SL)
SO5.1. Students are able to	1. Maintenance	Unit-5. Breeding methods in	3.Intellectual
understand the process of Breeding	of	asexually/ clonally	property
methods in asexually/ clonally	experimental	propagated crops and Special	rights, PBR,
propagated crops, clonal selection.	records.	breeding techniques.	PPV&FRA,
SO5.2. Students are able to	2. Study of	1. Breeding methods in	and FR.
understand the process of Special	agents	asexually/ clonally	
breeding techniques: Mutation	employed for	propagated crops, clonal	
breeding, breeding for abiotic and	the induction	selection.	
biotic stresses.	of various	2. Special breeding techniques:	
SO5.3. Students are able to	ploidy levels	Mutation breeding, breeding	
understand the Concept of plant	in different	for abiotic and biotic stresses.	
ideotype and its role in crop	crops.	3. Concept of plant ideotype and	
improvement, concept of MAS.	3. Learning	its role in crop improvement,	
SO5.4. Students are able to explain	techniques in	concept of MAS.	
the Concept of polyploidy and wide	hybrid seed	4. Concept of polyploidy and	
hybridization and doubled haploidy.	production	wide hybridization and	
SO5.5. Students are able to	using male-	doubled haploidy.	
understand the process of Cultivar	sterility in	5. Cultivar development:	
development: testing, release and	field crops	testing, release and	
notification, maintenance breeding.	4. Prediction of	notification, maintenance	
SO5.6. Students are able to	performance	breeding.	
understand the Participatory Plant	of double	6. Participatory Plant Breeding,	
Breeding, Plant breeders' rights and	cross hybrid.	Plant breeders' rights and	
regulations for plant variety		regulations for plant variety	
protection and farmers rights.		protection and farmers rights.	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

ii. Concept of polyploidy, production, doubling, and uses of haploids.

b. Mini Project:

- iii. Concepts of mutation breeding, classification, production, identification, and uses of mutants.
- d. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

88	C 1	a	G 10	— 11
Course Outcomes	Class	Sessional	Self	Total hour
	Lecture	Work	Learning	(Cl+SW+Sl)
	(Cl)	(SW)	(S1)	
GPB502.1: The knowledge of this course will enable	6	2	1	9
the student to know Patterns of Evolution, Centre of				
Origin, and Agro-biodiversity with their significance.				
GPB502.2: The knowledge of this course will enable	18	2	1	21
the student to know Genetic basis of breeding,				
variability, its components and combining ability.				
GPB502.3: The knowledge of this course will enable	16	2	1	19
the student to know breeding methods, different				
hybridization techniques for genomic reshuffling in				
self-pollinated crops.				
GPB502.4: The knowledge of this course will enable	6	2	1	9
the student to know breeding methods, different				
hybridization techniques for genomic reshuffling in				
cross-pollinated crops.				
GPB502.5: The knowledge of this course will enable	14	2	1	17
the student to know breeding methods, different				
hybridization techniques for genomic reshuffling in				
asexually/ clonally propagated crops				

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Ma	Total		
		R	U	Α	Marks
CO 1	Plant Breeding, introduction, objective,	3	4	2	9
	history and Agro-biodiversity of crop plants.				
CO 2	Genetic basis of breeding and gene actions.	5	3	3	11
CO 3	Plant breeding methods used for self	4	3	3	10
	pollinated crops.				
CO 4	Breeding methods in cross pollinated crops.	2	3	4	9
CO 5	Breeding methods in asexually/ clonally	3	4	4	11
	propagated crops and Special breeding				
	techniques.				
Total		17	17	16	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Principle of Genetics will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 10. Improved Lecture
- 11. Group Discussion
- 12. Demonstration

- 13. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 14. Brainstorming
- **15**. Power point presentation
- 16. Chalk and Board
- 17. Smart board
- 18. Assignments, quiz
- **19**. Group tasks, student's presentations

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition &		
No.				Year		
1	Principles of Plant	Allard R.W.	John Wiley & Sons	1981		
	Breeding					
2	Plant Breeding	Chopra V.L.	Oxford & IBH	2004		
3	Plant Breeding and-	Jain H.K. and	Narosa Publications, New Delhi	2004		
	Mendelian to	Kharakwal M.C.				
	Molecular Approach					
4	Principles and Practice	Sharma J.R.	Tata McGraw-Hill	2001		
	of Plant Breeding					
5	Plant Breeding	Singh B.D.	Kalyani Publishers, New Delhi	2006		
6	Principles of Plant	George Acquaah	John Wiley & Sons	2012		
	Genetics and Breeding					
7	Principles and	G. S. Chahal, S.	Alpha Science	2002		
	Procedures of Plant	S. Gosal				
	Breeding					
8	Handbook of Genetics	Rajendra Kumar	Bhavya Books	2021		
	and Plant Breeding	Yadav	-			
9	Plant Breeding in 21st	B.D. Singh, N.S.	Scientific Publishers	2019		
	Century	Shekhawat				

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Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
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	To give	The student		Disse	This	The stud	To dev	To gain	To	The stud	To diss	Dis	Thi	The stud	To dev	To		stud
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		familia			will	will	scie	rdis	stu	will	nate	e	gra	will	p	inte	stud	will
		r with		ehensi	provi	deve	ntifi	cipl	den	be	info	com	m	dev	scie	rdis	ents	be
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	plant	genetic		hybri	stand	g	for	gen	od	plan	hod	andi	tun	anal	el	of	odu	pla
	breedi	diversit	creativ	dizati	the	pres	com	etic	uct	t	s of	ng	itie	yzin	for	gen	ctio	nt
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Cos, POs and PSOs Mapping Course Code: GPB 502 Course Title: - Principles of Plant Breeding

								cont emp orar y agri cult ure.					uti ons			to con tem por ary agri cult ure.		
GPB5 02.1: The knowl edge of this course will enable the studen t to know Patter ns of Evolut ion, Centre of Origin , and Agro- biodiv ersity with their signifi cance.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 02.2: The knowl edge of this course will enable the studen t to know Geneti c	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

basis of breedi ng, variab ility, its comp onents and combi ning ability																		
GPB5 02.3: The knowl edge of this course will enable the studen t to know breedi ng metho ds, differe nt hybrid izatio n techni ques for geno mic reshuf fling in self- pollin ated crops.	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1
GPB5 02.4: The	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1

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Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Principle of Genetics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB502.1: The knowledge of this course will enable the student to know Patterns of Evolution, Centre of Origin, and Agrobiodiversity with their significance.	SO1.1 SO1.2 SO1.3		Unit-1. Plant Breeding, introduction, objective, history and Agro- biodiversity of crop plants.1.1, 1.2, 1.3	(SL) As mentioned in page number

PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB502.2: The knowledge of this course will enable the student to know Genetic basis of breeding, variability, its components and combining ability.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	To study Extraction of proteins and isozymes	Genetic basis of breeding and gene actions. 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB502.3: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in self-pollinated crops.	SO3.1 SO3.2 SO3.3	To study Use of Agrobacterium mediated method	Plant breeding methods used for self pollinated crops.	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB502.4: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in cross-pollinated crops.	SO4.1 SO4.2	To study Use of Biolistic gun method.	Breeding methods in cross pollinated crops. 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB502.5: The knowledge of this course will enable the student to know breeding methods, different hybridization techniques for genomic reshuffling in asexually/ clonally propagated crops	SO5.1 SO5.2		Breeding methods in asexually/ clonally propagated crops and Special breeding techniques. 5.1, 5.2	As mentioned in page number

Semester- I

Course Code:	GPB 503*
Course Title:	Fundamentals of Quantitative Genetics*
Pre- requisite:	Student should have fundamental knowledge of Genetics and Statistical Methods
Rationale:	Yield and quality characters are controlled by many genes and show the quantitative inheritance. If one has to go for improvement even for the components characters the knowledge of this course is very essential.

Course Outcomes:

GPB 503.1: Students will get knowledge Introduction and historical background of quantitative genetics.

GPB 503.2: Students will have the ability to apply the knowledge gained about designs for plant breeding experiments.

GPB 503.3: Student will be equipped with the knowledge of association analysis.

GPB 503.4: Student will be able to explain various mating designs.

GPB 503.5: Students will get knowledge on QTL mapping.

Scheme of Studies:

Board of	Course	Course Title					of studies s/Week)	Total Gradita
Study	Code	Course Title	СІ	LI	SW	SL	Total Study Hours CI+LI+SW+SL	Credits (C)
	GPB 503*	Fundamentals of Quantitative Genetics*	2	2	1	1	6	2+1=3

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Board of	e	Course Title			Sch	eme of A	ssessment	(Marks)		
Study	Code								End	Total
				Progre	essive As	ssessment	t (PRA)		Semester	Marks (PRA+ESA)
			Class/H ome Assignm ent 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks	Semina r one (SA)	Class Activity any one (CAT)	Class Attendan ce (AT)	Total Marks (CA+CT+ SA+CAT +AT)		
	GP	Fundament	15	30	0	0	5	50	50	100

B	als of				
503	Quantitativ				
*	e Genetics*				

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 503.1: Students will get knowledge Introduction and historical background of quantitative genetics.

	Approximate Hours
Item	Approximate Hours
CI	8
LI	0
SW	1
SL	1
Total	10

	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
 SO1.1. Student will be able to understand cell cycle. SO1.2. Students are able to explain architecture of chromosome in prokaryotes and eukaryotes. SO1.3. To know Chromonemata, chromosome matrix, chromosome matrix, chromomeres, centromere, secondary constriction and telomere SO1.4. Understand artificial chromosome construction and its uses SO1.5. Understand Special types of chromosomes and variation in chromosome structure. SO1.6. To know evolutionary 	(LI)	backgroundofquantitativegenetics1.Introductionbackgroundofquantitative genetics2.Historicalbackgroundofquantitative genetics3.Multiple factor hypothesis4Qualitativeandquantitativecharacters1.5.Analysis of continuousvariationmean, range, SD, CV;Componentsofvariation-6.Componentsofvariation-Phenotypic,Genotypic, Natureofgeneaction-additive, dominanceandepistatic,linkageeffect7.7.Principlesofanalysisofvarianceandlinearmodel,Expected	1. Qualitative and quantitative characters
significance; Introduction to techniques for karyotyping SO1.7. Understand Chromosome banding and painting -In situ		components, Random and fixed effect model.8. Comparison of means and variances for significance	

hybridization	and	various		
applications.				

SW-1 Suggested Sessional Work (SW):

- **g.** Assignments: Multiple factor hypothesis
- h. Mini Project:
- i. Other Activities (Specify):

GPB 503.2: Students will have the ability to apply the knowledge gained about designs for plant breeding experiments.

				Appro	oximate Hours
	Item			Approxi	mate Hours
		CI			5
			LI		2
			SW		0
			SL		1
			Total		8
Session Outcomes (SOs)		boratory	Class room In	struction	Self-
	In	struction	(CI)		Learning
		(LI)			(SL)
 SO2.1.Understand Structural variations of chromosomes and their implications. SO2.2. Students are able to explain Numerical variations of chromosomes and their implications SO2.3. Symbols and terminologies for chromosome numbers SO2.4. To know euploidy, haploids, diploids and polyploids SO2.5. Student will be able to understand utilization of aneuploids in gene location. SO2.6. Knowledge about Variation in chromosome behaviour, somatic segregation and chimeras SO2.7. Students are able to explain Endomitosis and somatic reduction; Evolutionary significance of chromosomal aberrations, balanced lethal SO2.8. Chromosome complexes; Intervarietal chromosome substitutions. 	inte of	alysis and erpretation variability rameters;	Unit-2. Designs breeding experin 1. Designs for pla experiments- prin 2. Designs for pla experiments- app 3. Variability para 4. Concept of simultaneous modes and se parents. 5. MANOVA	nents ant breeding aciples ant breeding lications ameters,	Variability parameters

SW-2 Suggested Sessional Work (SW):

- c. Assignments:
- d. Mini Project: Other Activities (Specify):

GPB 503.3: Student will be equipped with the knowledge of association analysis.

Item	Approximate Hours
CI	6
LI	14
SW	1
SL	1
Total	18

Session Outcomes (SOs)	Laboratory		Class room Instruction			S	elf-Learning	
	Instruction (LI)		(CI)				(SL)	
SO 3.1. Understand fertilization	1.	Analysis a	nd	Unit 3	3	Association	1.	Metroglyph
barriers in crop plants at pre-and		interpretation	of	analysis				and D2.
post fertilization levels; In-vitro		Index score.		1. Assoc	ciatior	n analysis-		
techniques to overcome the	2.	Analysis a	nd	Genotypi	c and	phenotypic		
fertilization barriers in crops;		interpretation	of	correlatio	n			
Polyploidy		Metroglyph.		2. Path ana	alysis			
SO3.2. Understand Genetic	3.	Clustering a	ınd	3. Discrim	inate	function		
consequences of polyploidization		interpretation	of	4 princi	ipal	component		
and role of polyploids in crop		D2 analysis.		analysis				
breeding	4.	Genotypic a	nd	5. Gene	etic	divergence		
SO3.3. To know autopolyploid and		phenotypic		analysis	Metro	oglyph and		
allopolyploids.		correlation		D2.				
SO 3.4. Knowledge about Role of		analysis a	nd	6. Ger	neratio	on mean		
aneuploids in basic and applied		interpretation		analysis,	Parer	nt progeny		
aspects of crop breeding, their	5.	Path coefficie	ent	regression	analy	vsis.		
maintenance and utilization in gene		analysis a	nd	-				
mapping and gene blocks transfer.		interpretation.						
SO3.5. Student will be able to	6.	Estimation	of					
understand Alien addition and		different types	of					
substitution lines, creation and		heterosis, a	nd					
utilization.		interpretation.						
SO3.6. Students are able to explain	7.	Estimation	of					
apomixis, evolutionary and genetic		inbreeding						
problems in crops with apomixes.		depression a	nd					
		interpretation						

SW-3 Suggested Sessional Work (SW):

g. Assignments:

Principal component analysis

- h. Mini Project:
- i. Other Activities (Specify):

GPB 503.4: Student will be able to explain various mating designs.

Item	Approximate Hours
CI	6
LI	10
SW	1
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning
SO4.1. Understand Reversion of	1.A, B and C	Unit 4. Mating designs	(SL) 1. Gene
autopolyploid to diploids.	Scaling test.	1.Mating designs-	action.
SO4.2 Student will be able to understand	2. $L \times T$ analysis	classification	
genome mapping in polyploids.	and interpretation.	2. Diallel and partial diallel	
SO4.3. Knowledge about Interspecific	3. Diallel analysis.	3. $L \times T$, NCDs, and TTC.	
hybridization and allopolyploids.	4. $G \times E$	4. Concept of combining	
SO.4.4. Students are able to explain	interaction.	ability	
Synthesis of new crops (wheat, Triticale,	5. Stability	4. Gene action, $G \times E$	
Brassica, and cotton).	analysis	interaction-Adaptability	
SO.4.5. Understand hybrids between		5. Stability; Methods and	
species with same chromosome number,		models for stability analysis	
alien translocations.		6. Basic models- principles	
SO4.6. To know Gene transfer using		and interpretation, Bi-plot	
amphidiploids bridge species.		analysis.	

SW-4 Suggested Sessional Work (SW):

- **g.** Assignments: Stability; Methods and models
- h. Mini Project:
- i. Other Activities (Specify):

GPB 503.5: Students will get knowledge on QTL mapping.

Item	Approximate Hours
CI	5
LI	4
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO5.1. Understand Chromosome	1. QTL	Unit-5: QTL mapping	1. Marker
manipulations in wide	analysis.	1. QTL mapping, Strategies for QTL	assisted
hybridization.	2. Use of	mapping- Desired population and	selection
SO5.2 Knowledge about	computer	statistical methods	
Production and use of haploids	packages.	2. QTL mapping in genetic analysis	
and dihaploids in genetics and		3. Marker assisted selection.	
breeding.		4. Factors influencing the MAS.	

SO5.3 Students are able to explain Production and use of doubled haploids in genetics and breeding.	5. Simultaneous selection based on marker and phenotype.
--	--

SW-5 Suggested Sessional Work (SW):

- a. Assignments: QTL mapping in genetic analysis
- b. Mini Project:

Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
GPB503.1: Students will get knowledge Introduction and historical background of quantitative genetics.	8	1	1	10
GPB 503.2: Students will have the ability to apply the knowledge gained about designs for plant breeding experiments.	7	0	1	8
GPB 503.3: Student will be equipped with the knowledge of association analysis.	20	1	1	22
GPB 503.4: Student will be able to explain various mating designs.	16	1	1	18
GPB 503.5: Students will get knowledge on QTL mapping.	9	1	1	11

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles	Marks Distribution			Total
		R	U	Α	Marks
CO 1	Introduction and historical background of	3	5	2	10
	quantitative genetics.				
CO 2	Designs for plant breeding experiments	2	5	3	10
CO 3	Association analysis	2	6	2	10
CO 4	Mating designs	4	4	2	10
CO 5	QTL mapping	4	4	2	10
	Total Marks	15	26	9	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Fundamentals of Quantitative Genetics** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Tutorial
- 3. Case Method
- 4. Group Discussion

- 5. Demonstration
- 6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 7. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Principles of Plant Breeding	Allard RW.	John Wiley & Sons	1981
2	Plant Breeding	Chopra VL.	Oxford & IBH	2004.
3	Plant Breeding and–Mendelian to Molecular Approach,	1.Jain HK and Kharakwal MC.	Narosa Publications, New Delhi	2004
4	Principles and Practice of Plant Breeding.	Sharma JR.	Tata McGraw-Hill	2001

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Course Code: GPB 503 Course Title: - Principles of Quantitative Genetics

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
Outc																	0	1
omes	То	The	То	Disse	This	The	То	То	То	The	То	Dis	Thi	The	То	То	То	The
		student			progr	stud	dev	gain	giv	stud	diss	sem	s s	stud	dev	gai	giv	stud
	U	will be			am	ents	elop	inte	e	ent	emi	inat	pro	ents	elo	n	e	ent
		familia			will	will	scie	rdis	stu	will	nate	e	gra	will	р	inte	stud	will
		r with		ehensi	provi	deve	ntifi	cipl	den	be	info	com	m	dev	scie	rdis	ents	be
	ehensi	the	about	ve	de	lop a	call	inar	ts a	fam	rma	pre	wil	elop	ntifi	cipl	a	fam
	ve	various	divers	practi	oppor	unde	У	у	co	iliar	tion	hen	1	а	call	inar	co	iliar
	introd	plant	e	cal	tunitie	rstan	trai	und	mp	wit	abo	sive	pro	und	У	У	mpr	wit
		reprod			s for	ding	ned	erst	reh	h	ut	prac	vid	erst	trai	und	ehe	h
	to	uctive			stude	and	pers	andi	ens	the .	dive	tical	e	andi	ned	erst	nsiv	the .
	-	system		-	nts to	anal	onn	ng	ive	vari	rse	und	op	ng	pers	and	e	vari
	cs and	s, genetic	g-edge and	crop hybri	under stand	yzin g	el for	of	intr od	ous plan	met hod	erst andi	por	and anal	onn el	ing of	intr odu	ous pla
	•	diversit		-	the	g pres	com	gen etic	uct	t pian	s of	ng	tun itie	yzin	for	gen	ctio	pla nt
		y, and	e	on,	major	ent	mu	s	ion	repr	cutt	of	s	g	co	etic	n to	repr
	U	breedin		in-	constr	diffi	nity	and	to	odu	ing-	cro	for	pres	mm	s	gen	odu
	apply	g and			aints	culti	serv	bree	gen	ctiv	edg	p	stu	ent	unit	and	etic	ctiv
	to	selecti		line	of	es in	ice,	din	etic	e	e	hyb	den	diffi	у	bre	s	e
	variou	on	breedi	devel	crop	local	part	g	s	syst	and	ridi	ts	cult	serv	edi	and	syst
	s	techniq	ng	opme	produ	and	icul	tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
	crops.	ues.	resear	nt,	ction	glob	arly	niq	pla	,	tive	on,	un	in	part	tech	nt	,
			ch.	and	and	al	in	ues	nt	gen	gen	in-	der	loca	icul	niq	bre	gen
				germp	their	agric	rura	for	bre	etic	etic	bre	sta	1	arly	ues	edi	etic
				lasm	soluti	ultur	1.	the	edi	dive	S 1	d	nd	and	in	for	ng	div
				screen	ons.	e	regi	cult	ng	rsit	and	line	the	glo	rura	the	as the	ersi
				ing.		and how	ons in	ivat ion	as the	y, and	plan t	dev elop	ma jor	bal	1 rogi	cult ivat	the	ty, and
						they	fiel	of	y y	bree	bree	men	con	agri cult	regi ons	ion	y app	bre
						may	d of	vari	y app	din	din	t,	stra	ure	in	of	ly	edi
						impa	agri	ous	ly	g	g	and	ints	and	fiel	vari	to	ng
						ct	cult	cro	to	and	rese	ger	of	how	d of	ous	vari	and
						futur	ure	ps	var	sele	arch	mpl	cro	they	agri	cro	ous	sele
						e		gro	iou	ctio		asm	р	may	cult	ps	cro	ctio
						agric		win	S	n		scre	pro	imp	ure	gro	ps.	n
						ultur		g	cro	tech		enin	duc	act		win		tech
						e.		fro	ps.	niq		g.	tio	futu		g fro		niq
								m (m. 1		ues.			n	re				ues.
								trad					and	agri		m trad		
								itio nal					the ir	cult ure.		trad itio		
								to					n sol	urc.		nal		
								cont					uti			to		
								emp					ons			con		
								orar								tem		

								y agri cult ure.								por ary agri cult ure.		
GPB5 03.1:S tudent s will get kn owled ge Intr oducti on and histori cal backgr ound of quanti tative geneti cs.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB 503.2: Stude nts will have the ability to apply the knowl edge gained about design s for plant breedi ng experi ments.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1
GPB 503.3: Stude nt will be equip	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1

ped with the knowl edge of associ ation analys is.																		
GPB 503.4: Stude nt will be able to explai n variou s matin g design s.	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
GPB5 03.5: Stude nts will get knowl edge on QT L mappi ng.	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

Legend: 1- Low,2 – Medium, 3- High

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB503.1: Students will get knowledge Introduction and historical background of quantitative genetics.	SO1.1 SO1.2 SO1.3	Analysis and interpretation of Index score.	Unit-1. Introduction and historical background of quantitative genetics .1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 503.2: Students will have the ability to apply the knowledge gained about designs for plant breeding experiments.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Analysis and interpretation of Metroglyph.	Designs for plant breeding experiments 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 503.3: Student will be equipped with the knowledge of association analysis.	SO3.1 SO3.2 SO3.3	Clustering and interpretation of D2 analysis.	Association analysis- Genotypic and phenotypic correlation.3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 503.4: Student will be able to explain various mating designs.	SO4.1 SO4.2	Genotypic and phenotypic correlation analysis and interpretation	Mating designs- classification 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB503.5: Students will get knowledge on QTL mapping.	SO5.1 SO5.2	Path coefficient analysis and interpretation.	QTL mapping, Strategies for QTL mapping- Desired population and statistical methods 5.1, 5.2	As mentioned in page number

Course Curriculum Map: Principle Quantitative Genetics

Semester- I

Course Code:	GPB 510
Course Title:	Seed Production and Certification
Pre- requisite:	Student should have basic knowledge of principles of Seed production, Nucleus
Rationale:	seed production and its maintenance, Hybrid seed production, Organic seed production and certification. The students studying seed technology should possess foundational understanding about seed production and seed certification. This course is aimed at understanding to produce genetically pure and good quality seed.

Course Outcomes:

GPB510.1: Student will be able to understand seed quality concept and Genetic purity in seed production.

GPB510.2: Students will have the ability to apply the knowledge gained about nucleus seed production and its maintenance.

GPB510.3: To understand principles of seed production in different crops.

GPB510.4: Student will be able to understand hybrid seed production of crop plants.

GPB510.5: Students will get knowledge on seed certification and minimum Seed Certification Standards (MSCS) for different crops.

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)						
Study	Code		CI	LI	SW	SL	Total Study Hours	Credits		
							CI+LI+SW+SL	(C)		
	GPB 510	Seed	1	2	0	0	3	(1+1) = 2		
		Production								
		and								
		Certification								

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Boa	Cour	Course		Scheme of Assessment (Marks)							
rd	se	Title		Progress	sive Asse	ssment (PRA)		End	Total	
of	Code		Class/Home	Class Test	Semina	Class	Class	Total	Semeste	Marks	
Stu			Assignment	2 (2 best	r one	Activi	Attenda	Marks	r	(PRA +	
dy			5 number	out of 3)		ty any	nce	(CA+CT+S	Assessm	ESA)	
			3 marks	10 marks		one	(AT)	\mathbf{A} +	ent		
			each	each		(CAT)		CAT+AT)	(ESA)		
			(CA)	(CT)							
	GPB	Seed	15	30	0	0	5	50	50	100	
	510	Production									
		and									
		Certificati									
		on									

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB510.1: Student will be able to understand seed quality concept and Genetic purity in seed production.

	Approximate Hours
Item	Approximate Hours
CI	3
LI	2
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-Learning (SL)
	(LI)		
SO1.1. Understand	1. Planning for	Unit-1. Seed and Seed quality	1 Seed quality
Beginning of genetics,	seed	1.1. Importance of seed as basic input in	concept.
early concepts of	production:	agriculture; Seed quality concept and	
inheritance,	cost benefit	importance.	2. seed demand
SO1.2. Understand	ratio, seed	1.2. Generation system of seed	and supply
Generation system of	multiplication	multiplication -Varietal replacement	
seed multiplication	ratio and seed	rate, Seed multiplication ratios, Seed	
SO1.3. Understand	replacement	replacement rate, Seed renewal period	
Various factors	rate.	and seed demand and supply	
influencing seed		1.3. Various factors influencing seed	
production.		production –Physical and Genetic	
		purity in seed production; Factors	
		responsible for varietal and genetic	
		deterioration.	

SW-1 Suggested Sessional Work (SW):

j. Assignments:

Generation system of seed multiplication.

k. Mini Project:

Various factors influencing seed production

l. Other Activities (Specify):

Importance of seed as basic input in agriculture

GPB510.2: Students will have the ability to apply the knowledge gained about nucleus seed production and its maintenance

			Ар	proximate Hours
		Item	Appro	ximate Hours
		СІ		3
		LI		4
		SW		2
		SL		1
		Total		10
Session Outcomes	Laboratory	Class room Instruction (C	I)	Self-Learning
(SOs)	Instruction			(SL)
	(LI)			
SO2.1. Nucleus seed	1. Visits to seed	Unit-2. Nucleus seed production	on and	6. Nucleus seed
production and its	production	its maintenance		production and
maintenance.	plots.	2.1. Nucleus seed production	and its	its
SO2.2. Understand	2.visit to seed	maintenance - Maintenance of p	parental	maintenance,
Principles of seed	industries;	lines of hybrids, Production of b	breeder,	7. Principles of
production in self- and		foundation and certified seed an	nd their	seed
cross-pollinated crops.		quality maintenance		production in
SO2.3. Understand		2.2. Principles of seed produc	tion in	self- and
Organic seed		self- and cross-pollinated crops;	Hybrid	cross-
production and		seed production - system and tech	hniques	pollinated
			-	-

involved in Seed village concept;,

certification.

2.3. Organic seed production and

SW-2 Suggested Sessional Work (SW):

e. Assignments:

certification

Maintenance of parental lines of hybrids.

f. Mini Project:

Principles of seed production in self- and cross-pollinated crops.

cii. Other Activities (Specify):

GPB510.3: To understand principles of seed production in different crops.

Item	Approximate Hours
СІ	3
LI	8
SW	2
SL	1
Total	14

crops

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction (LI)		(SL)
SO3.1. Understand Principles	1. Pollen	Unit 3 Principles of seed	4. Principles of
of seed production in field	collection and	production.	seed
crops	storage methods,	3.1. Principles of seed production	production in
SO3.2. Understand Floral	pollen viability	in field crops	field crops.

structure,	pollination	and stigma	3.2. Floral structure, pollination	5. Floral
mechanism an	nd seed	receptivity.	mechanism and seed production	structure of
production techniq	ues in self-	2.Pre-harvest	techniques in self- and cross-	self pollinated
and cross-pollinate	ed cereals.	sanitation,	pollinated cereals.	crops
SO3.3. Understa	ind Floral	3. Maturity	3. 3. Floral structure, pollination	
structure,	pollination	symptoms.	mechanism and seed production	
mechanism an	nd seed	4. harvesting	techniques in self- and cross-	
production techniq	ues in self-	techniques.	pollinated millets.	
and cross-pollinate	•	·	ſ	

SW-3 Suggested Sessional Work (SW):

j. Assignments:

Seed production techniques in self- and cross-pollinated cereals

k. Mini Project:

Floral structure and pollination mechanism cross-pollinated cereals

l. Other Activities (Specify):

GPB510.4: Student will be able to understand hybrid seed production of crop plants.

Item	Approximate Hours
CI	3
LI	8
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
SO4.1. Understand Floral structure, pollination mechanism and methods and techniques of seed production in major pulses and oilseed crops SO4.2. Varietal and hybrid seed production techniques in Pigeon pea, Mustard, Castor and Sunflower. Floral structure, pollination mechanism and methods and techniques of seed production in major commercial fibres. SO4.3. Hybrid-seed production techniques in major vegetatively propagated crops.	methods to achieve synchrony 3. Identification of rogues and pollen shedders,	 seed production techniques. 4.1. Floral structure, pollination mechanism and methods and techniques of seed production in major pulses and oilseed crops. 4.2. Varietal and hybrid seed production techniques in Pigeon pea, Mustard, Castor and Sunflower. Floral structure, pollination mechanism and methods and techniques of seed production in major commercial fibres. 4.3.Hybrid-seed production techniques in major 	(SL) 1. Floral structure and pollination mechanism major pulses. in

SW-4 Suggested Sessional Work (SW):

- **j.** Assignments: Hybrid seed production techniques in Pigeon pea,
- k. Mini Project:

Hybrid-seed production techniques in major vegetatively propagated crops.

l. Other Activities (Specify):

GPB510.5: Students will get knowledge on seed certification and minimum Seed Certification Standards (MSCS) for different crops.

Item	Approximate Hours
CI	3
LI	8
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
	1. General		4.Seed
certification - history, concept,		5.1 Seed certification - history,	certification
objectives Central seed	seed	concept, objectives Central seed	- history,
certification board Seed	certification,	certification board Seed	concept,
6.	2. Identification	certification agency/	objectives
organization and staff	of weed and	8	Central
requirement	other crop	requirement	seed
SO5.2. Legal status - Phases of	-	5.2 Legal status - Phases of seed	certification
seed certification, formulation,	specific	certification, formulation,	board Seed
revision and publication of seed	crops.	revision and publication of seed	certification
certification standards; Minimum		certification standards; Minimum	agency/
Seed Certification Standards	about field	Seed Certification Standards	organizatio
(MSCS) for different crops.	inspection at	(MSCS) for different crops.	n.
SO5.3. General and specific	different	5.3 General and specific	5. Minimum
crop standards, Field and seed	stages of a	crop standards, Field and seed	Seed
standards; Planning and	crop.	standards; Planning and	Certificatio
management of seed certification	4. Specification	management of seed certification	n Standards
programs; Eligibility of a variety	s for tags and	programs; Eligibility of a variety	(MSCS) for
for certification, area assessment,	labels to be	for certification, area assessment,	different
cropping history of the seed	used for	cropping history of the seed	crops.
field.	certification	field.	
	purpose.		

SW-5 Suggested Sessional Work (SW):

c. Assignments:

Phases of seed certification, formulation, revision and publication of seed certification standards;

d. Mini Project:

General and specific crop standards, Field and seed standards; Planning and management of seed certification programs

Other Activities (Specify):

brief of hours suggested i	of the Co		ne	
Course Outcomes	Class	Sessional	Self	Total hour
	Lecture	Work	Learning	(Cl+SW+Sl)
	(Cl)	(SW)	(S1)	
GPB510.1: Student will be able to understand seed	5	2	1	8
quality concept and Genetic purity in seed production.	5	2	1	0
GPB510.2: Students will have the ability to apply the				
knowledge gained about nucleus seed production and its	7	2	1	10
maintenance				
GPB510.3: To understand principles of seed production	11	2	1	14
in different crops	11	2	1	14
GPB510.4: Student will be able to understand hybrid	11	2	1	14
seed production of crop plants.	11	2	1	14
GPB510.5:Students will get knowledge on seed				
certification and minimum Seed Certification Standards	11	2	1	14
(MSCS) for different crops.				

Brief of Hours suggested for the Course Outcome

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Ma	Marks Distribution							
		R	U	Α	Marks					
CO 1	Seed and Seed quality.	5	3	2	10					
CO 2	Nucleus seed production and its maintenance.	4	3	3	10					
CO 3	Principles of seed production.	5	4	3	12					
CO 4	Varietal and hybrid seed production techniques.	4	3	2	9					
CO 5	Seed certification.	5	3	1	9					
Total		23	16	11	50					

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Seed Production and Certification** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 8. Improved Lecture
- 9. Tutorial
- 10. Case Method
- 11. Group Discussion

- 12. Role Play
- 13. Demonstration
- 14. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 15. Brainstorming

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition &
No.				Year
1	Seed Technology	Agarwal, R.L.	Oxford & IBH Publishing Co.	1991
			Delhi	
2	Seed Technology	Agarwal, P.K.	ICAR, New Delhi	1999
3	Seed Science and	Subir Sen and	Kalyani Publishers. New Delhi	1999
	Technology	Nabinanda		
		Ghosh.		
4	Beej Pradyogiki	Maloo,S.R.,	Agrotech Publishing Academy.	2008
		Intodia, S.K. and		
		Pratap Singh.		
5	Seed Technology.	A.K. Joshi and	Kalyani Publishers, New Delhi.	2005
		B.D. Singh.		
6	Seed Technology In The	Mackay D B	Scientific Publishers	2013
	Tropics			
7	Seed Science and	K. Vanangamudi	New India Publishing Agency	2014
	Technology			
8	Field Inspection Manual	Anonymous	NSC Publication, New Delhi	1965
	and Minimum Seed			
	Certification Standards			

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Cos, POs and PSOs Mapping
Course Code: GPB 510
Course Title: - Seed Production and Certification

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GPB5 10.1: Stude nt will be able to unders tand seed qualit y conce pt and Geneti c purity in seed produ ction.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 10.2: Stude nts will have the ability to apply the knowl edge gained about nucleu s seed produ ction and its maint enanc e.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1
GPB5 10.3:	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1

To unders tand princi ples of seed produ ction in differe nt crops.																		
GPB5 10.4: Stude nt will be able to unders tand hybrid seed produ ction of crop plants.	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
GPB5 10.5: Stude nts wi ll get knowl edge o n seed certifi cation and minim um Seed Certifi cation Stand ards (MSC S) for differe nt	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

crops.																		
	Legend: 1- Low,2 – Medium, 3- High																	

POs & PSOs No.	Course Curriculum Map: Seed 1 COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.1 : Student will be able to understand seed quality concept and Genetic purity in seed production.	SO1.1 SO1.2 SO1.3	General procedure of seed certification,	Unit-1. Importance of seed as basic input in agriculture; Seed quality concept and importance.1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.2 : Students will have the ability to apply the knowledge gained about nucleus seed production and its maintenance.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Identification of weed and other crop seeds as per specific crops.	Nucleus seed production and its maintenance 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.3 : To understand principles of seed production in different crops.	SO3.1 SO3.2 SO3.3	To study about field inspection at different stages of a crop.	Principles of seed production. 3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.4 : Student will be able to understand hybrid seed production of crop plants.	SO4.1 SO4.2	Specifications for tags and labels to be used for certification purpose.	Varietal and hybrid seed production techniques 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.5 :Students will get knowledge on seed certification and minimum Seed Certification Standards (MSCS) for different crops.	SO5.1 SO5.2	Path coefficient analysis and interpretation.	Seed certification - history, concept, objectives Central seed certification board Seed certification agency/ organization and staff requirement 5.1, 5.2	As mentioned in page number

Semester- I

Course Code: GPB 511

Course Title: Crop Breeding I (Kharif Crops)

Pre- requisite: To provide insight into recent advances in improvement of kharif cereals, legumes, oilseeds, fiber, sugarcane and vegetative propagated crops using conventional and modern biotechnological approaches.

Rationale: After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of important kharif field crops.

Course Outcomes:

GPB511.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rice, Maize, and Small millets.

GPB511.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Pigeon pea, Groundnut, and Other pulses.

GPB511.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Soybean, Castor and Sesame.

GPB511.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Cotton, and Jute.

GPB511.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Sugarcane, Forage crops, and Seed spices.

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)				
Study	Code		С	LI	SW	SL	Total Study Hours	Credits
			Ι				CI+LI+SW+SL	(C)
	GPB 511	Crop Breeding I	2	2	0	0	4	(1+2) = 3
		(Kharif Crops)						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

				Scheme of Assessment (Marks)							
Boa			Progressive Assessment (PRA)					End			
rd of Stu dy	Cour se Code	Course Title	Class/Home Assignment 5 number 3 marks each (CA)		Semina	Class Activi ty any one (CAT)	(AT)	Total Marks (CA+CT+S A+ CAT+AT)	Semeste r	Total Marks (PRA + ESA)	
	GPB	Crop	15	30	0	0	5	50	50	100	

511	Breeding I (Kharif				
	I (Kharif				
	Crops)				

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB511.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rice, Maize, and Small millets.

Approximate Ho	ours
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Item	Approximate Hours
CI	6
LI	2
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO1.1. Students able to explain the	1.Floral	Unit-1 Important botanical status	1. Genetics
Origin, evolution, mode of	biology,	and reproductive structures of	of rice,
reproduction, chromosome number;	emasculatio	crops and genetics of rice, maize,	maize,
Genetics – cytogenetics and genome	n,	and small millets.	and small
relationship of rice.		1. Rice: Origin, evolution, mode of	millets.
SO1.2. Students able to explain the	·	reproduction, chromosome number;	
Breeding objectives: yield, quality	in rice and		
characters, biotic and abiotic stress	maize.	relationship.	
resistance, etc.; Breeding approaches,		2. Rice: Breeding objectives: yield,	
introgression of alien gene(s) (if		quality characters, biotic and abiotic	
required), biotic and abiotic stress		stress resistance, etc.; Breeding	
resistance, heterosis breeding,		approaches, introgression of alien	
released varieties, examples of MAS		gene(s) (if required), biotic and	
used for improvement, Aerobic rice,		abiotic stress resistance, heterosis	
its implications and drought resistance		breeding, released varieties,	
breeding of rice.		examples of MAS used for	
SO1.3. Students able to explain the		improvement, Aerobic rice, its	
Origin, evolution, mode of		implications and drought resistance	
reproduction, chromosome number;		breeding.	
Genetics – cytogenetics and genome		3. Maize: Origin, evolution, mode of	
relationship of Maize.		reproduction, chromosome number;	
SO1.4. Students able to explain the		Genetics – cytogenetics and genome	
Breeding objectives: yield, quality		relationship.	

characters, biotic and abiotic stress	4. Maize: Breeding objectives: yield,
resistance, etc.; Breeding approaches,	quality characters, biotic and abiotic
introgression of alien gene(s) (if	stress resistance, etc.; Breeding
required), biotic and abiotic stress	approaches, introgression of alien
resistance, heterosis breeding,	gene(s) (if required), biotic and
releasedvarieties, examples of MAS	abiotic stress resistance, heterosis
used for improvement- QPM and Bt	breeding, releasedvarieties,
maize – strategies and implications of	examples of MAS used for
Maize.	improvement- QPM and Bt maize –
SO1.5. Students able to explain the	strategies and implications.
Evolution and distribution of species	5.Small millets: Evolution and
and forms - wild relatives and	distribution of species and forms -
germplasm of Small millets.	wild relatives and germplasm.
SO1.6. Students able to explain the	6.Small millets: Cytogenetics and
Small millets: Cytogenetics and	genome relationship - breeding
genome relationship - breeding	objectives yield, quality characters,
objectives yield, quality characters,	biotic and abiotic stress resistance,
biotic and abiotic stress resistance, etc	etc.
of Small millets.	

SW-1 Suggested Sessional Work (SW):

- a. Assignments:
 - i. Floral biology, emasculation and hybridization techniques in rice and maize.
- b. Mini Project:
 - iii. Centers of origin, distribution of species wild relatives of rice and maize.
- c. Other Activities (Specify):

GPB511.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Pigeon pea, Groundnut, and Other pulses.

		Approximate Hours
	Item	Approximate Hours
	CI	6
	LI	4
	SW	2
	SL	1
	Total	13
Laboratory	Class room Instruction	(CI) Self-Learning
Instruction		(SL)

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-Learning (SL)
	(LI)		
SO2.1. Students are able to	1.Floral	Unit-2 Important botanical	8. Learn about
understand the evolution, mode of	biology,	status and reproductive	qualitative
reproduction, chromosome number;	emasculatio	structures of crops and genetics of	and
Genetics – cytogenetics and genome	n,	Pigeon pea, Groundnut and	quantitative
relationship. Breeding objectives:	pollination	Other pulses.	characters
yield, quality characters, biotic and	techniques	1. Pigeon pea: evolution, mode of	different
abiotic stress resistance, etc of	in pigeon	reproduction, chromosome number;	pulse crops.

pigeon pea.	pea and	Genetics – cytogenetics and	
SO2.2. Students are able to	soybean.	genome relationship. Breeding	
	2. Attempting	objectives: yield, quality characters,	
introgression of alien gene(s) (if	crosses	biotic and abiotic stress resistance,	
required), biotic and abiotic stress	between	etc.	
resistance, heterosis breeding,	black gram	2. Pigeon pea: Breeding	
released varieties, examples of MAS	and green	approaches, introgression of alien	
used for improvement - Hybrid	gram.	gene(s) (if required), biotic and	
technology; maintenance of male		abiotic stress resistance, heterosis	
sterile, fertile and restorer lines,		breeding, released varieties,	
progress made at National and		examples of MAS used for	
International institutes of pigeon pea.		improvement - Hybrid technology;	
SO2.3. Students are able to		maintenance of male sterile, fertile	
understand the Origin, evolution		and restorer lines, progress made at	
mode of reproduction, chromosome		National and International	
number; Genetics – cytogenetics and		institutes.	
genome relationship, breeding		3. Groundnut: Origin, evolution	
objectives: yield, quality characters,		mode of reproduction, chromosome	
biotic and abiotic stress resistance,		number; Genetics – cytogenetics	
etc of groundnut.		and genome relationship, breeding	
SO2.4. Students are able to		objectives: yield, quality characters,	
understand the Breeding approaches,		biotic and abiotic stress resistance,	
introgression of alien gene(s) (if		etc.	
required), biotic and abiotic stress		4. Groundnut: Breeding	
resistance, released varieties,		approaches, introgression of alien	
examples of MAS used for		gene(s) (if required), biotic and	
improvement groundnut.		abiotic stress resistance, released	
SO2.5. Students are able to		varieties, examples of MAS used	
understand the Urdbean, mungbean,		for improvement.	
cowpea,: Origin, evolution, mode of		5. Other pulses: Urdbean,	
		I /	
reproduction, chromosome number;			
Genetics – cytogenetics and genome		evolution, mode of reproduction,	
relationship, breeding objectives:		chromosome number; Genetics –	
yield, quality characters, biotic and		cytogenetics and genome	
abiotic stress resistance, etc of other		relationship, breeding objectives:	
pulses.		yield, quality characters, biotic and	
SO2.6. Students are able to		abiotic stress resistance, etc.	
understand the Breeding approaches,		6. Other pulses: Breeding	
introgression of alien gene(s) (if		approaches, introgression of alien	
required), released varieties,		gene(s) (if required), released	
examples of MAS used for		varieties, examples of MAS used	
improvement. Interspecific crosses		for improvement. Interspecific	
attempted and its implications,		crosses attempted and its	
reasons for failure, ways of		implications, reasons for failure,	
overcoming them of other pulses.		ways of overcoming them.	

SW-2 Suggested Sessional Work (SW):

1. Assignments:

3. Plant genetic resources, its utilization and conservation in different pulse crops.

1. Mini Project:

3. Study of genetics, handling of germplasm of different pulse crops.

ciii. Other Activities (Specify):

GPB511.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Soybean, Castor and Sesame.

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self- Learning
	(LI)		(SL)
SO3.1. Students are able to	1. Floral	Unit 3 Important botanical	1. Concepts
understand the origin, evolution,	biology,		of breeding in
mode of reproduction,	emasculation,	structures of crops and genetics	
chromosome number; Genetics –	pollination	of soybean, castor and sesame.	castor and
cytogenetics and genome	techniques in	1. Soybean: Origin, evolution,	sesame.
relationship soybean.	sesame and	mode of reproduction,	
SO3.2. Students are able to	cotton.	chromosome number; Genetics	
understand the breeding	2. Study of	– cytogenetics and genome	
objectives: yield, quality	range of	relationship.	
characters, biotic and abiotic	variation for	2. Soybean: Breeding objectives:	
stress resistance etc. soybean.	yield and	yield, quality characters, biotic	
SO3.3. Students are able to	yield	and abiotic stress resistance,	
understand the breeding	components.	etc.	
approaches, introgression of alien	3. Study of	3. Soybean: Breeding approaches,	
gene(s) (if required), biotic and	segregating	introgression of alien gene(s) (if	
abiotic stress resistance, heterosis	populations in	required), biotic and abiotic	
breeding, released varieties,	cereal, pulses	stress resistance, heterosis	
examples of MAS used for	and oilseed	breeding, released varieties,	
improvement of Soybean.	crops.	examples of MAS used for	
SO3.4. Students are able to	4. Learning on	improvement.	
understand the origin, evolution	the crosses	4. Castor and Sesame: Origin,	
mode of reproduction,	between	evolution mode of reproduction,	
chromosome number; Genetics –	different	chromosome number; Genetics	
cytogenetics and genome	species.	-cytogenetics and genome	
relationship of castor and sesame.		relationship	
SO3.5. Students are able to		5. Castor and Sesame: Breeding	
understand the Breeding		objectives: yield, quality	
objectives: yield, quality		characters, biotic and abiotic	
characters, biotic and abiotic		stress resistance, etc.	
stress resistance, etc. of Castor		6. Castor and Sesame: Breeding	
and Sesame.		approaches, introgression of	
SO3.6. Students are able to		alien gene(s) (if required),	
understand the breeding		released varieties, examples of	
approaches, introgression of alien		MAS used for improvement;	

gene(s) (if required), released varieties, examples of MAS used for improvement; Hybrid	Hybrid breeding in castor – opportunities, constraints and achievements
breeding in castor – opportunities, constraints and achievements of	achievements
castor and sesame.	

SW-3 Suggested Sessional Work (SW):

- a) Assignments:
 - i. Important concepts of genetics and breeding soybean, castor and sesame.
- b) Mini Project:
 - ii. Techniques for seed production and hybrid seeds production soybean, castor and sesame.
- c) Other Activities (Specify):

GPB511.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Cotton, and Jute.

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Class room Instruction (CI)		Self-
	Instruction		Learning
	(LI)		(SL)
SO4.1. Students are able to	1. Evaluating the	-	1. Concepts of
understand the origin, evolution,	germplasm of	status and reproductive	breeding in
mode of reproduction,	cotton for	structures of crops and	cotton and
chromosome number; Genetics -	yield, quality	genetics of cotton and jute.	jute.
cytogenetics and genome	and resistance	1. Cotton: Origin, evolution,	
relationship of cotton.	parameters,	mode of reproduction,	
SO4.2. Students are able to	learning the	chromosome number; Genetics	
understand the breeding objectives:	procedures on	– cytogenetics and genome	
yield, quality characters, biotic and	development	relationship	
abiotic stress resistance, etc. of	of Bt cotton.	2. Cotton: Breeding objectives:	
cotton.	2. Visit to	yield, quality characters, biotic	
SO4.3. Students are able to	Cotton	and abiotic stress resistance,	
understand the breeding	Technology	etc.	
approaches, introgression of alien	Laboratory	3. Cotton: Breeding approaches,	
gene(s) (if required), biotic and	and Spinning	introgression of alien gene(s)	
abiotic stress resistance, heterosis	Mills.	(if required), biotic and abiotic	
breeding, released varieties,	3. Learning on	stress resistance, heterosis	
examples of MAS used for	the Standard	breeding, released varieties,	
improvement, Development and	Evaluation	examples of MAS used for	
maintenance of male sterile lines –	System (SES)	improvement, Development	
Hybrid development and seed	and	and maintenance of male	
production – Scenario of Bt	descriptors.	sterile lines – Hybrid	

cottons, evaluation procedures for Bt cotton of cotton. SO4.4. Students are able to understand the origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship of jute. SO4.5. Students are able to understand the breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc. of jute.	software for database management	1	
- ·			
		e v	
jute.			
SO4.6. Students are able to		6. Jute: Breeding approaches,	
understand the breeding		introgression of alien gene(s)	
approaches, introgression of alien		(if required), biotic and abiotic	
gene(s) (if required), biotic and		stress resistance, heterosis	
abiotic stress resistance, heterosis		breeding, released varieties,	
breeding, released varieties,		examples of MAS used for	
examples of MAS used for		improvement.	
improvement of jute.			

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Important concepts of genetics and breeding cotton and jute.

- b. Mini Project:
 - i. Techniques for seed production and hybrid seeds production cotton and jute.
- c. Other Activities (Specify):

GPB511.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Sugarcane, Forage crops, and Seed spices.

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning
SO5.1. Students are able to understand the evolution and	1.Practical learning on the	Unit-5. Important botanical status and reproductive	(SL) 6.Concepts of
distribution of species and forms, wild relatives and germplasm of	cultivation of fodder crop	structures of crops and genetics of Sugarcane, Forage	breeding in Sugarcane,
Sugarcane.	species on	crops and Seed spices.	Forage

SO5.2. Students are able to	como do motor	1.Sugarcane: Evolution and	arong and
SO5.2. Students are able to understand the cytogenetics and	sewage water, analysing them	1. Sugarcane: Evolution and distribution of species and	crops and Seed
genome relationship – Breeding	for yield		spices.
objectives- yield, quality characters,	components	germplasm.	
biotic and abiotic stress resistance,		2.Sugarcane: Cytogenetics and	
etc. of Sugarcane.	2.Laboratory	genome relationship –	
SO5.3. Students are able to	analysis of	Breeding objectives- yield,	
understand the evolution and	forage crops for	quality characters, biotic and	
distribution of species and forms -	crude protein,	abiotic stress resistance, etc.	
Wild relatives and germplasm;	digestibility	3.Forage crops: Evolution and	
Cytogenetics and genome	percent and	distribution of species and	
relationship of Forage crops.	other quality	forms - Wild relatives and	
SO5.4. Students are able to	attributes.	germplasm; Cytogenetics and	
understand the breeding objectives-		genome relationship.	
yield, quality characters and	1 0	4. Forage crops: Breeding	
palatability studies; Biotic and	factories.	objectives- yield, quality	
abiotic stress resistance, etc. of		characters and palatability	
Forage crops.	practice of	studies; Biotic and abiotic	
SO5.5. Students are able to	value addition;	stress resistance, etc.	
understand the origin, evolution,	Visiting the	5. Seed spices: Origin, evolution,	
mode of reproduction, chromosome	animal	mode of reproduction,	
number; Genetics – cytogenetics and	husbandry unit	chromosome number; Genetics	
genome relationship. Breeding	and learning the	- cytogenetics and genome	
objectives: yield, quality characters,	animal	relationship. Breeding	
biotic and abiotic stress resistance,	experiments	objectives: yield, quality	
etc. of Seed spices.	related with	characters, biotic and abiotic	
SO5.6. Students are able to	palatability and	stress resistance, etc.	
understand the breeding approaches,	digestibility of	6. Seed spices: Breeding	
introgression of alien gene(s) (if	fodder.	approaches, introgression of	
required), biotic and abiotic stress		alien gene(s) (if required),	
resistance, heterosis breeding,		biotic and abiotic stress	
released varieties, examples of MAS		resistance, heterosis breeding,	
used for improvement;		released varieties, examples of	
Achievements of important spice		MAS used for improvement;	
crops of Seed spices.		Achievements of important	
* 1		spice crops.	

SW-5 Suggested Sessional Work (SW):

e. Assignments:

i. Hybrid seed production technology in Sugarcane, Forage crops and Seed spices.

f. Mini Project:

- i. Examples of MAS used for improvement in Sugarcane, Forage crops and Seed spices.
- e. Other Activities (Specify):

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
GPB511.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rice, Maize, and Small millets.	8	2	1	11
GPB511.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Pigeon pea, Groundnut, and Other pulses.	10	2	1	13
GPB511.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Soybean, Castor and Sesame.	14	2	1	17
GPB511.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Cotton, and Jute.	14	2	1	17
GPB511.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Sugarcane, Forage crops, and Seed spices.	14	2	1	17

Brief of Hours suggested for the Course Outcome

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution		Total	
		R	U	Α	Marks
CO 1	Important botanical status and reproductive structures of		3	2	8
	crops and genetics of rice, maize, and small millets.				
CO 2	Important botanical status and reproductive structures of	4	4	2	10
	crops and genetics of Pigeon pea, Groundnut and Other				
	pulses.				

CO 3	Important botanical status and reproductive structures of	5	3	4	12
	crops and genetics of soybean, castor and sesame.				
CO 4	Important botanical status and reproductive structures of	4	3	3	10
	crops and genetics of cotton and jute.				
CO 5	Important botanical status and reproductive structures of crops and genetics of Sugarcane, Forage crops and Seed	3	4	3	10
	spices.				
Total		19	17	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Crop Breeding I (Kharif Crops) will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 16. Improved Lecture
- 17. Case Method
- 18. Group Discussion
- 19. Demonstration
- 20. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 21. Brainstorming
- 22. Smart board

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition &
No.				Year
1	Breeding of Field	Chopra, V.L. Parthasarathy	Oxford and IBH Publishing Co.	2000
	Crops	VA.	Pvt. Ltd., New Delhi.	
2	Vol. II Medicinal and Aromatic Plant	Chaddha. K.L. and Rajendra Gupta.	Malhotra Publishing House, New Delhi.	1995
3	Advances in Plant	Mandal, A. K., P.K. Ganguli and S.P. Banerjee.	CBS Publishers and	1991
4	Crop Improvement: Challenges in the Twenty-First Century.	Manjit S. Kang	International Book Distributing Co. Lucknow	2004
5	Breeding of Field Crops	Poehlman, J.M.	AVI Publishing Co. INC, East Port, Conneacticut, USA.	1987
6	Approaches for	Kannaiyan S, Uthamasamy S, Theodore R.K. and Palaniswamy S.	Directorate of Extension Education, TNAU, Coimbatore.	2002
7		Murty D.S. Tabo R. and Ajayi O.	ICRISAT, Patancheru, India	1994

	Management.			
8	Manual on Rice	Nanda JS.	Kalyani Publishers.	1997
	Breeding.			
9	Spices and Plantation	Parthasarathy V.A.	Today and Tomorrow Printers	2017
	Crops Vol.1 (Part A)		and Publishers	
	Breeding of			
	Horticultural Crops			
	Vol.1 (Part-B),			

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					(Course	Title:	- Crop	Breed	ling I ((Khari	f Crop	s)					
Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
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omes																		
	То	The	То	Disse	This	The	То	То	То	The	То	Dis	Thi	The	То	То	То	The
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		will be			am	ents will	elop	inte	e	ent	emi	inat	pro	ents	elo	n into	e	ent will
		familia r with		-	will provi	deve	scie ntifi	rdis cipl	stu den	will be	nate info	e	gra	will dev	p scie	inte rdis	stud ents	be
	ehensi		about		de	lop a	call	inar	ts a	fam	rma	com pre	m wil	elop	ntifi	cipl	a	fam
		various			oppor	unde	y	y	co	iliar	tion	hen	1	a	call	inar	co	iliar
	introd		e	cal	tunitie	rstan	trai	und	mp	wit	abo	sive	pro	und	y	y	mpr	wit
		reprod	metho		s for	ding	ned	erst	reh	h	ut	prac	vid	erst	trai	und	ehe	h
	to	uctive	ds of	standi	stude	and	pers	andi	ens	the	dive	tical	e	andi	ned	erst	nsiv	the
	geneti	system			nts to	anal	onn	ng	ive	vari	rse	und	op	ng	pers	and	e	vari
	cs and		g-edge	-	under	yzin	el	of	intr	ous	met	erst	por	and	onn	ing	intr	ous
	•	genetic		hybri	stand	g	for	gen	od	plan	hod	andi	tun	anal	el	of	odu	pla
		diversit			the	pres	com	etic	uct	t	s of	ng	itie	yzin	for	gen	ctio	nt
	U	y, and	e conoti	on, in	major	ent diffi	mu	S	ion	repr odu	cutt	of	S for	g	co	etic	n to	repr odu
	apply	breedin g and	•		constr aints	culti	nity serv	and bree	to gen	ctiv	ing- edg	cro p	for stu	pres ent	mm unit	s and	gen etic	ctiv
	to	selecti		line	of	es in	ice,	din	etic	e	e	hyb	den	diffi	y	bre	s	e
	variou		breedi		crop	local	part	g	s	syst	and	ridi	ts	cult	serv	edi	and	syst
		techniq		opme	produ	and	icul	tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
	crops.	ues.	resear	nt,	ction	glob	arly	niq	pla	,	tive	on,	un	in	part	tech	nt	,
			ch.	and	and	al	in	ues	nt	gen	gen	in-	der	loca	icul	niq	bre	gen
				germp	their	agric	rura	for	bre	etic	etic	bre	sta	1	arly	ues	edi	etic
				lasm	soluti	ultur	1.	the	edi	dive	S 1	d	nd	and	in	for	ng	div
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				ing.		and how	ons in	ivat ion	as the	y, and	plan t	dev elop	ma jor	bal	l regi	cult ivat	the	ty, and
						they	fiel	of	y y	bree	bree	men	con	agri cult	regi ons	ion	y app	bre
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						agric		win	S	n		scre	pro	imp	ure	gro	ps.	n
						ultur		g fue	cro	tech		enin	duc	act		win		tech
						e.		fro m	ps.	niq		g.	tio	futu		g fro		niq
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Cos, POs and PSOs Mapping Course Code: GPB 511 Course Title: - Crop Breeding I (Kharif Crops

								emp orar y agri cult ure.					ons			con tem por ary agri cult ure.		
GPB5 10.1: Stude nt will be able to unders tand seed qualit y conce pt and Geneti c purity in seed produ ction.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 10.2: Stude nts will have the ability to apply the knowl edge gained about nucleu s seed produ ction and its maint enanc e.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

GPB5 10.3: To unders tand princi ples of seed produ ction in differe nt crops.	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1
GPB5 10.4: Stude nt will be able to unders tand hybrid seed produ ction of crop plants.	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
GPB5 10.5: Stude nts wi Il get knowl edge o n seed certifi cation and minim um Seed Certifi cation Stand ards (MSC S) for	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

differe									
nt									
crops.									

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Crop Breeding I (Kharif Crops)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)		Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.1 : Student will be able to understand seed quality concept and Genetic purity in seed production.	SO1.1 SO1.2 SO1.3	General procedure of seed certification,	Unit-1. Importance of seed as basic input in agriculture; Seed quality concept and importance.1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.2 : Students will have the ability to apply the knowledge gained about nucleus seed production and its maintenance.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Identification of weed and other crop seeds as per specific crops.	Nucleus seed production and its maintenance 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.3 : To understand principles of seed production in different crops.	SO3.1 SO3.2 SO3.3	To study about field inspection at different stages of a crop.	Principles of seed production. 3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.4 : Student will be able to understand hybrid seed production of crop plants.	SO4.1 SO4.2	Specifications for tags and labels to be used for certification purpose.	Varietal and hybrid seed production techniques 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB510.5 :Students will get knowledge on seed certification and minimum Seed Certification Standards (MSCS) for different crops.	SO5.1 SO5.2	Path coefficient analysis and interpretation.	Seed certification - history, concept, objectives Central seed certification board Seed certification agency/ organization and staff requirement 5.1, 5.2	As mentioned in page number

Semester I

Course Code: STAT-502 Course Title: Statistical Methods for Applied Science

Pre-requisite: Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

Rationale: Statistical methods involved in carrying out a study include planning, designing, collecting data, analysing, drawing meaningful interpretation and reporting of the research findings. The statistical analysis gives meaning to the meaningless numbers, thereby breathing life into a lifeless data.

Course Outcomes: CO1 This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.

CO2 It can be used to find the best solution to any problem be it simple or complex.

CO3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.

CO4 To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.

CO5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Scheme of Studies:

Board of	Course	Course Title		Schem	e of st	tudies	(Hours/Week)	Total
Study	Code		Cl	LI	S	SL	Total Study Hours	
					W		(CI+LI+SW+SL)	(C)
Program	STAT-502	Statistical Methods for	2	01	02	01	6	3
Core		Applied Science						
(PCC)								

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C: Credits.**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

				Sc	heme of A	Assessment	(Marks)		-
				Progressive	Assessm	ent (PRA)			T (1
Board of Study	Course Code	Course Title	Class/Home Assignment 1 number 5 marks each (CA)	Class Test 2 (2 best out) 15 marks each (CT)	al Exam	Class Attendan ce (AT)	Total Marks (CA+CT+ PA+AT)	End Semester Assessment (ESA)	Total Mark s (PRA+ ESA)
	STAT-502	Statistical Methods for Applied Science	5	30	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion. STAT-502.1 Know the applications of Statistics and learn and apply these techniques in the agriculture field.

L.L	
Item	Appx. Hrs.
CI	6
LI	2
SW	1
SL	2
Total	11

Session Out Comes Laborato (SOs) Instruction		Classroom Instruction (CI)	Self- Learning	
	(LI)		(SL)	
SO1.1 Apply laws of probability to concrete problems. SO1.2 Perform statistical inference in several circumstances and interpret the results in an applied context. SO1.3 Communicate concepts in probability and statistics using both technical and non-technical language.SO1.4 Use a statistical software package for computations with data,	1) To impart knowledge on Statistical concepts like Exploratory data analysis.	Unit-1.Box-plot,Descriptivestatistics,Exploratorydataanalysis,TheoryTheoryofprobability,Randomvariableandmathematical expectation.1.1.Box-plot1.2Descriptive statistics1.3Exploratoryanalysis1.41.4Theory of probability.1.5Random variable1.6Mathematicalexpectation	1. Prepare the assignment on Random variable and mathematical expectation.	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Random variable and mathematical expectation.

b. Mini Project: -

c. Other Activities (Specify):

STAT-502 CO-2 Find the best solution to any problem be it simple or complex.

Approximate Hours				
Item Appx. Hrs.				
CI	6			
LI	8			
SW	1			
SL 2				
Total	17			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Lear ning (SL)
 SO2.1 Recognize the binomial probability distribution and apply it appropriately. SO2.2 Recognize the Poisson probability distribution and apply it appropriately. SO2.3 Recognize and understand discrete probability distribution functions, in general. SO2.4 Recognize the standard normal probability distribution and apply it appropriately. SO2.5 Compare normal probabilities by converting to the standard normal distribution. 	 Fitting of Binomial distributions. Fitting of Poisson distributions. Fitting of Negative Binomial distributions. Fitting of Normal distributions. 	 Unit-2 Discrete and continuous probability distributions, 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. 1.1 Discrete and continuous probability distributions 1.2 Binomial, Poisson, Negative Binomial 1.3. Normal distribution, Beta and Gamma distributions and their applications 1.4 Concept of sampling distributions. 1.5 Tests of significance based on Normal, chi-square, t and F distributions. 1.6 Tests of significance based on t and F distributions. 	1. Prepare the assignment on Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Probability. Binomial & Poisson Distributions.

a. Other Activities (Specify):

STAT-502.3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.

Approximate Hours				
Item	Appx. Hrs.			
CI	6			
LI	6			
SW	1			
SL	2			
Total	15			

Session Out Comes	Laboratory Instruction	Classroom Instruction	Self-	
(SOs)	(LI)	(CI)	Learning	
			(SL)	
SO3.1 Create and analyze	1- Large sample tests,	Unit-3 Definition of Correlation,	1. Prepare the	
scatter plots.	testing of hypothesis	Scatter Diagram. Karl Pearson's	assignment on	
scatter plots.	based on exact sampling	Coefficient of Correlation.	Karl Pearson's	
SO3.2 Discuss basic ideas of	distributions ~ chi square,	Linear Regression Equations.	Coefficient of	
linear regression and	t and F.	1.1 . Definition of Correlation	Correlation. Linear	
correlation.	2- Large sample tests,	1.2 Types of Correlation	Regression Equations.	
SO3.3 Create and interpret a	testing of hypothesis	1.3 . Scatter Diagram		
line of best fit.	based on exact sampling	1.4. Karl Pearson's Coefficient		
The of best fit.	distributions ~t-test.	of Correlation		
SO3.4 Calculate and interpret	3- Large sample tests,	1.5 Definition of Regression.		
the correlation coefficient.	testing of hypothesis	1.6 . Linear Regression		
	based on exact sampling	Equations		
	distributions ~F- test.			

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.

b. Other Activities (Specify):

STAT-502 CO-4 Understand the process of hypothesis testing and its significance. Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.

Approximate Hours				
Item	Appx Hrs.			
CI	6			
LI	8			
SW	1			
SL	2			
Total	17			

Session Out Comes	LaboratorClassroom InstructionSelf-y(CI)LearInstructionning(LI)(SL)			y	Lear
(SOs)				Instruction	ning
 SO4.1 Conduct and interpret hypothesis tests for a single population mean, population standard deviation known. SO4.2 Conduct and interpret hypothesis tests for a single population mean, population standard deviation unknown. SO4.3 Describe hypothesis testing in general and in practice SO4.4 Interpret the chi-square probability distribution as the sample size changes. SO4.5 Conduct and interpret chi-square goodness-of-fit hypothesis tests. 	1- Confidenc e interval estimation and 2- Correlation analysis 3- Regression analysis 4- Fitting of Linear and Quadratic Model.	 Unit-4 Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 1.1 Introduction to Test of Significance 1.2 One sample 1.3 Two sample test t for Means 1.4 Definition of Chi-Square 1.5 Application of Chi-square test 1.6 Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table 	1. Prepa re the assignment on Chi- Square Test of Independence of Attributes in 2×2 Contingency Table.		

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Chi-Square Test of Independence of Attributes in 2×2 Contingency Table

c. Other Activities (Specify):

STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Approximate Hours

Item	Appx Hrs.
CI	6
LI	6
SW	1
SL	2
Total	15

Session Out Comes	Laboratory	Classroom Instruction	Self-		
(SOs)	Instruction	(CI)	Learning		
	(LI)		(SL)		
SO5.1 Recognize and	1- Non-parametric	Unit-5 Introduction to Analysis of	1. Prepare the		
differentiate between key	tests.	Variance, Analysis of One Way	assignment on		
terms.	2- ANOVA: One	Classification. Introduction to	Introduction to		
SO5.2 Apply various types	way	Sampling Methods, Sampling versus	Analysis of		
of sampling methods to	3- ANOVA: Two	Complete Enumeration, Simple	Variance, Analysis		
data collection.	Way	Random Sampling with and without	of One Way		
data concetion.		replacement, Use of Random Number	Classification.		
SO5.3 Create and interpret		Tables for selection of Simple	Introduction to		
frequency tables.		Random Sample.	Sampling Methods,		
		1.1 Introduction to Analysis of	Sampling versus		
		Variance	Complete		
		1.2 . Analysis of One Way	Enumeration.		
		Classification			
		1.3 . Introduction to Sampling Methods			
		1.4 Sampling versus Complete			
		Enumeration			
		1.5 Simple Random Sampling with			
		and without replacement			
		1.6 Use of Random Number Tables for			
		selection of Simple Random Sample.			

SW-1 Suggested Sessional Work (SW): Assignments: Other Activities (Specify)

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (L I)		Self- Learning (S l)	Total hour (C l + LI+ SW +Sl)
01: This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	06	02	01	02	15
02: It can be used to find the best solution to any problem be it simple or complex.	06	08	01	02	15
03: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient,	06	06	01	02	15

Brief of Hours suggested for the Course Outcome

partial correlation coefficient and Multiple correlation coefficient.					
04: To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	06	08	01	02	15
05: Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	06	06	01	02	15

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title	Marks Distribution			Total	
		R	U	Α	Marks	
CO-1	This course will help students to know the applications of					
	Statistics and learn and apply these techniques in the	02	02	02	06	
	agriculture field of their study.					
CO-2	It can be used to find the best solution to any problem be it simple or complex.	02	03	03	08	
CO-3	Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	02	04	04	10	
CO-4	To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	03	04	05	12	
CO-5	Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	04	05	05	14	
	Total	13	18	19	50	

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Statistical Methods for Applied Science will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Tutorial
- 3. Case Method
- 4. Group Discussion

- 5. Role Play
- 6. Demonstration
- 7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 8. Brainstorming

S. No.	Title	Author	Publisher	Edition & Year
01	An Outline of Statistical Theory	Goon AM, Gupta MK &Dasgupta B.	The World Press	1977 1 st adition
02	Fundamentals of Statistics	Goon AM, Gupta MK &Dasgupta B	The World Press	1983. First edition
03	Introduction to Mathematical Statistics	Hoel PG	John Wiley	05th Edition 1971
04	An Introduction to Multivariate Statistical Analysis	T.W. Anderson	John Wiley.	3rd Edition 2009
05	Introduction to Mathematical Statistics	Robert V. Hogg, Joseph W. McKean, Allen T. Craig	Hogg	7th Edition 2012

Suggested Learning Resources:

Curriculum Development Team:

1. Professor B.B. Beohar, Director Planning, & Director Extension, A.K.S. University

2. Dr. V.K. Vishwakarma, Head Department of Agricultural Economics, FAST

3. Mr. Navneet Raj Rathore, Teaching Associate, Department of Agricultural Economics, FAST

Cos, POs and PSOs Mapping Course Code: STAT-502

		Course	cout	• D I I I	1 004				
Course	Title: -	Statist	ical M	ethods	s for A	pplied	Scienc	e	
			DC	DC	DC	DC	DC	DC	DC

Course	PO 1	PO 2	PO-3		PO-5		PO 7			PS PS	PS PS	PS	PS	PS	DC	PS	PS	Р
Outco	PUI	PO 2	PO-3	PO-4	PO-5	PO-0	PU /	PS 01	PS O2	PS 03	P5 04	P5 05	PS 06	P5 07	PS O8	PS 09	PS 01	r S
								01	02	05	04	05	00	07	00	09	0	5 0
mes																	U	11
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	Studen	Student	The	The	Stude	Stud	Stu	Stu	Stu	Stu	Stu	Stu	Aft	Stu	Stu	Stu	Stu	St
	t will		studen		nt	ent	dent	dent	den	dent	dent	dent	er	den	den	den	den	ud
	identif	experti		nt	will	will	will	will	t	will	will	will	gai	t	t	t	t	en
	y the	se in	have	will	plan	appl	und	iden	wil	reco	appl	und	nin	wil	will	will	will	t
	current	latest	expert	have	about	y	erst	tify	1	gniz	y	erst	g	1	pra	app	app	wi
	scenari	vegeta	ise in	expert	the	vario	and	diff	pra	e	diff	and	exp	rec	ctic	ly	ly	11
	o, crop	ble	nurser	ise in	big	us	abo	eren	ctic	diff	eren	role	erie	ogn	e	vari	basi	ap
	diversi	product	у-	differ	scale	statis	ut	t	e	eren	t	of	nce,	ize	turf	ous	c	pl
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	require	vegeta	and	condit	t and	to	niqu	war	bre	ilize	proc	e in	get	flo	oor	serv	lab	с
	ment	ble	protec	ions	also	anal	es,	m	edi	d	essi	veg	the	wer	pla	ices	orat	st
	and	breedin		requir	mana	yze	tech	seas	ng	veg	ng	etab	posi	,	nt	,	ory	ati
	breedi	g	cultiva	ed for	ge the	their	nica	on	tec	etab	and	le	tion	orn	and	tech	tech	sti
	ng	techniq	tion of	comm	resear	mast	1	and	hni	le	post	and	s of	am	inte	nica	niq	ca
	techni	ues and	vegeta	on	ch	er	writ	und	que	and	-	flo	spe	ent	rios	1	ues	1
	ques	post-	bles	veget	trails	resea	ing	erut	S	spic	harv	wer	cial	al	capi	writ	duri	to
	of	harvest		able	under	rch	skill	ilize	use	e	est-	crop	ists	cro	ng	ings	ng	ol
	differe	manag	flower		veget	work	,	d	d	crop	han	pro	for	ps	ma	and	thei	S
	nt	ement	crops.	well	able		IPR	veg	in	S	dlin	duct	han	and	nag	co	r	du
	vegeta			as	and		,	etab	veg		g	ion	dlin	thei	eme	mm	rese	ri
	ble	vegeta		under	flowe		labo	le	eta		met	und	g	r	nt	uni	arc	ng
	and	bles		utilize	r		rato	crop	ble		hod	er	pla	nur		cati	h	th
	flower			d	crops		ry	S	and		S	diff	ntat	ser		on	wor	eir
	crops.			veget			tech		flo		for	eren	ion,	У		skil	k	re
				able			niqu		we		veg	t	nur	ma		ls in		se
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Statistic s and learn and apply these techniq ues in																		
student s to know the applicat																		

their study.																		
STAT- 502.2 It can be used to find the best solution to any proble m be it simple or comple x.	1	1	3	1	2	1	1	1	2	3	2	1	1	1	1	1	1	1
STAT- 502.3 Concep t of correlat ion, various correlat ion coeffici ents- Pearson 's correlat ion coeffici ent, Spearm an's rank correlat ion coeffici ent, partial correlat ion	3	1	3	2	1	1	1	1	1	2	1	1	3	1	1	1	1	1

coeffici ent and Multipl e correlat ion coeffici ent.																		
STAT- 502.4 To underst and the process of hypothe sis testing and its signific ance. Testing of hypothe sis using Non- Parame tric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them	3	1	2	3	1	1	1	2	3	1	2	3	2	1	1	1	1	1

judicio usly for the testing of given data																		
STAT- 502.5 Apply the differen t samplin g method s for designi ng and selectin g a sample from a populat ion. Compar e the pairs of treatme nt means using differen t method s when null hypothe sis in rejected in ANOV A.	3	3	2	3	2	1	1	2	2	2	2	2	3	1	1	1	1	1

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Statistical Methods for Applied Science

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT-502.CO 1: This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	SO1.1 SO1.2 SO1.3 SO1.4	 1.1. To impart knowledge on Statistical concepts like Exploratory data analysis. 	Unit-1.0 Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation. 1.1, 1.2, 1.3. 1.4, 1.5, 1.6	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT-502.CO 2: It can be used to find the best solution to any problem be it simple or complex.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	 2.1. Fitting of Binomial distributions. 2.2. Fitting of Poisson distributions. 2.3. Fitting of Negative Binomial distributions 2.4. Fitting of Normal distributions. 	Unit-2.0 – Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, <i>t</i> and <i>F</i> distributions. Tests of significance based on Normal, chi-square, <i>t</i> and <i>F</i> distributions. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT-502.CO3:Conceptofcorrelation, variouscorrelationcoefficients-Pearson'scorrelationcoefficient,Spearman'srankcorrelationcoefficient,partialcorrelation	SO3.1 SO3.2 SO3.3 SO3.4	 3.1. Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F. 3.2. Large sample tests, testing of hypothesis based on exact sampling distributions ~ t- 	Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6	As mentioned in page number

PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	coefficientandMultiple correlationcoefficient.STAT-502.CO4:To understand theprocessofhypothesistestingand its significance.TestingofhypothesisusingNon-ParametricteststestslikeMediantest,Runstest,Runstest,KruskalWallistest etc.and abilitytousethemjudiciouslyfor thetestingofgivendata.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	test. 3.3. Large sample tests, testing of hypothesis based on exact sampling distributions ~ F- test 4.1.Confidence interval estimation and. 4.2. Correlation analysis. 4.3. Regression analysis. 4.4. Fitting of Linear and Quadratic Model.	Unit-4.0 Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 4.1, 4.2, 4.3. 4.4, 4.5, 4.6	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT-502.CO 5: Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	SO5.1 SO5.2 SO5.3	5.1. Non-parametric tests.5.2. ANOVA: One way5.3. ANOVA: Two Way	Unit-5.0 Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample. 5.1, 5.2, 5.3. 5.4, 5.5, 5.6.	As mentioned in page number

Semester-I

	Semester-1
Course Code:	PGS 501
Course Title:	Library and Information Services
Pre-requisite:	Student should have basic knowledge of library because course aims to familiarize the learners with the basic concept of use of library services.
Rationale:	To impart to the students an understanding of knowledge classification and the theories of library classification, to develop skills in document classification and content analysis. To select, evaluate and acquire library materials in varied formats to meet and respond to the needs of our diverse community. To promote literacy and disseminate useful daily information to the people and encourage lifelong learning through its reading materials and resources.
	To provide opportunity, ensuring freedom and equal access to information for all members of the community, to educate and enlighten them.
	To maintain and preserve books, materials and resources with historical, cultural, social, economic and archival value, and other related materials in an organized collection to provide members of the community these materials and enriched their personal and professional lives.
	To provide materials and resources that entertain and inspire as well as services offering space for people and information to come together, and programs that would create library awareness and consciousness.

Course Outcomes:

CO1. Compare and critique approaches to information systems, structures, and standards.

CO2. Able to understand about various concepts of Library, its functions, objective.

CO3. Connect foundational concepts, theories, and principles of information organization and access to professional contexts.

CO4.Design and develop systems and services that provide access to information.

CO5. Analyze evidence to address information challenges and opportunities.

Scheme of Studies:

Doord				Schem	e of stud	lies (H	lours/Week)	Total
Board of Study	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Total Credits (C)
	PGS 501	Library and Information Services	1	0	1	2	4	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies.Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performance sin laboratory workshop, field or

other locations using different instructional strategies), SW: Sessional Work (includes assignment, seminar, mini project etc.), SL: Self Learning, C: Credits.

Note: SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

				Scheme						
				Progres	sive Ass	essmen	t (PRA)		End	
			Class/Hom	Class					Semester	
Board	Couse	Course	e	Test 2 (2		Class		Total	Assessme	Total
of	Code	Title	Assignmen	best out	Semina	Activit	Class	Marks	nt (ESA)	Marks
Study	Coue	THE	t 5 number	of 3) 10	r one	y any	Attendanc	(CA+CT		(PRA+ES
			3 marks	marks	(SA)	one	e (AT)	+SA+C		A)
			each	each		(CAT)		AT+AT)		
			(CA)	(CT)						
	PGS 501	Library and Informatio n Services	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion

Topic Covered:

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 Sic Access Catalogue and other computerized library services; Use of Internet including search engines resources; ere sources access methods.

CO.1: Able to understand about the origin of Library and information Services.

Appro	oximate Hours
Item	Appx Hrs.
Cl	1
LI	0
SW	1
SL	2
Total	4

Session Outcomes	(LI)	Classroom Instruction	(SL)
(SOs)		(CI)	
SO1.1 Understand the		1.1 Introduction to library,	1. How to
Concept, Definition &		1.2 Types of library,	Accessioning of
Characteristics of Library		1.3 Role of library in society	Books on
SO1.2Understand the		1.4 Role of Education sector,	software
Importance & Functions of		1.5 Classification scheme,	2 How to Books
Library		1.6 Types of Information sources	search in Library
SO1.3 Understand the		1.7 Abstracting and indexing services,	through the
Role of Library and		1.8 Use of Databases, OPAC	OPAC
Information Services		1.9 Computerized library services	3. Difference
Information Services		1.10 Library Services	Between Library
		1.11 Online Public Access Catalogue	and Information
		1.12 Types of Information Centers	Services
		1.13 Library Automation	
		1.14 Create a Digital Library	
		1.15 Use of e resources	

SW-1 Suggested Sessional Work (SW):

Assignments: 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.

Reference Books:

Foundations of Library and Information Science By Pawan Tripathi, Ansh Book International

<u>Management Basics for Information Professionals</u> by G. Edward Evans, Patricia Layzell Ward, Neal Schuman Publishers

Library Classification by Purushotham Tiwari APH Publishing Corporation

Cos, POs and PSOs Mapping Course Code: PGS 501 Course Title: - Library and Information Services

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PSO1	PSO	PSO3	PSO4	PSO5	PSO	PSO7	PSO	PSO	PSO	PSO
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Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Library and Information Services

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS501CO1Able to understand aboutvarious conceptsofLibrary,itsfunctions, objective andconnectfoundational concepts, theories, and principlesofinformation organizationand accesstoto	SO1.1 SO1.2 SO1.3	 1.1 Introduction to library, 1.2 Types of library 1.3 Role of library in society 1.4 Role of Education sector, 1.5 Classification scheme, 1.6 Types of Information sources 1.7 Abstracting and indexing services, 1.8 Use of Databases, OPAC 1.9 Computerized library services 1.10 Library Services 1.11 Online Public Access Catalogue 1.12 Types of Information Centers 1.13 Library Automation 		As mentioned in page number

professional contexts bulb and tuber crops.	1.14 Create a Digital Library1.15 Use of e resources		
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Semester- I

Course Code:	PGS502
Course Title:	Technical writing and communication.
Pre- requisite:	Understanding the principles of various technical writing including thesis,
	reviews, abstracts and developing communication skills through the proper use of
	language.
Rationale:	The basic purpose of technical writing is to convey complex information in a
	simple manner. It explains a topic in detail using proper abstract and citations
	having communication skills being accessible to a general audience.
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Course Outcomes:

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing) **Scheme of Studies:**

Γ	Board of	Course	Course Title	S	chem	e of s	tudie	s (Hours/Week)	Total
	Study	Code			LI	S	S	Total Study	Credits
				I		W	L	Hours	(C)
								CI+LI+SW+SL	
		PGS 502	Technical writing and	0	2	0	0	2	0+1
			communication.						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Boar d of Stud v	Cours e Code	Course Title		Scheme of Assessment (Marks)												
				Progres	sive As	sessment	t (PRA)		End Semester Assessment (ESA)	Total Marks (PRA+ESA)						
			Class/Ho me Assignme nt 5 number 3 marks each (CA)	Test 2 (2 best out of 3) 10	ar one	Class Activity any one (CAT)		Total Marks (CA+CT+ SA+CAT +AT)								

PGS	Technical								
502	writing and communicatio	0	0	0	0	0	0	100	100
	n								

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.

	Approximate Hours
Item	Approximate Hours
CI	00
LI	08
SW	01
SL	02
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
various technical	 Various form of scientific writing – thesis, technical papers, reviews, manuals etc. Various part of thesis and research communication Title page, Authorship content page, Preface, Introduction, Review of literature Material and methods, Experimental result, Discussion citations etc. Commonly used abbreviations in the thesis and research communication. Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. 		Enlisting and write description of research communicatio n contents.

SW-1 Suggested Sessional Work (SW):

d. Assignments:

i. Various part of thesis and research communications.

- ii. Writing of abstract, summaries, précis, citations.
- iii. Commonly used abbreviations in the thesis and research communication.
- iv. Write down the principal of editing and press reading.

e. Mini Project:

f. Other Activities (Specify):

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing).

	Approximate Hours
Item	Approximate Hours
CI	00
LI	07
SW	01
SL	02
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction	Self-Learning (SL)
		(CI)	(3L)
SO2.1. To understand the types,	Communication skill-		Enlisting and
forms, tenses clauses and their	1 Grammar (Tenses, part of speed,		write the
uses.	clauses, punctuation marks)		description of
SO2.2. To understand common	2 Error analysis (common error),		communication
errors, punctuation in the	concord, collocation, phonetic,		using proper
sentences.	symbols and transcription.		language skills.
SO2.3. To understand part of	3 Accentual pattern: weak forms in		
speech or word class and their	connected speech.		
uses.	4 Participation in group discussion		
SO2.4. To understand	5 Facing of interview.		
discussion in groups and	6 Presentation of scientific paper.		
interviews.			

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1 Writing types of clauses.

- 1 Writing the sentences using correct punctuation.
- 2 Writing the types and forms of tenses.
- b. Mini Project:
- civ. Other Activities (Specify):

Difer of Hours sug	gesteu for th	c course ou	come	
Course Outcomes	Class	Sessional	Self Learning	Total hour
	Lecture (Cl)	Work (SW)	(Sl)	(Cl+SW+Sl)
PGS 502.1: Learning the various form of	0	2	1	3
scientific writing and implementing skills for				
Formulation of research based documents.				
PGS 502.2: Acquisition of technical	0	2	1	3
communication skill and articulate in English				

Brief of Hours suggested for the Course Outcome

(verbal as writing)											

	Suggested Specification T		-		
CO	Unit Titles	Ma	Total		
		R	U	Α	Marks
CO 1	Technical writing	00	05	05	10
	1.1 Various form of scientific writing –				
	thesis, technical papers, reviews, manuals				
	etc.	03	03	04	10
	1.2 Various part of thesis and research				
	communication				
	- Title page				
	- Authorship content page				
	- Preface	00	05	05	10
	- Introduction	00	0.5	0.5	10
	- Review of literature	03	02	05	10
	- Material and methods	00	00	10	10
	- Experimental result				
	- Discussion	00	05	05	10
	1.3 citations etc.	04	02	04	10
		03	02	05	10
	1.4 Commonly used abbreviations in the				
	thesis and research communication.				
	1.5 Illustrations, photography and drawing				
	with suitable captions pagination				
	numbering of tables and illustrations.				
	1.6 Writing of numbers and dates in				
	e				
	scientific write ups.				
	1.7 Editing and press reading				
	1.8 Writing of review articles.				
CO 2	Communication skill-				
	1.1 Grammar (Tenses, part of speed,	03	02	05	10
	clauses, punctuation marks)		~		
	charges, punctuation marks)	02	03	05	10
	1.2 Error analysis (common error), concord,	04	04	00	08
	collocation, phonetic, symbols and	05	02	00	07
	transcription.	00	05	05	10
	1.3 Accentual pattern: weak forms in	00	05	05	10
	connected speech.				
	1.4 Participation in group discussion				

Suggested Specification Table (For ESA)

1.6 Presentation of scientific paper.		

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Technical writing and communication** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 23. Improved Lecture
- 24. Tutorial
- 25. Case Method
- 26. Group Discussion
- 27. Role Play
- 28. Demonstration
- 29. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- **30**. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	er e e e	Barnes and Noble. Robert C. (Ed.).	Flourish Your Language	2005
2	Technical communication	Mike markel Stular A. Selber	Bedford/St. Martins, 12 th edition	2017
3	The Essentials of Technical communication	Elizabeth tebeaux sam dragga.	Oxford university press,4 th edition	2017
4	e	Kieran morgan and sanja spajic	Better on paper publications, 1th edition	2015
5	1 0 1 5	lanyi, Deirdrelongo	IBM press 3th edition	2014

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Cos, POs and PSOs Mapping Course Code: PGS502 Course Title: - Technical writing and communication

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
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	ty, climati	0		condit	t and	ods	niq	war	bre	ilize		te	y wil	wei	oor	ser	in	tool
	ciinati	ble	and	ions	also	to	ues,	m	edi	d	pro cess	in	1	, orn	pla	vic	lab	s
		breedin			mana	anal	tech	seas	ng	veg	ing	veg	get	ame	nt	es,	orat	duri
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	ng	and	of	veget	trails	er	ing	erut	es	spic	har	flo	ns	and	capi	writ	que	rese
	techni		vegeta	-	under	rese	skill	ilize	use	e	vest	wer	of	thei	ng	ing	s	arc
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PGS 502. 1: Lear ning the vario us form of scien tific writi ng and impl emen ting skills for Form ulati on of	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	3	3	3

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Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map	Technical writing	and communication
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POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
1,2,3,4,5,6,7 PSO 1,2, 3,	scientific writing	SO1.1 SO1.2 SO1.3	 Technical writing Various form of scientific writing – thesis, technical papers, reviews, manuals etc. Various part of thesis and research Title page Authorship content page Preface Introduction Review of literature Material and methods Experimental result Discussion citations etc. Commonly used abbreviations in the thesis and research communication . Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. Writing of numbers and dates in 8. Writing of review articles. 		As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 502.CO2: Acquisition of technical communication skill and articulate in English (verbal as writing)	SO2.1 SO2.2 SO2.3 SO2.4	 Grammar (Tenses, part of speed, clauses, punctuation marks) Error analysis (common error), concord, collocation, phonetic, symbols and transcription. Accentual pattern: weak forms in connected speech. Participation in group discussion Facing of interview. Presentation of scientific paper. 		As mentioned in page number

Detailed Syllabus M.Sc. Ag. in Genetics & Plant breeding Semester- II

Course Code:	GPB 505
Course Title:	Principles of Cytogenetics
Pre- requisite:	Student should have basic knowledge of cell, chromosome and variations of chromosomes.
Rationale:	The very purpose of this course is to acquaint the students with cell cycle and architecture of chromosome in prokaryotes and eukaryotes, special types of chromosomes, techniques for karyotyping. This course aims to impart knowledge of variations in chromosomes numbers and their structures. It acquaints the students for the production and use of haploids, apomictic populations and their role in genetics and breeding.

Course Outcomes:

GPB 505.1: Student will be able to understand Cell cycle and architecture of chromosome.

GPB 505.2: Students will have the ability to apply the knowledge gained about Structural and numerical variations of chromosomes.

GPB 505.3: To understand Fertilization barriers, Polyploidy and genetic problems in crops with apomixes.

GPB 505.4: Student will be able to explain Reversion of autopolyploid to diploids; Genome mapping in polyploids

GPB 505.5: Students will get knowledge on Chromosome manipulations

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)			Total	
Study	Code		CI	CI LI SW SL Total Study Hours				Credits
							CI+LI+SW+SL	(C)
	GPB 505	Principles of	2	2	1	1	6	2+1=3
		Cytogenetics						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Board	Cous	Course Title		Scheme of Assessment (Marks)						
of	e			Progre	essive A	ssessme	ent (PRA)		End	Total
Study	Code								Semester	Marks
				Assessment (PRA+ES					(PRA+ESA	
									(ESA))
			Class/Ho	Class	Semin	Class	Class	Total		
			me	Test 2 (2	ar one	Activit	Attendan	Marks		
			Assignme	best out	(SA)	y any	ce (AT)	(CA+CT+		
			nt 5	of 3) 10		one		SA+CAT		
			number 3	marks		(CAT)		+AT)		
			marks	each						

		each (CA)	(CT)						
GP	Principles	15	30	0	0	5	50	50	100
В	of								
505	Cytogeneti								
	cs								

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 505.1: Student will be able to understand cell cycle and architecture of chromosome.

Approximate Hours

	ippi ominiate inours
Item	Approximate Hours
CI	7
LI	16
SW	1
SL	1
Total	25

Session Outcomes (SOs)	Session Outcomes (SOs) Laboratory		Self-Learning
	Instruction (LI)		(SL)
SO1.1. Student will be able to	1. Learning the	Unit-1. Cell cycle and	1. Special
understand cell cycle.	cytogenetical	architecture of chromosome	types of
SO1.2. Students are able to	laboratory	1.1. Cell cycle	chromoso
explain architecture of	techniques.	1.2. Architecture of	mes
chromosome in prokaryotes and	2. Various chemicals	chromosome in prokaryotes	
eukaryotes.	to be used for	and eukaryotes.	
SO1.3. To know Chromonemata,	fixation.	1.3. Chromonemata,	
chromosome matrix,	3. Various chemicals	chromosome matrix,	
chromomeres, centromere,	to be used for	chromomeres, centromere,	
secondary constriction and	dehydration.	secondary constriction and	
telomere.	4Various chemicals	telomere.	
SO1.4. Understand artificial	,	1.4. Artificial chromosome	
chromosome construction and its	embedding, staining,	construction and its uses	
uses.	cleaning, etc.	1.5. Special types of	
SO1.5. Understand Special types	5 Microscopy:		
of chromosomes and variation in	various types of		
chromosome structure.	microscopes.	1.6.Evolutionary	
SO1.6. To know evolutionary	6. Preparing		
significance; Introduction to	specimen for	techniques for karyotyping.	
techniques for karyotyping.	observation.	1.7. Chromosome banding	
SO1.7. Understand Chromosome		and painting -In situ	
banding and painting -In situ		hybridization and various	
hybridization and various	8. Studies on meiosis	applications.	
applications.	in crop plants.		

SW-1 Suggested Sessional Work (SW):

g. Assignments:

Architecture of chromosome in prokaryotes

- h. Mini Project:
- i. Other Activities (Specify):

GPB 505.2: Students will have the ability to apply the knowledge gained about Structural and numerical variations of chromosomes.

				Appro	oximate Hours
			Item	Approxir	nate Hours
	-		CI		8
			LI		8
			SW		1
	-		SL		1
	-		Total		18
Session Outcomes (SOs)	Labora	tory	Class room Instruc	ction (CI)	Self-
	Instru	tion			Learning
	(LI)			(SL)
SO2.1.Understand Structural	1. Fix	ative	Unit-2. Variation	ons of	1.Numerical
variations of chromosomes and their	prepara	ion	chromosomes.		variations of
implications.	~ ~	ixing	1. Structural var	riations of	chromosomes
SO2.2. Students are able to explain	specime	n for	chromosomes an	nd their	and their
Numerical variations of	light		implications		implications
chromosomes and their implications	microsc	ору	2. Numerical var	riations of	-
SO2.3. Symbols and terminologies	studies	in	chromosomes an	nd their	
for chromosome numbers.	cereals.		implications		
SO2.4. To know euploidy, haploids,	2. 1	Jsing	3.Symbols and termin	nologies for	
diploids and polyploids	microm		chromosome number	rs	
SO2.5. Student will be able to		lying	4. Euploidy, haploids,	diploids and	
understand utilization of aneuploids	-	ollen	polyploids		
in gene location.	grain si		5. Utilization of an	neuploids in	
SO2.6. Knowledge about Variation	wheat	and	gene location		
in chromosome behaviour, somatic	mustarc			chromosome	
segregation and chimeras.		lying	behaviour, somatic	segregation	
SO2.7. Students are able to explain	·	ollen	and chimeras,		
Endomitosis and somatic reduction;	grain si	-	7. Endomitosis ar		
Evolutionary significance of	maize	and	-	Evolutionary	
chromosomal aberrations, balanced	pearel n	nillet	U	hromosomal	
lethal.			aberrations, balanced		
SO2.8. Chromosome complexes; Inter-varietal chromosome			8. Chromosome comp		
				chromosome	
substitutions.			substitutions.		

SW-2 Suggested Sessional Work (SW):

- c. Assignments: Utilization of aneuploids in gene location
- d. Mini Project:

Other Activities (Specify):

GPB 505.3: To understand Fertilization barriers, Polyploidy and genetic problems in crops with apomixes.

Item	Approximate Hours
CI	6
LI	4
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction		(SL)
	(LI)		
SO3.1. Understand fertilization	1.Pollen	Unit 3 Fertilization barriers	1. Role of
barriers in crop plants at pre-and	germination	and Polyploidy	aneuploids in
post fertilization levels; In-vitro	in vivo	1. Fertilization barriers in crop	basic and
techniques to overcome the		plants at pre-and post fertilization	
fertilization barriers in crops;	germination	levels; In-vitro techniques to	of crop breeding,
Polyploidy	in-vitro.	overcome the fertilization barriers	their
SO3.2. Understand Genetic		in crops; Polyploidy	maintenance and
consequences of polyploidization		2. Genetic consequences of	utilization in
and role of polyploids in crop		polyploidization and role of	gene mapping
breeding		polyploids in crop breeding	and gene blocks
SO3.3. To know autopolyploid and		3. Evolutionary advantages of	transfer.
allopolyploids.		autopolyploid vs allopolyploids.	
SO3.4. Knowledge about Role of		4 Role of aneuploids in basic and	
aneuploids in basic and applied		applied aspects of crop breeding,	
aspects of crop breeding, their		their maintenance and utilization	
maintenance and utilization in gene		in gene mapping and gene blocks	
mapping and gene blocks transfer.		transfer.	
SO3.5. Student will be able to		5. Alien addition and substitution	
understand Alien addition and		lines, creation and utilization.	
substitution lines, creation and		6. Apomixis, evolutionary and	
utilization.		genetic problems in crops with	
SO3.6. Students are able to explain		apomixes.	
apomixis, evolutionary and genetic			
problems in crops with apomixes.			

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Alien addition and substitution lines, creation and utilization.

- b. Mini Project:
- c. Other Activities (Specify):

GPB 505.4: Student will be able to explain Reversion of autopolyploid to diploids; Genome mapping in polyploids.

Item	Approximate Hours
CI	6
LI	2
SW	1
SL	1
Total	10

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction (LI)		(SL)
SO4.1. Understand Reversion	1. Demonstration of	Unit 4. Reversion of	1.Interspecific
of autopolyploid to diploids.	polyploidy.	polyploids.	hybridization
SO4.2 Student will be able to		1.Reversion of autopolyploid	and
understand genome mapping		to diploids	allopolyploids.
in polyploids.		2.Genome mapping in	
SO4.3. Knowledge about		polyploids.	
Interspecific hybridization and		3. Interspecific hybridization	
allopolyploids.		and allopolyploids.	
SO.4.4. Students are able to		4. Synthesis of new crops	
explain Synthesis of new crops		(wheat, Triticale, Brassica, and	
(wheat, Triticale, Brassica, and		cotton).	
cotton).		4. Hybrids between species	
SO.4.5. Understand hybrids		with same chromosome	
between species with same		number, alien translocations.	
chromosome number, alien		5. Hybrids between species	
translocations.		with different chromosome	
SO4.6. To know Gene transfer		number.	
using amphidiploids bridge		6. Gene transfer using	
species.		amphidiploids bridge species.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Hybrids between species with same chromosome number, alien translocations.

- b. Mini Project:
- c. Other Activities (Specify):

GPB 505.5: Students will get knowledge on Chromosome manipulations.

Item	Approximate Hours
CI	3
LI	0
SW	1
SL	1
Total	5

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO5.1. Understand Chromosome		Unit-5 Chromosome	Production
manipulations in wide hybridization.		manipulations	and use of
SO5.2. Knowledge about Production		1. Chromosome manipulations in	haploids
and use of haploids and dihaploids in		wide hybridization.	and
genetics and breeding.		2. Production and use of haploids	dihaploids
SO5.3. Students are able to explain		and dihaploids in genetics and	in genetics
Production and use of doubled		breeding.	and
haploids in genetics and breeding.		3. Production and use of doubled	breeding.
		haploids in genetics and breeding.	

SW-5 Suggested Sessional Work (SW):

- g. Assignments:
- h. Mini Project:
- **Other Activities (Specify):**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Sessional	Self-	Total hour
	Lecture	Work (SW)	Learning	(Cl+SW+Sl)
	(Cl)+ LI		(Sl)	
GPB 505.1: Student will be able to understand	23	1	1	25
Cell cycle and architecture of chromosome.				
GPB 505.2: Students will have the ability to	16	1	1	18
apply the knowledge gained about Structural				
and numerical variations of chromosomes.				
GPB 505.3: To understand Fertilization	10	1	1	12
barriers, Polyploidy and genetic problems in				
crops with apomixes.				
GPB 505.4: Student will be able to explain	8	1	1	10
Reversion of autopolyploid to diploids;				
Genome mapping in polyploids.				
GPB 505.5: Students will get knowledge on	3	1	1	05
Chromosome manipulations				

Suggestion for End Semester Assessment

СО	Unit Titles	Ma	Total		
		R	U	Α	Marks
CO 1	Cell cycle and architecture of chromosome	3	6	2	11
CO 2	Variations of chromosomes.	2	5	2	9
CO 3	Fertilization barriers and Polyploidy	2	7	2	11
CO 4	Reversion of polyploids.	4	4	2	10
CO 5	Chromosome manipulations.	4	4	1	9
	Total Marks	15	26	9	50

Suggested Specification Table (For ESA)

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Principles of Cytogenetics** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 31. Improved Lecture
- 32. Case Method
- 33. Group Discussion
- 34. Role Play
- 35. Demonstration
- 36. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 37. Brainstorming
- 38. Smart Board

Suggested Learning Resources:

S.	Title	Author	Publisher	Edition &
No.				Year
1	World of the Cell.	Becker K and	Pearson Edu.	2004.
		Hardin J.		
2	Discussions in Cytogenetics.	Charles B.	Prentice Hall Publications.	1993.
3	Cytogenetics	Gupta PK.	Rastogi Pubishers	2010.
4	Cell and Molecular Biology:	Karp G.	John Wiley & Sons.	1996
	Concepts and Experiments.			
5	Cytogenetics of aneuploids.	Khush GS.	Elsevier. 1 edition.	1973
6	Chromosome Techniques:	Sharma AK and	Butterworth Heinemann	1988
	Theory and Practice.	Sharma A.	publisher	
7	Introduction to Cytogenetics	Ganesh Prasad	Kalyani Publishers	2013
8	Fundamentals of Cytogenetics	Mahabal Ram	PHI	2010
	and Genetics			
9	Understandings ion Cytogenetic	V & H P	Vasudev, V & H P	2017
	Techniques	Gurushankara	Gurushankara	
		Vasudev		

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	Course Code: GPB 505																	
	1					Course '							1	1	1	1		·
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Cos, POs and PSOs Mapping

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GPB 505.1: Stude nt will be able to unders tand Cell cycle and archite cture of chrom osome	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB 505.2: Stude nts will have the ability to apply the knowl edge gained about Struct ural and numer ical variati ons of chrom osome s.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1
GPB 505.3	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1

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GPB	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
505.4:	5	2	2	2	1	1	1	5	1	2	1	1	2	1	1	1	1	1
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GPB	2	3	2	3	2	1	1	1	2	2.	1	2	1	1	1	1	1	1
GPB 505.5:	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

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Legend: 1- Low,2 – Medium, 3- High

	Course Curriculum M		· · · ·		A
POs & PSOs	COs No.& Titles	SOs	Laboratory	Classroom	Self-
No.		No.	Instruction (LI)	Instruction (CI)	Learning
					(SL)
РО	GPB 505.1: Student will be able to	SO1.1	Fixative	Unit-1.	As
1,2,3,4,5,6,7	understand Cell cycle and architecture of	SO1.2	preparation and	Cell cycle and	mentioned
PSO 1,2, 3,	chromosome.	SO1.3	fixing specimen	architecture of	in page
4, 5, 6, 7, 8,			for light	chromosome.1.1, 1.2,	number
9, 10, 11			microscopy	1.3	
			studies in cereals.		
PO	GPB 505.2: Students will have the ability	SO2.1	2. Using	Structural variations of	As
1,2,3,4,5,6,7	to apply the knowledge gained about	SO2.2	micrometres. 3.	chromosomes and their	mentioned
PSO 1,2, 3,	Structural and numerical variations of	SO2.3	Studying the	implications	in page
4, 5, 6, 7, 8,	chromosomes.	SO2.4	pollen grain size	2.1, 2.2, 2.3, 2.4, 2.5	number
9, 10, 11		SO2.5	in wheat and		
			mustard.		
PO	GPB 505.3: To understand Fertilization	SO3.1	4. Studying the	Fertilization barriers in	As
1,2,3,4,5,6,7	barriers, Polyploidy and genetic problems	SO3.2	pollen grain size	crop plants at pre-and	mentioned
PSO 1,2, 3,	in crops with apomixes.	SO3.3	in maize and	post fertilization levels;	in page
4, 5, 6, 7, 8,			pearel millet	In-vitro techniques to	number
9, 10, 11				overcome the	
				fertilization barriers in	
				crops; Polyploidy 3.3,	
DO		0044		3.2, 3.3	
PO	GPB 505.4: Student will be able to	SO4.1		Reversion of	As
1,2,3,4,5,6,7	explain Reversion of autopolyploid to	SO4.2		autopolyploid to	mentioned
PSO 1,2, 3,	diploids; Genome mapping in polyploids.			diploids Genome	in page number
4, 5, 6, 7, 8,				mapping in polyploids.	
9, 10, 11					
				4.1.4.2	
РО	CDR 505 5: Students will get knowledge	SO5.1		4.1, 4.2 Chromosome	As
1,2,3,4,5,6,7	GPB 505.5: Students will get knowledge on Chromosome manipulations	SO5.1 SO5.2		manipulations in wide	mentioned
PSO 1,2, 3,	on Chromosome manipulations	505.2		hybridization	in page
4, 5, 6, 7, 8,				5.1, 5.2	number

9, 10, 11			

Semester- II

Course Code:	GPB 506*
Course Title:	Molecular Breeding and Bioinformatics*
Pre- requisite:	Student should have basic knowledge of genetics, plant breeding and molecular marker.
Rationale:	The course will provide deep knowledge to the students on genotyping and kinds of markers including biochemical and molecular, mapping populations, allele mining. This will also add ways to perform marker-assisted selection and gene pyramiding to evolve superior varieties
C O (

Course Outcomes:

GPB 506.1: Student to know about various molecular tools and approaches for genotyping and their uses in crop improvement.

GPB 506.2: Students will have the ability to apply the knowledge gained about QTLs analysis in crop plants.

GPB 506.3: To understand genome sequencing and nanotechnology.

GPB 506.4: Student will be able to explain recombinant DNA technology and Biotechnology applications in crop improvement.

GPB 506.5: Students will get knowledge about International regulations and biosafety issues of GMOs

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)			es (Hours/Week)	Total
Study	Code		CI	LI	SW	SL	Total Study Hours	Credits
							CI+LI+SW+SL	(C)
	GPB	Molecular	2	2	1	1	6	2+1=3
	506*	Breeding and						
		Bioinformatics*						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Board	Cous			Scheme of Assessment (Marks)						
of	e	Course Title								
Study	Code									
				End Total						
				Drogressive Assessment (DDA) Semester Marks						
				Progressive Assessment (PRA) Definester Marks Assessme (PRA+ESA)						
				nt (ESA))						
			Class/H	Class Test	Semin	Class	Class	Total		
			ome	ome 2 (2 best ar one Activity Attendan Marks						
			Assignm	out of 3)	(SA)	any one	ce (AT)	(CA+CT		

			10 marks each (CT)		(CAT)		+SA+CA T+AT)		
GP B 506 *	Molecular Breeding and Bioinformat ics*	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 506.1: Student to know about various molecular tools and approaches for genotyping and their uses in crop improvement.

	Approximate Hours
Item	Approximate Hours
CI	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1. Student will be able to		Unit-1. Genotyping;	1. Mapping
understand genotyping.		Biochemical and Molecular	populations
SO1.2. Students are able to		markers.	
explain biochemical and		1. Genotyping	
molecular markers.		2 Biochemical and Molecular	
SO1.3. Student will be able to		markers; Morphological,	
understand RFLP, RAPD, AFLP,		biochemical	
SSR, SNPs, ESTs, etc.		3 DNA-based markers	
SO1.4. Understand Functional		4. Functional markers; Mapping	
markers; Mapping populations		populations (F2s, back crosses,	
SO1.5. Students are able to		RILs, NILs and DH);	
explain molecular mapping and		5. Molecular mapping and	
tagging of agronomically		tagging of agronomically	
important traits.		important traits.	
so1.6. To know Statistical tools		6 Statistical tools in marker	

in marker analysis. analysi	is.
-----------------------------	-----

SW-1 Suggested Sessional Work (SW):

j. Assignments:

Mapping populations (F2s, back crosses, RILs, NILs and DH);

k. Mini Project:

l. Other Activities (Specify):

GPB 506.2: Students will have the ability to apply the knowledge gained about QTLs analysis in crop plants.

				App	proximate Hours
			Item	Approx	ximate Hours
			CI		6
			LI		0
			SW		1
			SL		1
			Total		8
Session Outcomes (SOs)	Labor Instru (L)	ction	Class room Instruct	tion (CI)	Self-Learning (SL)
 SO2.1.Understand allele mining; Marker-assisted selection for qualitative and quantitative traits. SO2.2. Students are able to explain QTLs analysis in crop plants. SO2.3. Students will have the ability to apply the knowledge gained about marker-assisted backcross breeding for rapid introgression. SO2.4. To know Genomics- assisted breeding. SO2.5. Student will be able to understand Generation of EDVs. SO2.6. Knowledge about Gene pyramiding. 			 Unit-2. Allele mining, 1. Allele mining; assisted selection for and quantitative traits. 2. QTLs analysis in crossing 3. Marker-assisted breeding for rapid intro 4. Genomics- assisted 5. Generation of EDVs 6. Gene pyramiding. 	Marker- qualitative op plants. backcross ogression. breeding.	1. QTLs analysis in crop plants.

SW-2 Suggested Sessional Work (SW):

e. Assignments:

Marker-assisted selection for qualitative and quantitative traits.

f. Mini Project:

Other Activities (Specify):

GPB 506.3: To understand genome sequencing and nanotechnology.

Item	Approximate Hours
CI	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO 3.1. Understand Introduction to		Unit 3 Genome sequencing and	Human
Comparative Genomics.		Nanotechnology.	genome
SO3.2. Knowledge about Large scale		1. Introduction to Comparative	project.
genome sequencing strategies.		Genomics.	
SO3.3. To know Human genome		2. Large scale genome sequencing	
project; Arabidopsis genome project		strategies.	
SO3.4. Knowledge Rice genome		3. Human genome project;	
project; Comparative genomics tools.		Arabidopsis genome project	
SO3.5. Student will be able to		4 Rice genome project; Comparative	
understand Introduction to		genomics tools.	
proteomics; 2D gel electrophoresis;		5. Introduction to proteomics; 2D gel	
chromatography and sequencing by		electrophoresis; chromatography and	
Edman degradation and mass		sequencing by Edman degradation	
spectrometry; Endopeptidases SO3.6.		and mass spectrometry;	
Students are able to explain		Endopeptidases;	
Nanotechnology and its applications		6. Nanotechnology and its	
in crop improvement.		applications in crop improvement.	

SW-3 Suggested Sessional Work (SW):

d. Assignments:

Nanotechnology and its applications in crop improvement

- e. Mini Project:
- f. Other Activities (Specify):

GPB 506.4: Student will be able to explain recombinant DNA technology and Biotechnology applications in crop improvement.

Item	Approximate Hours
CI	7
LI	30
SW	1
SL	1
Total	39

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-
	(LI)		Learning
			(SL)
SO4.1. Understand	1. Requirements for plant	Unit 4. Recombinant DNA	1.
Recombinant DNA	tissue culture laboratory.	technology and	Production
technology.	2. Techniques in plant tissue	Application of Tissue	of
SO4.2 . Student will be able	culture.	culture in molecular	transgenic
to understand Clean	3. Media components	breeding.	plants in
transformation techniques,	4. Media preparation.	1.Recombinant DNA	various field
vector-mediated gene	5. Aseptic manipulation of	technology, transgenes	crops.
transfer	various explants,	,method of transformation	
SO4.3. Knowledge	observations on the	and selectable markers	
about physical methods	contaminants occurring in	2. Clean transformation	
of gene transfer.	media, interpretation.	techniques, vector-mediated	
SO4.4. Students are able to	6. Inoculation of explants,	gene transfer	
explain Production of	callus induction and plant	3. physical methods of gene	
transgenic plants in various	regeneration.	transfer;	
field crops: and commercial	7. Standardizing the	4. Production of transgenic	
releases.	protocols for regeneration.	plants in various field crops:	
SO4.5. Understand	8. Hardening of regenerated	cotton, wheat, maize, rice,	
Biotechnology applications	plants.	soybean, oilseeds, sugarcane,	
in male sterility/ hybrid	9. Establishing a greenhouse	etc. and commercial releases.	
breeding, molecular	10 Hardening procedures	5. Biotechnology applications	
farming;	11.Visit to commercial micro	in male sterility/ hybrid	
SO4.6 . Student will be able	propagation unit	breeding, molecular farming;	
to understand application of	12. DNA isolation	6. Application of Tissue	
Tissue culture in molecular	13. DNA purity and	culture in molecular breeding	
breeding.	quantification tests.	7. MOs and related issues	
SO4.7. Knowledge	14. GUS assay in	(risk and regulations); GMO.	
about MOs and related	transformed cells/ tissues.		
issues (risk and regulations)	15.Transformation using		
GMO.	Agrobacterium strains		

SW-4 Suggested Sessional Work (SW):

d. Assignments:

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

- e. Mini Project:
- f. Other Activities (Specify):

GPB 506.5: Students will get knowledge about International regulations and biosafety issues of GMOs.

Item	Approximate Hours
CI	5
LI	0
SW	0
SL	1
Total	6

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction		(SL)
	(LI)		
SO5.1. Understand International		Unit-5 International regulations of	Intellectual
regulations, biosafety issues of		GMOs and bioinformatics.	property
GMOs		1 International regulations, biosafety	rights.
SO5.2. Knowledge about		issues of GMOs	_
Regulatory procedures in major		2. Regulatory procedures in major	
countries including India.		countries including India.	
SO5.3. Students are able to		3. Ethical, legal and social issues.	
understand ethical, legal and		4. Intellectual property rights.	
social issues.		5. Introduction to bioinformatics:	
SO5.4. Knowledge about		bioinformatics tools, biological data	
Intellectual property rights.		bases (primary and secondary),	
SO5.5.Students will get knowled		implications in crop improvement.	
ge about bioinformatics.			

SW-5 Suggested Sessional Work (SW):

- i. Assignments:
- j. Mini Project:

Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Sessional	Self-	Total hour
	Lecture	Work	Learning	(Cl+SW+Sl)
	(Cl)	(SW)	(Sl)	
GPB 506.1: Student to know about various molecular				
tools and approaches for genotyping and their uses in	6	1	1	8
crop improvement.				
GPB 506.2: Students will have the ability to apply the	6	1	1	8
knowledge gained about QTLs analysis in crop plants.	0	1	1	o
GPB 506.3: To understand genome sequencing and	6	1	1	8
nanotechnology.	U	1	1	o
GPB 506.4: Student will be able to explain				
recombinant DNA technology and Biotechnology	37	1	1	39
applications in crop improvement.				
GPB506.5: Students will get knowledge about				
International regulations and biosafety issues of	5	0	1	6
GMOs				

Suggestion for End Semester Assessment

СО	Unit Titles	Mark	ution	Total	
		R	U	Α	Marks
CO 1	Genotyping; Biochemical and Molecular markers	4	6	2	12
CO 2	Allele mining.	2	5	2	9
CO 3	Genome sequencing and Nanotechnology.	2	6	2	10
CO 4	Recombinant DNA technology and Application of Tissue culture in molecular breeding.	4	4	3	11
CO 5	International regulations of GMOs and bioinformatics.	2	4	2	8
	Total Marks	14	25	11	50

Suggested Specification Table (For ESA)

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Molecular Breeding and Bioinformatics will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 39. Improved Lecture
- 40. Group Discussion
- 41. Demonstration
- 42. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 43. Brainstorming
- 44. Smart Board

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition &
No.				Year
1	Data Analysis and Visualization in	Azuaje F and	John Wiley and Sons	2005
	Genomics and Proteomics.	Dopazo J		
2	Essential Molecular Biology: a	Brown TA.	Oxford university press,	1991
	practical Approach.			
3	Introduction to Plant Biotechnology	Chawala HS.	Oxford & IBH Publishing	2000
			Co. Pvt. Ltd.	
4	Genetic Engineering and	Chopra VL and	Oxford & IBH.	1990
	Biotechnology: Concepts, Methods	Nasim A.		
	and Applications			
5	Elements of Biotechnology	Gupta PK.	Rastogi Publ	1997
6	An Introduction to Recombinant		Benjamin Publ. Co.	1988
	DNA Technology – Basic	JA and Messing		
	Experiments in Gene Manipulation.	JW.		
7	Proteomics in Functional	Jollès P and	Birkhäuser.	2000
	Genomics: Protein Structure	Jörnvall H.		
	Analysis.	* · D		2017
8	Genes XII.	Lewin B.	Jones & Bartlett learning,	2017
9	Biotechnology, Expanding	Singh BD.	Kalyani Publishers, New	2005.

Horizons Delhi.

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		1	1		Course					0				1	1		1	
Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
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omes																		
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	to	selecti	plant	line	of	es in	ice,	din	etic	e	e	hyb	den	diffi	у	bre	s	e
	variou		breedi	devel	crop	local	part	g	s	syst	and	ridi	ts	cult	serv	edi	and	syst
	s	techniq	ng	opme	produ	and	icul	tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
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Course Code: GPB 506 Course Title: - Molecular Breeding and Bioinformatics

								agri cult ure.								ary agri cult ure.		
GPB 506.1: Stude nt to know about variou s molec ular tools and approa ches for genoty ping and their uses in crop impro vemen t.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB 506.2: Stude nts will have the ability to apply the knowl edge gained about QTLs analys is in crop plants.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1
GPB 506.3: To	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1

unders tand geno me seque ncing and nanote chnol ogy.																		
ogy. GPB 506.4: Stude nt will be able to explai n recom binant DNA techno logy and Biotec hnolo gy applic ations in crop impro vemen t.	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1
GPB5 06.5: Stude nts wi ll get knowl edge a bout Intern ationa l regula tions and biosaf ety	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

issues									
of									
GMO									
s									

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Molecular Breeding and Bioinformatics											
POs & PSOs	COs No.& Titles	SOs	Laboratory		Self-						
No.		No.	Instruction (LI)	Instruction (CI)	Learning						
					(SL)						
РО	GPB 506.1: Student to know about		Requirements for	Unit-1.	As						
1,2,3,4,5,6,7	various molecular tools and approaches	SO1.2	plant tissue	Genotyping;	mentioned						
PSO 1,2, 3,	for genotyping and their uses in crop	SO1.3	culture	Biochemical and	in page						
4, 5, 6, 7, 8, 9, 10, 11	improvement.		laboratory.	Molecular markers.	number						
				1.1, 1.2, 1.3							
PO	GPB 506.2: Students will have the ability	SO2.1	2. Techniques in	Allele mining; Marker-	As						
1,2,3,4,5,6,7	to apply the knowledge gained about		plant tissue	assisted selection for	mentioned						
PSO 1,2, 3,	QTLs analysis in crop plants.	SO2.3	culture.	qualitative and	in page						
4, 5, 6, 7, 8,		SO2.4		quantitative traits.	number						
9, 10, 11		SO2.5		1	•••••						
				2.1, 2.2, 2.3, 2.4, 2.5							
PO	GPB 506.3: To understand genome	SO3.1	3. Media	Genome sequencing	As						
1,2,3,4,5,6,7	sequencing and nanotechnology.	SO3.2	components	and Nanotechnology.	mentioned						
PSO 1,2, 3,		SO3.3		3.3, 3.2, 3.3	in page						
4, 5, 6, 7, 8,					number						
9, 10, 11											
РО	GPB 506.4: Student will be able to	SO4.1	4. Media	Recombinant DNA	As						
1,2,3,4,5,6,7	explain recombinant DNA technology and	SO4.2	preparation.	technology and	mentioned						
PSO 1,2, 3,	Biotechnology applications in crop			Application of Tissue	in page						
4, 5, 6, 7, 8,	improvement.			culture in molecular	number						
9, 10, 11				breeding.							
				biecuing.							
				4.1, 4.2							
РО	GPB506.5:	SO5.1	5. Aseptic	International	As						
1,2,3,4,5,6,7	Students will get knowledge about	SO5.2	manipulation of	regulations of GMOs	mentioned						
PSO 1,2, 3,	International regulations and biosafety		various explants,	and bioinformatics.	in page						
4, 5, 6, 7, 8,	issues of GMOs		observations on		number						
9, 10, 11			the contaminants	5.1, 5.2							
			occurring in								
			media,								
			interpretation.								

Course Curriculum Map: Molecular Breeding and Bioinformatics

Semester- II

Course Code: GPB 508

Course Title: Mutagenesis and Mutation Breeding

Pre- requisite: To impart the knowledge about general principles of mutagenesis for crop improvement and various tests/ methods for detection of mutations.

Rationale: After completing this course will make the student well versed with the process of mutation and its use in crop improvement. This course will also give in depth knowledge of mutations in genomics, allele mining and TILLING.

Course Outcomes:

GPB 508.1 This course will make the student well versed with the mutation and its history, nature and classification of mutations.

GPB 508.2 This course will make the student well versed with the mutagenic agents and effect of mutations.

GPB 508.3 This course will make the student well versed with the chemical mutagens, their properties and mode of action

GPB 508.4 This course will make the student well versed with the process of observing mutagen effects in M1, M2 and M3 generation.

GPB 508.5 This course will make the student well versed with the use of mutagens in creating oligogenic and polygenic variations and Handling of segregating M2 generations.

Doord of	Course			Sch	es (Hours/Week)	Total			
Board of Study	Course Code	Course Title	CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	Credits (C)	
	GPB 508	Mutagenesis and Mutation Breeding	2	2	0	0	4	(2+1) = 3	

Scheme of Studies:

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

		-			Scheme	of Assess	sment (M	(arks)		
Boa				Progress	sive Asse	ssment (PRA)		End	
rd of	Cour	Course	Class/Home Class Test Assignment 2 (2 best			Class A ctivi	Class Attenda	Total Marks	Semeste	Total Marks
Stu dy	se Code	Title	5 number 3 marks each	out of 3) 10 marks each		ty any one (CAT)		(CA+CT+S) $(CA+CT+S)$ $(CA+CT+AT)$	Assessm ent (ESA)	
			(CA)	(CT)		(CAI)		CAITAI)	(ESA)	
	GPB 508	Mutagene sis and Mutation	15	30	0	0	5	50	50	100

	Breedin	5							
0									

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 508.1 This course will make the student well versed with the mutation and its history, nature and classification of mutations.

	Approximate Hours
Item	Approximate Hours
CI	4
LI	2
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
 SO1.1. Students able to explain the mutation and its history and nature SO1.2. Students able to explain the classification of mutations: spontaneous and induced mutations, micro and macro mutations, pre and post adaptive mutations. SO1.3. Students able to explain the detection of mutations. SO1.4. Students able to explain the paramutations in crops plants. 	1.Precautions on handling of mutagens.	 Unit-1 Mutation history, nature and Classification. 1. Mutation and its history and nature 2. Classification of mutations: spontaneous and induced mutations, micro and macro mutations, pre and post adaptive mutations. 3. Detection of mutations. 4. Paramutations in crops plants. 	1. Classification and Detection of mutations.

W-1 Suggested Sessional Work (SW):

- a. Assignments:
 - j. History, nature and Paramutations in crops plants.
- b. Mini Project:
- c. Other Activities (Specify):

GPB 508.2 This course will make the student well versed with the mutagenic agents and effect of mutations.

	Approximate Hours
Item	Approximate Hours
CI	6
LI	12
SW	2
SL	1

	Tot	al	21
Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instructio	on (CI) Self Learning (SL)
SO2.1. Students are able to understand the mutagenic agents: physical – radiation types and sources: Ionizing and non-ionizing radiations. SO2.2. Students are able to understand the radiobiology: mechanism of action of various radiations (photoelectric absorption, Compton scattering and pair production) and their biological effects – RBE and LET relationships. SO2.3. Students are able to understand the effect of mutations on DNA – repair mechanisms operating at DNA, chromosome, cell and organism level to counteract the mutation effects. SO2.4. Students are able to understand the dosimetry -Objects and methods of treatment. SO2.5. Students are able to understand the factors influencing mutation: dose rate, acute vs chronic irradiation, recurrent irradiation, enhancement of thermal neutron effects. SO2.6. Students are able to understand the radiation sensitivity and modifying factors: External and internal sources – Oxygen, water content, temperature and nuclear volume.	Chemical mutagens. 3. Learning on Radioactivity. 4. Learning about gamma chamber. 5. Radiation hazards: Monitoring – safety regulations and safe transportation of radioisotopes 6. Learning on safe disposal of radioisotopes.	 DNA. 1. Mutagenic agents: phradiation types and a lonizing and non-radiations. 2. Radiobiology: mecha action of various radiations. 2. Radiobiology: mecha action of various radiations of various radiations. 2. Radiobiology: mecha action of various radiations. 2. Radiobiology: mecha action of various radiations. 3. Effect of scattering and production) and their bideffects – RBE and relationships. 3. Effect of mutations of at DNA, chromosome, organism level to counter mutation effects. 4. Dosimetry -Object methods of treatment. 5. Factors influencing methods of treatment. 	ions on agents, radiobiology and effect of mutations on DNA. unism of diations corption, and pair ological d LET on DNA perating cell and eract the tts and mutation: chronic ecurrent ent of ity and rnal and Dxygen,

SW-2 Suggested Sessional Work (SW):

2. Assignments:

1. Radiation sensitivity and modifying factors External and internal sources.

- 1. Mini Project:
 - 4. Radiobiology: mechanism of action of various radiations.

cv. Other Activities (Specify):

GPB 508.3 This course will make the student well versed with the chemical mutagens, their properties and mode of action.

Item	Approximate Hours
CI	6
LI	6

SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction (LI)		Learning
			(SL)
SO3.1. Students are able to	1.Hazards due to	8	
understand the chemical mutagens:	chemical	their properties and mode	methods using
Classification – base analogues,	mutagens –		physical and
antibiotics, alkylating agents, acridine	Treating the	1. Chemical mutagens:	chemical
dyes.	plant propagules	Classification – base	mutagens.
SO3.2. Students are able to	at different	analogues, antibiotics,	
understand the other mutagens: their	doses of	alkylating agents, acridine	
properties and mode of action.	physical and	dyes.	
SO3.3. Students are able to	chemical	2. Other mutagens: their	
understand the dose determination and	mutagens.	properties and mode of	
factors influencing chemical	2. Procedures in	action.	
mutagenesis.	combined	3. Dose determination and	
SO3.4. Students are able to	mutagenic	factors influencing chemical	
understand the treatment methods	treatments.	mutagenesis.	
using physical and chemical	3. Raising the crop	4. Treatment methods using	
mutagens, Combination treatments.	for observation;	physical and chemical	
SO3.5. Students are able to	Mutagenic	mutagens, Combination	
understand the other causes of	effectiveness	treatments.	
mutation – direct and indirect action.	and efficiency,	5. Other causes of mutation –	
SO3.6. Students are able to	calculating the	direct and indirect action.	
understand the comparative	same from	6. Comparative evaluation of	
evaluation of physical and chemical	earlier literature.	physical and chemical	
mutagens.		mutagens.	

SW-3 Suggested Sessional Work (SW):

d) Assignments:

iii. Comparative evaluation of physical and chemical mutagens.

e) Mini Project:

- i. Treatment methods using physical and chemical mutagens, Combination treatments.
- f) Other Activities (Specify):

GPB 508.4 This course will make the student well versed with the process of observing mutagen effects in M1, M2 and M3 generation.

Item	Approximate Hours	
CI	7	
LI	6	
SW	2	
SL	1	
Total	16	

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction (LI)		(SL)
SO4.1. Students are able to understand	1.Study of M1	Unit 4. Observing mutagen	Estimation of
the observing mutagen effects in M1	generation &	effects in M1, M2 and M3	mutagenic
generation: plant injury, lethality,	M2 generation	generation.	efficiency and
sterility, chimeras, etc.	– Parameters.	1. Observing mutagen effects	effectiveness -
SO4.2. Students are able to understand	2. Mutation	in M1 generation: plant	spectrum of
the observing mutagen effects in M2	breeding in	injury, lethality, sterility,	chlorophyll
generation.	cereals and	chimeras, etc.	and viable
SO4.3. Students are able to understand	pulses-	2. Observing mutagen effects	mutations.
the estimation of mutagenic efficiency	achievements	in M2 generation.	
and effectiveness – spectrum of	made and an	3. Estimation of mutagenic	
chlorophyll and viable mutations.	analysis.	efficiency and effectiveness –	
SO4.4. Students are able to understand	3. Mutation	spectrum of chlorophyll and	
the mutations in traits with continuous	breeding in	viable mutations.	
variation	oilseeds and	4. Mutations in traits with	
SO4.5. Students are able to understand	cotton-	continuous variation	
the factors influencing the mutant	achievements	5. Factors influencing the	
spectrum: genotype, type of mutagen	and	mutant spectrum: genotype,	
and dose, pleiotropy and linkage, etc.	opportunities.	type of mutagen and dose,	
SO4.6. Students are able to understand		pleiotropy and linkage, etc.	
the individual plant based mutation		6. Individual plant based	
analysis and working out effectiveness		mutation analysis and	
and efficiency in M3 generation		working out effectiveness and	
SO4.7. Students are able to understand		efficiency in M3 generation	
the comparative evaluation of physical		7. Comparative evaluation of	
and chemical mutagens for creation of		physical and chemical	
variability in the some species- Case		mutagens for creation of	
studies.		variability in the some	
		species- Case studies.	

SW-4 Suggested Sessional Work (SW):

g. Assignments:

ii. Factors influencing the mutant spectrum: genotype, type of mutagen and dose, pleiotropy and linkage, etc.

h. Mini Project:

- ii. Comparative evaluation of physical and chemical mutagens for creation of variability.
- i. Other Activities (Specify):

GPB 508.5 This course will make the student well versed with the use of mutagens in creating oligogenic and polygenic variations and Handling of segregating M2 generations.

Item	Approximate Hours
CI	7
LI	4

SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction (LI)		Learning (SL)
SO5.1. Students are able to understand	1. Mutation	Unit 5. Use of mutagens and	7. Validation
the use of mutagens in creating	breeding in	Handling of segregating M1,	of mutants.
oligogenic and polygenic variations -	forage crops	M2, and M3 generations.	
Case studies.	and	1. Use of mutagens in creating	
SO5.2. Students are able to understand	vegetatively	oligogenic and polygenic	
the in-vitro mutagenesis - Callus and	propagated	variations – Case studies.	
pollen irradiation.	crops.	2. In-vitro mutagenesis – Callus	
SO5.3. Students are able to understand	2. Procedure for	and pollen irradiation.	
the handling of segregating M2	detection of	3. Handling of segregating M2	
generations and selection procedures.	mutations for	generations and selection	
SO5.4. Students are able to understand	polygenic	procedures.	
the validation of mutants; Mutation	traits in M2	4. Validation of mutants;	
breeding for various traits (disease	and M3	Mutation breeding for various	
resistance, insect resistance, quality	generations.	traits (disease resistance, insect	
improvement, etc.) in different crops		resistance, quality improvement,	
SO5.5. Students are able to understand		etc.) in different crops.	
the procedures for micromutations		5. Procedures for	
breeding/ polygenic mutations		micromutations breeding/	
SO5.6. Students are able to understand		polygenic mutations.	
the achievements of mutation		6. Achievements of mutation	
breeding- varieties released across the		breeding- varieties released	
world, problems associated with		across the world, problems	
mutation breeding.		associated with mutation	
SO5.7. Students are able to understand		breeding.	
the use of mutagens in genomics, allele		7. Use of mutagens in genomics,	
mining, TILLING.		allele mining, TILLING.	

SW-5 Suggested Sessional Work (SW):

k. Assignments:

ii. In-vitro mutagenesis – Callus and pollen irradiation.

I. Mini Project:

- ii. Mutation breeding for various traits in different crops.
- f. Other Activities (Specify):

Brief of Hours suggested for the	Course	Jucome		
Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
GPB 508.1 This course will make the student well versed with the mutation and its history, nature and classification of mutations.	6	1	1	8
GPB 508.2 This course will make the student well versed with the mutagenic agents and effect of mutations.	18	2	1	21
GPB 508.3 This course will make the student well versed with the chemical mutagens, their properties and mode of action	12	2	1	15
GPB 508.4 This course will make the student well versed with the process of observing mutagen effects in M1, M2 and M3 generation.	13	2	1	16
GPB 508.5 This course will make the student well versed with the use of mutagens in creating oligogenic and polygenic variations and Handling of segregating M2 generations.	11	2	1	14

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks	5 Distribu	ıtion	Total
		R	U	Α	Marks
CO 1	Mutation history, nature and Classification.	4	3	3	10
CO 2	Mutagenic agents and Effect of mutations on DNA.	5	2	4	11
CO 3	Chemical mutagens their properties and mode of action.	3	3	3	9
CO 4	Observing mutagen effects in M1, M2 and M3 generation.	4	2	4	10
CO 5	Use of mutagens and Handling of segregating M1, M2, and M3 generations.	3	4	3	10
Total		19	14	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Mutagenesis and Mutation Breeding** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 45. Improved Lecture
- 46. Group Discussion and Demonstration
- 47. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 48. Brainstorming
- 49. Smart board

(a) Books:

S.	Title	Author	Publisher	Edition
No.				& Year
1	Cellular Radiobiology	Alper T.	Cambridge Univ.	1979
			Press, London	
2	The Molecular Theory of	Chadwick K.H. and	SpringerVerlag	1981
	Radiation Biology	Leenhouts H.P.		
3	Mutation Detection: A Practical	Cotton R, Edkin E and	Oxford Univ. Press	2000
	Approach	Forrest S.		
4	Manual on Mutation Breeding	International Atomic	International Atomic	1970
		Energy Agency	Energey Agency,	
			Vienna, Italy	
5	Plant Mutation Breeding and	Shu QY, Forster BP and	Gutecnberg Press	2012
	Biotechnology.	Nakagawa N.	Ltd. Rome Italy	
6	Genetics.	Singh BD.	Kalyani Publishers,	2003
			New Delhi	
7	Genetics. 3rd Ed.	Strickberger MW.	Prentice Hall.	2005

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	Cos, POs and PSOs Mapping Course Code: GPB 508 Course Title: - Mutagenesis and Mutation Breeding																	
Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7		PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
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GPB 508.1 This course will make the studen t well versed with the mutati on and its histor y, nature and classif ication of mutati ons.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB 508.2 This course will make the studen t well versed with the mutag enic agents and effect of mutati ons.	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

GPB	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1
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POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 508.1 This course will make the student well versed with the mutation and its history, nature and classification of mutations.	SO1.1 SO1.2 SO1.3	Study of M1 generation & M2 generation – Parameters.	Unit-1. Mutation history, nature and Classification. 1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 508.2 This course will make the student well versed with the mutagenic agents and effect of mutations.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Mutation breeding in cereals and pulses- achievements made and an analysis.	Mutagenic agents and Effect of mutations on DNA. 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 508.3 This course will make the student well versed with the chemical mutagens, their properties and mode of action	SO3.1 SO3.2 SO3.3	Mutation breeding in oilseeds and cotton- achievements and opportunities	Chemical mutagens their properties and mode of action. 3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 508.4 This course will make the student well versed with the process of observing mutagen effects in M1, M2 and M3 generation.	SO4.1 SO4.2		Observing mutagen effects in M1, M2 and M3 generation. 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 508.5 This course will make the student well versed with the use of mutagens in creating oligogenic and polygenic variations and Handling of segregating M2 generations.	SO5.1 SO5.2		Use of mutagens and Handling of segregating M1, M2, and M3 generations. 5.1, 5.2	As mentioned in page number

Course Curriculum Map: Mutagenesis and Mutation Breeding

Semester- II

Course Code: GPB 512

Course Title: Crop Breeding II (Rabi Crops)

Pre- requisite: To provide insight into recent advances in improvement of Rabi cereals, legumes, oilseeds, fibre and vegetative propagated crops using conventional and modern biotechnological approaches.

Rationale: After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of important rabi field crops.

Course Outcomes:

GPB512.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Wheat, Oats and Barley.

GPB512.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Chickpea, and Other pulses.

GPB512.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rapeseed, Mustard, Sunflower and Safflower.

GPB512.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Mesta, minor fibre crops and Forage crops.

GPB512.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Seed spices.

Scheme of Studies:

Board of	Course	Course Title Scheme of studies (Hours/Week)			Total			
Study	Code		C LI SW SL Total Study Hours		Credits			
			Ι				CI+LI+SW+SL	(C)
	GPB 512	Crop Breeding II	2	2	0	0	4	(2+1) = 3
		(Rabi Crops)						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

					Scheme	of Asses	ssment (N	(larks)		
Boa				Progressive Assessment (PRA)						
rd of Stu dy	Cour se Code	Course Title	Class/Home Assignment 5 number 3 marks each (CA)		Semina	Class Activi ty any one (CAT)	Class Attenda nce (AT)	Total Marks (CA+CT+S A+ CAT+AT)	End Semeste r Assessm ent (ESA)	Total Marks (PRA + ESA)
	GPB 512	Crop Breeding II (Rabi Crops)	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB512.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Wheat, Oats and Barley.

Approximate Hours

Item	Approximate Hours
CI	8
LI	8
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO1.1. Students able to explain the	1.Floral	Unit-1 Important botanical status	1. Genetics
origin, evolution, mode of	biology,	and reproductive structures of	of wheat,
reproduction, chromosome number.	emasculation	crops and genetics of wheat, oats,	oats, and
Genetics – cytogenetics and genome	and	and barley.	barley.
relationship of Wheat.	pollination	1. Wheat: Origin, evolution, mode	
SO1.2. Students able to explain the	techniques in		
breeding objectives: yield, quality	wheat.	number. Genetics - cytogenetics	
characters, biotic and abiotic stress	2. Floral	and genome relationship.	
resistance, etc. of Wheat.	biology,	2. Wheat: Breeding objectives:	
SO1.3. Students able to explain the	emasculation	yield, quality characters, biotic and	
breeding approaches, introgression of	and	abiotic stress resistance, etc.	
alien gene(s) (if required), biotic and	pollination	3. Wheat: Breeding approaches,	
abiotic stress resistance, heterosis	•	introgression of alien gene(s) (if	
breeding, released varieties, examples	oats.	required), biotic and abiotic stress	
of MAS used for improvement of	3.Floral	resistance, heterosis breeding,	
Wheat.	biology,	released varieties, examples of	
SO1.4. Students able to explain the	emasculation	MAS used for improvement.	
origin, evolution, mode of	and	4. Oats: Origin, evolution, mode of	
reproduction, chromosome number;	pollination	reproduction, chromosome number;	
Genetics – cytogenetics and genome	techniques	Genetics – cytogenetics and	
relationship of Oats.	barley.	genome relationship.	
SO1.5. Students able to explain the	4. Study of	6 3 5	
breeding objectives: yield, quality	segregating	quality characters, biotic and abiotic	
characters, biotic and abiotic stress	populations in		
resistance, etc. of Oats.	cereals.	6. Oats: Breeding approaches,	
SO1.6. Students able to explain the		introgression of alien gene(s) (if	
breeding approaches, introgression of		required), biotic and abiotic stress	
alien gene(s) (if required), biotic and		resistance, released varieties,	
abiotic stress resistance, released		examples of MAS used for	

varieties, examples of MAS used for	improvement.
improvement of Oats.	7. Barley: Origin, evolution, center
SO1.7. Students able to explain the	of origin, mode of reproduction,
origin, evolution, center of origin,	chromosome number; Genetics –
mode of reproduction, chromosome	cytogenetics and genome
number; Genetics – cytogenetics and	relationship
genome relationship of Barley.	8. Barley: Breeding objectives:
SO1.8. Students able to explain the	yield, quality characters, biotic and
breeding objectives: yield, quality	abiotic stress resistance, etc.,
characters, biotic and abiotic stress	breeding approaches, introgression
resistance, etc., breeding approaches,	of alien gene(s) (if required), biotic
introgression of alien gene(s) (if	and abiotic stress resistance,
required), biotic and abiotic stress	released varieties, examples of
resistance, released varieties,	MAS used for improvement.
examples of MAS used for	
improvement of Barley.	

SW-1 Suggested Sessional Work (SW):

d. Assignments:

k. Floral biology, emasculation and hybridization techniques in wheat, oats, and barley.

e. Mini Project:

iv. Centers of origin, distribution of species wild relatives of wheat, oats, and barley.

f. Other Activities (Specify):

GPB512.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Chickpea, and Other pulses.

Approximate Hours

Item	Approximate Hours
СІ	6
LI	4
SW	2
SL	1
Total	13

			G 18
Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO2.1. Students are able to	1.Floral	Unit-2 Important botanical	10. Learn
understand the origin, evolution	biology,	status and reproductive	about
mode of reproduction, chromosome	emasculation	structures of crops and genetics	qualitative
number; Genetics – cytogenetics	and	of Chickpea, and Other pulses.	and
and genome relationship of	pollination	1. Chickpea: Origin, evolution	quantitative
Chickpea.	techniques in	mode of reproduction,	characters
SO2.2. Students are able to	chickpea,	chromosome number; Genetics -	different
understand the breeding objectives:	rajma.	cytogenetics and genome	pulse crops.
yield, quality characters, biotic and	2.Study of	relationship.	
abiotic stress resistance, etc. of	segregating	2. Chickpea: Breeding objectives:	
Chickpea.	populations	yield, quality characters, biotic and	
SO2.3. Students are able to	Pulses.	abiotic stress resistance, etc.	
understand the breeding approaches,		3. Chickpea: Breeding	

introgression of alien gene(s) (if	approaches, introgression of alien
required), biotic and abiotic stress	gene(s) (if required), biotic and
resistance, released varieties,	abiotic stress resistance, released
examples of MAS used for	varieties, examples of MAS used
improvement of Chickpea.	for improvement.
SO2.4. Students are able to	4. Other pulses: Lentil, field pea,
understand the origin, evolution,	Rajma, Horse gram: Origin,
mode of reproduction, chromosome	evolution, mode of reproduction,
number; Genetics. cytogenetics and	chromosome number; Genetics.
genome relationship of other pulses.	cytogenetics and genome
SO2.5. Students are able to	relationship
understand the breeding objectives:	5. Other pulses: Lentil, field pea,
yield, quality characters, biotic and	Rajma, Horse gram: Breeding
abiotic stress resistance, etc. of	objectives: yield, quality
other pulses.	characters, biotic and abiotic stress
SO2.6. Students are able to	resistance, etc.
understand the breeding approaches,	6. Other pulses: Lentil, field pea,
introgression of alien gene(s) (if	Rajma, Horse gram: Breeding
required), biotic and abiotic stress	approaches, introgression of alien
resistance, heterosis breeding,	gene(s) (if required), biotic and
released varieties, examples of	abiotic stress resistance, heterosis
MAS used for improvement.	breeding, released varieties,
Interspecific crosses attempted and	examples of MAS used for
its implications, reasons for failure,	improvement. Interspecific crosses
ways of overcoming them of other	attempted and its implications,
pulses.	reasons for failure, ways of
	overcoming them.

SW-2 Suggested Sessional Work (SW):

3. Assignments:

- 4. Plant genetic resources, its utilization and conservation in different pulse crops.
- 1. Mini Project:
 - 5. Study of genetics, handling of germplasm of different pulse crops.

cvi. Other Activities (Specify):

GPB512.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rapeseed, Mustard, Sunflower and Safflower.

Item	Approximate Hours
CI	6
LI	8
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)

SO3.1. Students are able to	1.Floral biology,	Unit 3 Important botanical 1. Concepts
understand the origin, evolution,	emasculation	status and reproductive of breeding in
mode of reproduction,	and pollination	structures of crops and genetics Rapeseed,
chromosome number. Genetics –	techniques in	of Rapeseed, Mustard, Mustard,
cytogenetics and genome	rapeseed	Sunflower and Safflower. Sunflower
relationship of rapeseed and	mustard.	1. Rapeseed and Mustard: and
mustard.	2. Floral biology,	Origin, evolution, mode of Safflower.
SO3.2. Students are able to	emasculation	reproduction, chromosome
understand the breeding objectives;	and pollination	number. Genetics – cytogenetics
yield, quality characters, biotic and	techniques in	and genome relationship.
abiotic stress resistance, etc. of	sunflower.	2. Rapeseed and Mustard:
rapeseed and mustard.	3. Study of range	Breeding objectives; yield,
SO3.3. Students are able to	of variation for	quality characters, biotic and
understand the breeding	yield and yield	abiotic stress resistance, etc.
approaches, introgression of alien	components.	3. Rapeseed and Mustard:
gene(s) (if required), biotic and	-	Breeding approaches,
abiotic stress resistance, heterosis	segregating	introgression of alien gene(s) (if
breeding, released varieties,	populations	required), biotic and abiotic stress
examples of MAS used for	oilseed crops.	resistance, heterosis breeding,
improvement, Oil quality,	chibeed erops.	released varieties, examples of
Improvement for oil quality of		MAS used for improvement, Oil
rapeseed and mustard.		quality, Improvement for oil
SO3.4. Students are able to		quality.
understand the origin, mode of		4. Sunflower, Safflower: Origin,
reproduction, chromosome		mode of reproduction,
number; Genetics, cytogenetics		chromosome number; Genetics,
and genome relationship of		cytogenetics and genome
Sunflower, Safflower.		relationship.
SO3.5. Students are able to		5. Sunflower, Safflower:
understand the breeding objectives:		Breeding objectives: yield,
yield, quality characters, biotic and		quality characters, biotic and
abiotic stress resistance, etc. of		abiotic stress resistance, etc.
Sunflower, Safflower.		6. Sunflower, Safflower:
SO3.6. Students are able to		Breeding approaches,
understand the of breeding		introgression of alien gene(s) (if
approaches, introgression of alien		required), biotic and abiotic stress
gene(s) (if required), biotic and		resistance, heterosis breeding,
abiotic stress resistance, heterosis		released varieties, examples of
breeding, released varieties,		MAS used for improvement.
examples of MAS used for		L L
improvement of Sunflower,		
Safflower.		
CW 2 Suggested Segural Work (

SW-3 Suggested Sessional Work (SW):

g) Assignments:

iv. Important concepts of genetics and breeding Rapeseed, Mustard, Sunflower and Safflower.

h) Mini Project:

ii. Techniques for seed production and hybrid seeds production Rapeseed, Mustard, Sunflower and Safflower.

i) Other Activities (Specify):

GPB512.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Mesta, minor fibre crops and Forage crops.

Item	Approximate Hours
CI	6
LI	6
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction (LI)		Learning (SL)
SO4.1. Students are able to	1.Use of	Unit 4. Important botanical status	Concepts
understand the origin, mode of	descriptors	and reproductive structures of	of
reproduction, chromosome number;	for	crops and genetics of Mesta,	breeding
Genetics-cytogenetics and genome	cataloguing.	minor fibre crops and Forage	in Mesta,
relationship of Mesta and minor fibre	•••	crops.	minor
crops.	the crosses	1. Mesta and minor fibre crops:	fibre
SO4.2. Students are able to	between	Origin, mode of reproduction,	crops and
understand the breeding objectives:	different	chromosome number; Genetics-	Forage
yield, quality characters, biotic and	species.	cytogenetics and genome	crops.
abiotic stress resistance, etc. of Mesta	3.Trait based	relationship.	
and minor fibre crops.	screening	2. Mesta and minor fibre crops:	
SO4.3. Students are able to	for stress	Breeding objectives: yield, quality	
understand the breeding approaches,	resistance.	characters, biotic and abiotic stress	
introgression of alien gene(s) (if		resistance, etc.	
required), biotic and abiotic stress		3. Mesta and minor fibre crops:	
resistance, released varieties,		Breeding approaches, introgression	
examples of MAS used for		of alien gene(s) (if required), biotic	
improvement of Forage crops of		and abiotic stress resistance,	
Mesta and minor fibre crops.		released varieties, examples of	
SO4.4. Students are able to		MAS used for improvement.	
understand the origin, evolution mode		4. Forage crops: Origin, evolution	
of reproduction, chromosome number;		mode of reproduction, chromosome	
Genetics-cytogenetics and genome		number; Genetics-cytogenetics and	
relationship. SO4.5. Students are able to		genome relationship. 5. Forage crops: Breeding	
SO4.5. Students are able to understand the Breeding objectives:		5. Forage crops: Breeding objectives: yield, quality characters,	
yield, quality characters, biotic and		biotic and abiotic stress resistance,	
abiotic stress resistance, etc. of Forage		etc.	
crops.		6. Forage crops: Breeding	
SO4.6. Students are able to		approaches, introgression of alien	
understand the breeding approaches,		gene(s) (if required), biotic and	
understand the breeding approaches,		Sene(5) (Il requirea), biotic alla	

introgression of alien gene(s) (if	abiotic stress resistance.	
required), biotic and abiotic stress		
resistance of Forage crops.		
	· · · · · · · · · · · · · · · · · · ·	

SW-4 Suggested Sessional Work (SW):

j. Assignments:

iii. Important concepts of genetics and breeding Mesta, minor fibre crops and Forage crops.

k. Mini Project:

- iii. Techniques for seed production and hybrid seeds production Mesta, minor fibre crops and Forage crops.
- **l.** Other Activities (Specify):

GPB512.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Seed spices.

Item	Approximate Hours
CI	4
LI	4
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO5.1. Students are able to understand	1. Learning	Unit 5. Important botanical status	8.Concepts
the origin, evolution, mode of	on the	and reproductive structures of	of
reproduction, chromosome number of	Standard	crops and genetics of Seed spices.	breeding
Seed spices.	Evaluation	1. Seed spices: Origin, evolution,	in Seed
SO5.1. Students are able to understand	System	mode of reproduction, chromosome	spices.
the genetics– cytogenetics and genome	(SES) and	number.	
relationship of Seed spices.	descriptors.	2. Seed spices: Genetics-	
SO5.1. Students are able to understand	2. Use of	cytogenetics and genome	
the breeding objectives: yield, quality	software	relationship.	
characters, biotic and abiotic stress	for	3. Seed spices: Breeding	
resistance, etc. of Seed spices.	database	objectives: yield, quality characters,	
SO5.1. Students are able to understand	manageme	biotic and abiotic stress resistance,	
the breeding approaches, introgression	nt and	etc.	
of alien gene(s) (if required), biotic and	retrieval.	4. Seed spices: Breeding	
abiotic stress resistance, scope of		approaches, introgression of alien	
heterosis breeding, released varieties,		gene(s) (if required), biotic and	
examples of MAS used for crop		abiotic stress resistance, scope of	
improvement of Seed spices.		heterosis breeding, released	
		varieties, examples of MAS used	
		for crop improvement.	

SW-5 Suggested Sessional Work (SW):

- m. Assignments:
 - **iii.** Hybrid seed production technology in Seed spices.
- n. Mini Project:

iii. Examples of MAS used for improvement in Seed spices.

g. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
GPB512.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Wheat, Oats and Barley.	16	2	1	19
GPB512.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Chickpea, and Other pulses.	10	2	1	13
GPB512.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rapeseed, Mustard, Sunflower and Safflower.		2	1	17
GPB512.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Mesta, minor fibre crops and Forage crops.	12	2	1	15
GPB512.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Seed spices.	8	2	1	11

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles	Mark	s Distrib	ution	Total
		R	U	Α	Marks
CO 1	Important botanical status and reproductive structures	3	3	2	8
	of crops and genetics of wheat, oats, and barley.				
CO 2	Important botanical status and reproductive structures	4	4	3	11
	of crops and genetics of Chickpea, and Other pulses.				
CO 3	Important botanical status and reproductive structures	5	3	3	11
	of crops and genetics of Rapeseed, Mustard, Sunflower				
	and Safflower.				
CO 4	Important botanical status and reproductive structures	4	2	4	10
	of crops and genetics of Mesta, minor fibre crops and				
	Forage crops.				
CO 5	Important botanical status and reproductive structures	3	4	3	10
	of crops and genetics of Seed spices.				

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Crop Breeding I (Kharif Crops) will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 50. Improved Lecture
- 51. Case Method
- 52. Group Discussion
- 53. Demonstration
- 54. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 55. Brainstorming
- 56. Smart board

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition
No.				& Year
1	Identifying Characteristics of Crop	Agarwal R.L.	Oxford & IBH.	1996
	Varieties.			
2	Genetics, Cytogenetics and	Bahl P.N. and Salimath	Oxford & IBH.	1996
	Breeding of Crop Plants. Vol. I.	P.M.		
	Pulses and Oilseeds.			
3	Technological Innovations in	Gupta S.K.	Springer, USA.	2012
	Major World Oil crops. Vol. I.			
4	Technological Innovations in	Gupta S.K.	Springer, USA.	2012
	Major World Oil crops. Vol. II.			
5	Breeding of Oilseed Crops for	Gupta S.K.	Academic Press,	2016
	Sustainable Production.	_	USA.	
6	New Dimensions and Approaches	Kannaiyan S,	Directorate of	2002
	for Sustainable Agriculture.	Uthamasamy S,	Extension Education,	
		Theodore R.K. and	TNAU, Coimbatore.	
		Palaniswamy S.		
7	Spices and Plantation Crops Vol.1	Parthasarathy V.A.	John Wiley & Sons.	2017
	(Part A) Breeding and Genetics.			
C	igulum Dovalanmant Taam.			

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	Course Code: GPB 512 Course Title: - Crop Breeding II (Rabi Crops)																	
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Cos, POs and PSOs Mapping Course Code: GPB 512 Course Title: - Crop Breeding II (Rabi Crops)

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GPB5 12.1. After compl eting this course , the studen t will be able to know about import ant botani cal status and reprod uctive structu res of crops and geneti cs of Wheat , Oats and Barley	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 12.2. After compl eting this course , the studen t will be able	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

to know about import ant botani cal status and reprod uctive struct ures of crops and geneti cs of Chick pea, and Other									
12.3. After compl eting this course , the studen t will be able to know about import ant botani cal status and reprod uctive struct ures of crops									

and geneti cs of Rapes eed, Musta rd, Sunflo wer and Safflo wer.																		
GPB5 12.4. After compl eting this course , the studen t will be able to know about import ant botani cal status and reprod uctive struct ures of crops and geneti cs of Mesta , minor fibre crops and Forag e crops.	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1

	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1
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Legend: 1- Low,2 – Medium, 3- High

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB512.1. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Wheat, Oats and Barley.	SO1.1 SO1.2 SO1.3	Learning on the Standard Evaluation System (SES) and descriptors.	Unit-1. Important botanical status and reproductive structures of crops and genetics of wheat, oats, and barley. 1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB512.2. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Chickpea, and Other pulses.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Use of software for database management and retrieval.	Important botanical status and reproductive structures of crops and genetics of Chickpea, and Other pulses. 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB512.3. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Rapeseed, Mustard, Sunflower and Safflower.	SO3.1 SO3.2 SO3.3	Mutation breeding in oilseeds and cotton- achievements and opportunities	Important botanical status and reproductive structures of crops and genetics of Rapeseed, Mustard, Sunflower and Safflower. 3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB512.4. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Mesta, minor fibre crops and Forage crops.	SO4.1 SO4.2		Mesta and minor fibre crops: Origin, mode of reproduction, chromosome number; Genetics–cytogenetics and genome relationship. 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB512.5. After completing this course, the student will be able to know about important botanical status and reproductive structures of crops and genetics of Seed spices.	SO5.1 SO5.2		Importantbotanicalstatus and reproductivestructures of crops andgeneticsofSeedspices.5.1, 5.2	As mentioned in page number

Course Curriculum Map: Crop Breeding II (Rabi Crops)

Semester-II

Course Code: STAT 512

Course Title: EXPERIMENTAL DESIGNS

Pre-requisite: Experimental design is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Generally, the purpose is to establish the effect that a factor or independent variable has on a dependent variable.

Rationale: Experimental design is used to establish the effect an independent variable has on a dependent variable. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.

Course Outcomes: CO1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

CO2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

CO3 Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

CO4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Scheme of Studies:

Board of Study	Course Code	Course Title					cheme of (Hours/Week)	Total Credits
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	(C)
Program Core (PCC)	STAT 512	EXPERIMENTA L DESIGNS	2	01	02	01	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C: Credits.**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

			Scheme Progressive		ment (Ma ent (PRA)	,			
Board of Study	Course Code	Course Title	Class/Home	Class Test 2 (2 best out) 15 marks each (CT)	Practical Exam (PA)	Class Attendan ce(AT)	Total Marks (CA+CT +PA+AT)	End Semester Assessme nt (ESA)	Total Mark s (PRA + ESA)

	STAT 512	ED	5	30	10	5	50	50	100
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Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

STAT 512 CO-1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

Approximate Hours						
Item	Appx. Hrs.					
CI	3					
LI	4					
SW	1					
SL	2					
Total	10					

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO1.1 Design of Experiment is a tool to develop an experimentation strategy that maximizes learning using a minimum of resources. SO1.2 Extensively used by engineers and scientists involved in the improvement of manufacturing processes to maximize yield and decrease variability. SO1.3 It is widely used in many fields with broad application across all the natural and social sciences, to name a few: Biostatistics, Agriculture, Marketing, Software engineering, Industry etc.	 1-Uniformity trial data analysis. 2- formation of plots and blocks, 	 Unit-1. Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control. 1.1. Need for designing of experiments 1.2 characteristics of a good design 1.3 Basic principles of designs- randomization, replication and local control. 	1. Prepare the assignment on Basic principles of designs- randomization, replication and local control.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Basic principles of designs- randomization, replication and local control.

b. Mini Project: -

c. Other Activities (Specify):

STAT 512 CO-2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

Approximate Hours					
Item	Appx. Hrs.				
CI	5				
LI	6				
SW	1				
SL	2				
Total	14				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
 SO2.1 Good experimental design is important in all research, it helps to ensure the data collection, data analysis and conclusions from a study, are valid (true). SO2.2 Experiments are designed to test hypotheses, or specific statements about the relationship between variables. 	 Analysis of data obtained from CRD - Analysis of data obtained from RBD - Analysis of data obtained from LSD 	 Unit-2 Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. 1.1 Uniformity trials 1.2 size and shape of plots and blocks 1.3. Analysis of variance; Completely randomized design 1.4 Analysis of variance; randomized block design 1.5 Analysis of variance; Latin square design. 	1. Prepare the assignment on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

d. Other Activities (Specify):

STAT 512 CO-3 Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

Appro	oximate Hours
Item	Appx. Hrs.
CI	6
LI	14
SW	1
SL	2
Total	23

Session Out Comes	Laboratory	Classroom Instruction	Self-
(SOs)	Instruction	(CI)	Learni
	(LI)		ng (SL)
 SO3.1 Experimental methods introduce exogeneity, allowing researchers to draw conclusions about the effects of an event or a program. SO3.2. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result. 	 Analysis of factorial experiments without confounding. Analysis of factorial experiments with confounding. Analysis with missing data in CRD. Analysis with missing data in RBD. Analysis with missing data in LSD. Split plot designs. Strip plot designs 	 Unit-3 Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. 1.1. Factorial experiments, (symmetrical) 1.2 Factorial experiments, (asymmetrical) 1.3 orthogonality 1.4 partitioning of degrees of freedom 1.5. Confounding in symmetrical factorial experiments 1.6. Factorial experiments with 	1. Prepare the assignment on Factorial experiments with control treatment.
		control	

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Factorial experiments with control treatment. Other Activities (Specify):

STAT 512 CO-4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Approximate Hours					
Item	Appx Hrs.				
CI	16				
LI	6				
SW	1				
SL	2				
Total	25				

Session Out	Laborator	Classroom Instruction	Self-
Comes	У	(CI)	Learning
(SOs)	Instructio		(SL)
	n		
	(LI)		
experiment is unbiased.	 7- Transform ation of data. 8- Analysis of resolvable designs 9- Fitting of response surfaces. 	 Unit-4 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. 1.1 Split plot 1.2 strip plot designs 1.3 Analysis of covariance 1.4 Missing plot techniques in randomized block. 1.5 Missing plot techniques in Latin square designs. 1.6 Transformations 1.7 crossover designs 1.8 balanced incomplete block design 1.9 resolvable designs 1.10 Applications of resolvable designs Lattice design 1.12 Applications of Lattice design 1.13 Alpha design-concepts. 1.14 Randomisation procedure. 1.15 Interpretation of results. 1.16 Response surfaces. Experiments with mixtures 	2. Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

SW-1 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

	00	tor the cours			
Course Outcomes	Class Lecture (C l)	Laborator y Lecture (L I)	Sessional Work (SW)	Self Learnin g (S l)	Total hour (C l + LI+ SW +S l)
01: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	03	04	01	02	10
02: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	05	06	01	02	14
03: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	06	14	01	02	25
04: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	16	06	01	02	25

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title	Mar	·ks Distribu	tion	Total
		R	U	Α	Marks
CO- 1	Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	04	04	04	12
CO- 2	Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive	04	04	04	12
CO- 3	Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	04	04	04	12
CO- 4	Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the	05	04	05	14

applications of DOE and learn and apply these techniques in the field experiment.				
Total	17	16	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Experimental Designs will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 9. Improved Lecture
- 10. Tutorial
- 11. Case Method
- 12. Group Discussion
- 13. Role Play
- 14. Demonstration
- 15. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 16. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
01	Basic Concepts and Application of Experimental Designs and Analysis	Felix Kusanedzie Sylverster Achio Edmund Ameko	Science PG	2015
02	Theory and Analysis of Experimental Designs	B.L. Agrawal	CBS	2011
03	Design and Analysis of Experiments	Angela Dean Daniel Voss	Springer	2017

Curriculum Development Team:

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Cos, POs and PSOs Mapping Course Code: STAT 512 Course Title: - EXPERIMENTAL DESIGNS

Course	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
Outco	101	101	100		100	100	10,	01	02	03	04	05	06	07	08	09	01	01
mes																	0	1
	Studen	Studen		The	Stude	Stud	Stu	Stu	Stu	Stu	Stu	Stu	Aft	Stu	Stu	Stu	Stu	Stu
	t will				nt	ent	dent	dent	den	dent	dent	dent	er	den	den	den	den	den
		experti		nt	will	will	will	will	t	will	will	will	gai	t ·ı	t	t	t	t
	y the	se in	have	will	plan	appl	und	iden	wil	reco	appl	und	nin	wil	will	will	will	will
	curren t	latest vegeta	expert		about the	y vario	erst and	tify diff	1 pro	gniz	y diff	erst and	g	1 roc	pra ctic	app 1v	app ly	app ly
	scenar	-	nurser	-	big	us	abo	eren	pra ctic	e diff	eren	role	exp erie	rec ogn	e	ly vari	basi	basi
	io,	produc		differ	scale	statis	ut	t	e	eren	t	of	nce,	ize	turf	ous	c	C C
	crop	•	raising		comm	tical	libr	cool	diff	t	veg	mic	the	diff	gras	info	con	stati
	-	technol			ercial	meth	ary	seas	ere	und	etab	rocl	y	ere	s,	rma	cept	stic
	ty,	ogies,	ques	ic	projec	ods	tech	on,	nt	erut	le	ima	will	nt	ind	tion	s in	al
	-	vegeta	and	condit	t and	to	niq	war	bre	ilize	pro	te in	get	flo	oor	serv	lab	tool
	c	ble	protec		also	anal	ues,	m	edi	d	cess	veg	the	wer	pla	ices	orat	S
	<u> </u>	breedin		requir	mana	yze	tech	seas	ng	veg	ing	etab	posi	,	nt	,	ory	duri
	ement		cultiva		ge the	their	nica	on	tec	etab	and	le	tion	orn	and	tech	tech	ng
		techniq			resear	mast	1	and	hni	le	post	and	s of	am	inte	nica	niq	thei
		ues and	bles		ch trails	er	writ	und erut	que s	and spic	- har	flo wer	spe cial	ent al	rios	1 writ	ues duri	r rese
	ng techni	post- harvest		veget able	under	resea rch	ing skill	ilize	s use	e	vest	cro	ists	cro	capi ng	ings	ng	arc
	ques	manag			veget	work	SKIII	d	d	cro	-	p	for	ps	ma	and	thei	h
	of	ement		well	able	work	, IPR	veg	in	ps	han	pro	han	and	nag	co	r	wor
	differe		1	as	and		,	etab	veg	1	dlin	duct	dlin	thei	eme	mm	rese	k
	nt	vegeta		under	flowe		labo	le	eta		g	ion	g	r	nt	uni	arc	
	vegeta	bles		utilize	r		rato	cro	ble		met	und	pla	nur		cati	h	
	ble			d	crops		ry	ps	and		hod	er	ntat	ser		on	wor	
	and			veget			tech		flo		S	diff	ion,	У		skil	k	
	flower			able			niq		we		for	eren	nur	ma		ls ·		
	crops.			cultiv			ues		r		veg	t	seri	nag		in thei		
				ation.			and rese		pro duc		etab les	prot ecte	es and	em ent		r		
							arch		tio		and	d	oth	Cint		aca		
							ethi		n		flo	stru	er			de		
							cs				wer	ctur	prot			mic		
							in				s	es	ecte			S		
							man						d					
							uscr						cult					
							ipt						ivat					
							writ						ion .					
							ing						proj					
STAT	1	1	1	1	2	3	2	1	1	1	1	2	ects	1	2	2	3	3
STAT 512.1	1	1	1	1	2	3	2	1	1	1	1	2	1	1	2	3	3	3
Underst																		
and of																		
and of		l				l		L	I	l								

basic concept s of design of experi ments. Introdu ction to plannin g valid and econom ical experi ments within given																		
resourc es. STAT 512.2 Analyz e comple tely random ized design, Rando mized block design, Latin square design, Latin square design. The conditi ons and circums tances under which results of the experi ment are valid should be	1	1	1	1	2	2	2	1	2	2	1	1	1	1	1	2	2	3

extensi																		
ve.																		
STAT 512.3 Underst and and comput e Full and confou nded factoria l designs with two and three levels. Fractio nal factoria l designs with two levels.	1	1	1	1	1	3	1	1	1	2	1	1	2	1	1	3	2	3
STAT 512.4 Underst and the purpose for balance d incomp lete block design, resolva ble designs and their applicat ions. Split and Strip plot design	1	1	1	1	2	3	1	1	1	1	2	2	2	1	1	3	3	3

'11		I								
will										
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ues in										
the										
field										
experi										
ment.										

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Statistical Methods for Applied Science

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning
					(SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT 512.CO 1: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	SO1.1 SO1.2 SO1.3	 1.1. Uniformity trial data analysis. 1.2 Formation of plots and blocks, Fairfield Smith Law 	Need for designing of experiments, characteristics of a good design. Basic principles of	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	STAT 512.CO 2: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	SO2.1 SO2.2	 2.1. Analysis of data obtained from CRD 2.2. Analysis of data obtained from RBD 2.3. Analysis of data obtained from LSD 	Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.	As mentioned in page number

PO 1,2,3,4,5,6,7	STAT 512.CO 3:	SO3.1	3.1 Analysis of	Unit-3.0	As
PSO 1,2, 3, 4, 5, 6,	Understand and	SO3.2	factorial experiments	Factorial experiments,	mentioned
7, 8, 9, 10, 11	compute Full and		without confounding.	(symmetrical as well as	in page
	confounded		3.2 Analysis of	asymmetrical). orthogonality and	number
	factorial designs		factorial experiments	partitioning of degrees of	
	with two and three		with confounding.	freedom, Confounding in	
	levels. Fractional		3.3Analysis with	symmetrical factorial	
	factorial designs		missing data in CRD.	experiments, Factorial	
	with two levels.		3.4 Analysis with	experiments with control	
			missing data in RBD.	treatment.	
			3.5 Analysis with	3.1, 3.2, 3.3, 3.4, 3.5, 3.6	
			missing data in LSD.		
			3.6 Split plot designs.		
			3.7Strip plot designs		
PO 1,2,3,4,5,6,7	STAT 512.CO 4:	SO4.1	4.1Transformation of	Unit-4.0	As
PSO 1,2, 3, 4, 5, 6,	Understand the	SO4.2	data.	Split plot and strip plot designs;	mentioned
7, 8, 9, 10, 11	purpose for	SO4.3	4.2Analysis of	Analysis of covariance and	in page
	balanced		resolvable designs	missing plot techniques in	number
	incomplete block		4.3 Fitting of response	randomized block and Latin	
	design, resolvable		surfaces.	square designs; Transformations,	
	designs and their			crossover designs, balanced	
	applications. Split			incomplete block design,	
	and Strip plot			resolvable designs and their	
	design will help			applications ~ Lattice design,	
	students to know			alpha design-concepts,	
	the applications of			randomisation procedure,	
	DOE and learn and			analysis and interpretation of	
	apply these			results. Response surfaces.	
	techniques in the			Experiments with mixtures.	
	field experiment.			4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7,	
				4.8, 4.9, 4.10, 4.11, 4.12, 4.13,	
				4.14, 4.15, 4.16	

Semester- II

Course Code:	PGS 503
Course Title:	Intellectual Property and Its Management in Agriculture
Pre- requisite:	To teach the physiology of Intellectual Property and Its Management in
	Agriculture
Rationale:	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.
-	

Course outcomes:

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Scheme of Studies:

Board of	Course Code	Course Title	Scheme of studies (Hours/Week)			Total Credits(C)		
Study			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Progra m Core (PGS)	PGS 503	Intellectual Property and Its Management in Agriculture	1	0	1	1	3	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T)and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW&SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

					Schem	e of Assess	sment (Ma	rks)	
			P	rogressiv	e Assess	ment (PR	A)		
Board of Study	Course Code	Course Title	Class/Ho me Assignme nt1 number	Class Test2 (2 best out) 20 marks	Practi cal Exam (PA)	Class Attenda nce (AT)	Total Marks (CA+CT +PA+A T)	End Semester Assessmen t (ESA)	Total Marks (PRA+ES A)

			5 marks each (CA)	each (CT)					
PGS	PGS 503	Intellectu al Property and Its Manage ment in Agricultu re	5	40	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

Approximate Hours				
Item	AppXHrs			
C1	04			
LI	0			
SW	01			
SL	02			
Total	07			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Student will understand		Unit-1.0 Historical perspectives	1 Role of IPR
		and need for the introduction of	
the Historical perspectives and			
need for the introduction of		Intellectual Property Right	
Intellectual Property Right.		regime; TRIPs and various	
		provisions in TRIPS Agreement;	TRIPS and its
SO1.2 Student will recognize		Intellectual Property and	benefits
the TRIPs and various		Intellectual Property Rights (IPR),	
provisions in TRIPS		benefits of securing IPRs.	
Agreement.		1.1 Historical perspectives and	
		need for the introduction of	
SO1.3 Student will understand		Intellectual Property Right	
different Intellectual Property		regime.	
and Intellectual Property		1.2 TRIPs and various provisions	
Rights (IPR), benefits of		in TRIPS Agreement.	
securing IPRs		1.3 Intellectual Property and	
č		Intellectual Property Rights (IPR).	
		1.4 Benefits of securing IPRs.	

SW-1 Suggested Sessional Work (SW):

Assignments: 1. Preparation of file and write the role of IPR and TRIPS and their purpose.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

Approximate Hours				
AppXHrs				
06				
0				
02				
03				
11				

			I otal	11		
Session Outcomes (SOs)	Laboratory	Classroom l	Instruction (CI)		Self	-Learning
	Instruction (LI)				(SL)	
SO2.1 Students will			n Legislations fo			
understand the Indian			ypes of Intellect			
Legislations for the		Fundamenta	1	s, copyrights,	2. Pla	nt varieties
protection of various types of		geographical	indications,	designs and	and	farmers'
Intellectual Properties;		layout, tra	de secrets ar trademarks, prot	nd traditional	rights	act (2001).
Fundamentals of patents,		varieties a	and farmers'	rights and	3. I	Biodiversity
copyrights, geographical			protection; Prot			002).
indications, designs and		matters, p	rotection in	biotechnology,		
layout			of other biolog			
SO2.2Students will		-	nd period of prote			
understand the trade secrets			egislations for the	*		
and traditional knowledge,			s of Intellectual F	-		
trademarks, protection of			entals of patent indications,			
plant varieties and farmers'		layout.	i indications,	designs and		
rights and biodiversity		•	rets and tradition	nal knowledge		
protection.		and trademan		har knowledge		
SO2.3 Students will identify			ion of plant	varieties and		
the role of Protectable		^	ts and biodiversi			
subject matters, protection in		-	ble subject matte	• •		
biotechnology, protection of		in biotechno	logy.			
other biological materials,		2.6 Protection	n of other biolog	gical materials,		
ownership and period of		ownership and	d period of protec	ction.		
protection.						
^						

SW-2 Suggested Seasonal Work (SW):

Assignments:

- I. Note on Plant varieties and farmers' rights act (2001).
- II. Note on Biodiversity act (2002).

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement.

Approx	imate Hours
Item	AppXHrs
Cl	05
LI	0
SW	02
SL	01
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)		Self- Learning (SL)
 SO3.1 Students will identify the National Biodiversity protection initiatives and Convention on Biological Diversity. SO3.2 Students will understand the International Treaty on Plant Genetic Resources for Food and Agriculture and Licensing of technologies. SO3.2 Students will understand the Material transfer agreements, Research collaboration Agreement and License Agreement. 		 Unit-3: 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. 3.1 National Biodiversity protection initiatives. 3.2 Conventions on Biological Diversity. 3.3 International Treaty on Plant Genetic Resources for Food and Agriculture. 	1. Plant Genetic Resources.
and License Agreement.		3.4 Licensing of technologies and Material transfer agreements.3.5 Research collaboration Agreement and License Agreement.	

SW-3 Suggested Sessional Work (SW):

- Assignments: a.
- i. Note on Plant Genetic Resources.
- Note on National Biodiversity protection initiatives ii.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Sessional	Self-	Total hour
	Lecture	Work (SW)	Learning	(Cl+SW+Sl)
	(Cl)		(Sl)	
PGS 503.1: Students will be able to understand	04	01	02	07
Historical perspectives and need for the introduction				
of Intellectual Property Right.				
PGS 503.2: Students will be able to understand	06	02	03	11
National Biodiversity protection initiatives.				
Convention on Biological Diversity.				
PGS 503.3: Students will be able to understand	05	02	01	08
Research collaboration Agreement, License				
agreement.				

CO	Unit Titles	Mark	ks Distri	bution	Total
		R	U	Α	Marks
CO 1	Historical perspectives and need for the introduction of	7	8	5	20
	Intellectual Property Right regime; TRIPs and various				
	provisions in TRIPS Agreement; Intellectual Property				
	and Intellectual Property Rights (IPR), benefits of				
	securing IPRs.				
CO 2	Indian Legislations for the protection of various types	6	5	4	15
	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; Protectable subject				
	matters, protection in biotechnology, protection of other				
	biological materials, ownership and period of				
	protection.				
CO 3	National Biodiversity protection initiatives; Convention	5	4	6	15
	on Biological Diversity; International Treaty on Plant				
	Genetic Resources for Food and Agriculture; Licensing				
	of technologies, Material transfer agreements, Research				
	collaboration Agreement, License Agreement.				
Total		18	17	15	50

Suggestion for End Semester Assessment Suggested Specification Table (For ESA)

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Intellectual Property and Its Management in Agriculture** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Tutorial
- 3. Group Discussion
- 6. Visit to organic fields
- 7. Demonstration
- 8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 9. Brainstorming

Suggested Learning Resources: (a) Books:

S.	Title	Author	Publisher	Edition &
No.				Year
1	Intellectual Property Rights in	 Erbisch FH and Maredia 	CABI.	1998
	Agricultural Biotechnology	К		
2	Intellectual Property Rights:	•Ganguli P	McGraw-Hill.	2001
	Unleashing Knowledge Economy			
3	Intellectual Property Rights: Key to		NRDC and Aesthetic	2001
	New Wealth Generation		Technologies.	
4	State of Indian Farmer. Vol. V.	 Ministry of Agriculture, 	Academic Foundation	2004
	Technology Generation and IPR	Government of India		
	Issues			
5	Intellectual Property Rights in	 Rothschild M and Scott N 	CABI	2003
	Animal Breeding and Genetics			

Curriculum Development Team:

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Cos, POs and PSOs Mapping

Course Code: PGS503

Course Title: - Intellectual Property and Its Management in Agriculture

Cou	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
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PGS 503. 1: Stud ents will be able to unde rstan d Hist orica 1 pers pecti ves and need for the	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	2	1	2

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PGS 503. 2: Stud ents will be able to unde rstan d Nati onal Biod ivers ity prote ction initia tives Con venti on Biol ogic al Dive rsity.	1	1	1	1	1	3	2	1	1	1	1	1	1	1	1	2	1	3
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Legend: 1- Low,2 – Medium, 3- High

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS503.CO1:Students will beable to understandHistoricalperspectives andneed for theintroduction ofIntellectualProperty Right	SO1.1 SO1.2 SO1.3		Unit-1.0 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. 1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 503.CO2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	SO2.1 SO2.2 SO2.3		Unit-2 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; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 503.CO3: Students will be able to understand Research Collaboration Agreement, License agreement	SO3.1 SO3.2 SO3.3	1.	Unit-3: 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. 3.1, 3.2, 3.3, 3.4, 3.5	

Course Curriculum Map: Intellectual Property and Its Management in Agriculture

Semester II

Course Code: PGS 504

Course Title: Basic Concepts in Laboratory Techniques

Pre requisite: No specific requirements

Rationale: Studying basic laboratory techniques are fundamental for scientific research, ensuring accurate experimentation and data analysis. Mastery of these skills cultivates precision, reproducibility, and safety, forming the cornerstone of scientific inquiry across disciplines and facilitating advancements in knowledge and technology.

Course Outcomes: CO1_ PGS504 Student will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.

Scheme of Studies

Board	Course	Course Title		Schei	me of	Studie	s (Hours/Week)	Total Credit
of Study	Code		CI	LI	SW	SL	Total Study Hours	(C)
NC	PGS504	Basic Concepts in Laboratory	00	2	00	00	2	01
		Techniques						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Practical

Boar	Course	Course			Sc	cheme o	of Assessme	ent (Marks)		
d of	Code	Title		Pro	gressive	Assess	ment (PRA	.)	End	Total
Stud			Class/Ho	Class	Semina	Class	Class	Total Marks	Semester	Marks
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NC	PGS50	Basic	0	0	0	0	0	0	100	100
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Course-Curriculum Detailing:

Laboratory techniques are important for any person conducting an experiment. Every procedure needs to be complete with accuracy and precision with proper safety measures. Student will understand the safety and details of working in scientific laboratory. Student will familiarize with various instruments and their principles. Student will practice and visualize common experimental procedures.

PGS504 Basic Concept of Laboratory Techniques

PGS504 Basic Concept of Labora	tory Techniques	Арі	oroximate I
		Item	Appx Hrs
		CI	00
		LI	30
		SW	00
		SL	00
		Total	30
Session Outcomes (SOs)	Laboratory Instructions (LI)	Classroom	
Session Outcomes (SOS)		Instruction	
		(CI)	(SL)
SO.L1 Identify safety measures	L1. Safety measures while in Lab;	()	(~_)
while in Lab	L2. Use of burettes, pipettes,		
SO.L2 Recognize use of	measuring cylinders, flasks,		
glasswares.	separatory funnel, condensers,		
SO.L3 Discover handling of	1 2		
glasswares.	L3. Washing, drying and sterilization		
SO.L4 Recognize Drying of			
solvents/ chemicals;	L4. Drying of solvents/ chemicals;		
SO.L5 Describe working with	L5. Handling of chemical substances;		
chemicals.	Weighing and preparation of		
SO.L6 Describe working with	solutions of different strengths and		
solutions.	their dilution;		
SO.L7 Articulate the technique of	L6. Handling techniques of solutions;		
formulating doses of	L7. Preparation of different agro-		
agrochemicals	chemical doses in field and pot		
SO.L8 Discover handling	applications;		
techniques of solutions	L8. Preparation of solutions of acids;		
SO.L9 Identify the handling of	L9. Neutralisation of acid and bases;		
acid and bases	L10. Preparation of buffers of		
SO.L10 Discover the formulation	different strengths and pH values;		
of buffer and solutions of specific	L11. Use and handling of microscope,		
pH.	laminar flow, vacuum pumps,		
SO.L11 Identify the use of lab	viscometer, thermometer, magnetic		
instruments	stirrer, micro-ovens, incubators,		
SO.L12 Recognize and categorize			
the media requirements and its	wiring and earthing;		
types	L12. Preparation of media and		
SO.L13 Discover the methods	methods of sterilization;		
and application of viability of	L13. Seed viability testing, testing of		
germplasm	pollen viability;		
SO.L14 Illustrate procedure for	L14. Tissue culture of crop plants;		
plant tissue culture	L15. Description of flowering plants		
SO.L15 Recognize flowering	in botanical terms in relation to		
plant by its taxonomical	taxonomy		

description				
Brief of Hours suggested for the Course Outo	ome			
Course Outcomes	Class	Sessional	Self-	Total hour
	Lecture	Work	Learning	(CL+SW+SL)
	(CL)	(SW)	(SL)	
		(211)		
Basic Concept of Laboratory Techniques	0+30	0	0	30

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles	Marks	Distrib	ution	Total
		R	U	Α	Marks
CO1	Basic Concept of Laboratory Techniques		30	70	100

Suggested Learning Resources:

Sl. No.	Title	Author	Publisher	Edition and Year
01	Laboratory Techniques	Jerry R. Mohrig,	W. H.	2014
	in Organic Chemistry	David G. Alberg, and	Freeman	
		Gretchen M. Adams	and	
			Company.	
02	Biotechnology:	B D Singh	Kalyani	2005
	Expanding Horizons		Publishers	

Cos, POs and PSOs Mapping Course Code: PGS 504 Course Title: - Basic Concepts in Laboratory Techniques

Course	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PSO1	PSO2	PSO	PSO	PSO	PS	P	PS	P
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Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map: Basic Concepts in Laboratory Techniques

PSO 1.2, 3, 4, 5, 6, 7, 8, 9, 10, 11instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.SO1.2 SO1.4 SO1.5measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; SO1.4 L3. Washing, drying and sterilization of glassware;in pag numberSO1.5 about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viabilitySO1.7 SO1.8 SO1.9L4. Drying of solvents/ chemicals; substances; Weighing and preparation of solutions of different strengths and their dilution;SO1.11 SO1.12 SO1.12 SO1.13SO1.20 L6. Handling techniques of solutions;L6. Handling techniques of applications;SO1.14 SO1.14 SO1.15SO1.14 L9. Neutralisation of solutions of acids; L9. Neutralisation of acid and bases; L10. Preparation of buffers of	POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
different strengths and pH values; L11. 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; L12. Preparation of media and	1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8,	will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability	SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7 SO1.8 SO1.7 SO1.8 SO1.9 SO1.10 SO1.11 SO1.12 SO1.13 SO1.14	 L2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; L3. Washing, drying and sterilization of glassware; L4. Drying of solvents/ chemicals; L5. Handling of chemical substances; Weighing and preparation of solutions of different strengths and their dilution; L6. Handling techniques of solutions; L7. Preparation of different agrochemical doses in field and pot applications; L8. Preparation of solutions of acids; L9. Neutralisation of acid and bases; L10. Preparation of buffers of different strengths and pH values; L11. 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; 		mentioned in page number

methods of sterilization;	
L13. Seed viability testing, testing of pollen viability;	
L14. Tissue culture of crop plants;	
L15. Description of flowering plants in botanical terms in relation to taxonomy	

	Semester - III
Course Code:	GPB 507
Course Title:	Breeding For Quality and Special Traits
Pre- requisite:	Students should have able to basic knowledge of developmental biochemistry
	grain quality parameters genetic resources management achievement and genetic engineering protocols with generation transgenics.
Rationale:	To provide insight into recent advances in improvement of quality traits in cereals, millets, legumes, oilseeds, forage and industrial crops using conventional and modern biotechnological approaches

Semester- III

Course Outcomes:

GPB507.1: The knowledge of this course will expose the student to know about basic developmental biochemistry and genetics of nutritional improvement of human perspective.

GPB507.2: The knowledge of this course will expose the student to know about breeding for grain quality parameters and its analysis.

GPB507.3: Student will be able to understand genetic resource management for sustaining nutritive quality in crops.

GPB507.4: The knowledge of this course will expose the student to know about breeding for quality improvement, cooking quality and achieve more PUFA in oil crops.

GPB507.5: The knowledge of this course will expose the student to know about genetic engineering protocols for quality improvement and nutritional genomics and second generation transgenics.

Scheme of Studies:

Board of	Course	Course Title		Sch	Total			
Study	Code		CI	LI	SW	SL	Total Study Hours	Credits
							CI+LI+SW+SL	(C)
	GPB 507	Breeding For	2	2	0	0	4	(2+1)=3
		Quality and						
		Special Traits						

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Boa	Cour	Course		Scheme of Assessment (Marks)						
rd	se	Title		Progressive Assessment (PRA)						Total
of	Code		Class/Home	Class Test	Semin	Class	Class	Total	Semeste	Mark
Stu			Assignment	2 (2 best	ar one	Activi	Attenda	Marks	r	S
dy			5 number	out of 3)		ty any	nce	(CA+CT+S	Assessm	(PRA
			3 marks	10 marks		one	(AT)	\mathbf{A} +	ent	+
			each	each		(CAT)		CAT+AT)	(ESA)	ESA)
			(CA)	(CT)					· · ·	
	GPB	Breeding	15	30	0	0	5	50	50	100
	507	For								
		Quality								
		and								

Special				
Traits				

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB507.1: The knowledge of this course will expose the student to know about basic developmental biochemistry and genetics of nutritional improvement of human perspective.

Approximate Hours

	Approximate nours
Item	Approximate Hours
CI	5
LI	0
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory	Class room Instruction	Self -Learning
	Instruction (LI)	(CI)	(SL)
SO1.1. Students are able		Unit-1 Developmental	1.Genetics of
to Understand		biochemistry and genetics	carbohydrates.
developmental		of nutritional and anti-	2.Nutritional
biochemistry and		nutritional factors.	improvements.
genetics.		1.1. Developmental	
SO1.2. Students are able		biochemistry.	
to explain anti-nutritional		1.2. genetics of	
factors		carbohydrates, proteins.	
SO1.3. Students are able		1.3 . genetics of fats,	
to Understand		vitamins, amino acids.	
carbohydrates and other		1.4 . anti-nutritional factors in	
minerals.		genetics.	
SO1.4. Students are able		1.5 . Nutritional improvement	
to Understand the process		- A human perspective	
of nutritional			
improvement in human			
perspective.			

SW-1 Suggested Sessional Work (SW):

- a. Assignments: anti-nutritional factors; Nutritional improvement A human perspective.
- **b.** Mini Project: Developmental biochemistry and genetics of carbohydrates.
- c. Other Activities (Specify):

GPB507.2: The knowledge of this course will expose the student to know about breeding for grain quality parameters and its analysis.

		тррголи	mate Hours		
			Item	Approxim	ate Hours
			CI	7	1
			LI	1	0
			SW	2	
			SL	1	
			Total	2	
Session Outcomes (SOs)	Labor	•	Class room Ins	truction (CI)	Self-
	Instructi	ion (LI)			Learning (SL)
Understand the molecular basis quality traits. SO2.4. Students are able to Understand the process of post harvest manipulations. SO2.5. Students are able to Understand the process breeding for backing quality.	 Grain qua evaluation Correlatin and qualit improvem rice. Quality an millets. Estimation nutritiona like tannin different v hybrids: A compariso Quality pa evaluation wheat. 	n in rice. ng ageing y nent in nalysis in n of anti- l factors ns in varieties/ A on. arameters	Unit-2. Breedin quality parama analysis 2.1. quality para and its analysis 2.2. Golden rice rice. 2.3. Breeding achievements an in Indian contex 2.4. Molecular b traits and their in rice 2.5. Post harvest for quality impro 2.6. Breeding qualities in whea 2.7. molec cytogenetic.	eters and its umeters in rice and aromatic and aromatic strategies, and application t. basis of quality manipulation t manipulation t manipulation for baking at	Golden rice and aromatic rice.

Approximate Hours

SW-2 Suggested Sessional Work (SW):

a. Assignments: Molecular basis of quality traits and their manipulation in rice.

b. Mini Project:

1. quality parameters in rice and its analysis.

c. Other Activities (Specify):

GPB507.3: Student will be able to understand genetic resource management for sustaining nutritive quality in crops.

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-Learning (SL)
	(LI)		
SO3.1. Students are able to		Unit 3 Genetic resource	1 . Analysis of
Understand the Breeding for		management for sustaining	breeding quality
quality improvement in		1 0 1	improvement in
Sorghum, pearl millet.		3.1 . Breeding for quality	crops.
SO3.2. Students are able to		improvement in Sorghum, pearl	2 . analysis of
Understand the Breeding for		millet.	concept and
quality improvement in barley		3.2. Breeding for quality	breeding
and oats.		improvement in barley and oats.	strategies.
SO3.3. Students are able to		3.3. Quality protein maize,	
Understand the Quality protein		specialty corns,	
maize, specialty corns,		3.4. Concept and breeding	
SO3.4. Students are able to		strategies.	
Understand the Concept and		3.5. Breeding for quality	
breeding strategies.		improvement in important	
SO3.5. Students are able to		forage crops for stay green	
Understand the Breeding for		traits.	
quality improvement in		3.6. Genetic resource	
important forage crops for stay		management for sustaining	
green traits.		nutritive quality in crops.	
SO3.6. Students are able to			
Understand the Genetic			
resource management for			
sustaining nutritive quality in			
crops.			

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Analysis of Nutritive quality in crops.

- b. Mini Project:
 - a. concept and breeding strategies.

Other Activities (Specify):

GPB507.4: The knowledge of this course will expose the student to know about breeding for quality improvement, cooking quality and achieve more PUFA in oil crops.

Item	Approximate Hours
CI	7
LI	12
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory	Class room Instruction	Self-Learning				
	Instruction (LI)	(CI)	(SL)				
SO 4.1. Students are able to Understand the Breeding for quality improvement in pulses- Chickpea, pigeonpea. SO4.2. Students are able to Understand the Breeding for quality improvement in pulses- green gram and black gram and Cooking quality. SO 4.3. Students are able to Understand the Breeding for quality in oilseeds - groundnut, mustard, soybean. SO 4.4. Students are able to Understand the Breeding for quality in sesame, sunflower and minor oilseeds. SO 4.5. Students are able to Understand the Molecular basis of fat formation and manipulation to achieve more PUFA in oil crops. SO 4.6. Students are able to Understand the Genetic manipulation for quality improvement in cotton. SO 4.7. Students are able to Understand the Breeding for quality improvement in Sugarcane, potato.	 Quality parameters evaluation in pulses and oilseeds. Evaluation of quality parameters in cotton. Evaluation of quality parameters in cotton. Evaluation of quality parameters in sugarcane. Evaluation of quality parameters in sugarcane. Evaluation of quality parameters in potato. Value addition in crop plants. Post-harvest processing of major field crops. 		3. Breeding for quality improvement in various pulses crops.				

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Breeding for quality improvement in Sugarcane, potato

b. Mini Project:

- i. Molecular basis of fat formation.
- c. Other Activities (Specify):

GPB507.5: The knowledge of this course will expose the student to know about genetic engineering protocols for quality improvement and nutritional genomics and second generation transgenics.

Item	Approximate Hours
CI	5
LI	8
SW	2
SL	1
Total	16

Session Outcomes	Laboratory Instruction	Class room Instruction	Self-Learning
(SOs)	(LI)	(CI)	(SL)
SO5.1.Geneticengineering protocols forqualityimprovement:Achievements made.SO5.2.Biofortificationin crops.SO5.3 Classification andimportanceofBiofortification.SO5.4.SO5.5.Secondgeneration transgenics.	 Successful example of application of MAS for quality trait in rice. Successful example of application of MAS for quality trait in mustard 	Unit-5.Genetic engineering protocols for quality improvement.1. Genetic engineering protocols for quality improvement: Achievements made.2. Biofortification crops.3. Classification 	 Genetic engineering protocols. Classification and importance, Nutritional genomics.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- **i.** Classification and importance, Nutritional genomics.
- b. Mini Project:
 - iv. Protocols for quality improvement.
- c. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Sessional	Self	Total hour
	Lecture	Work	Learning	(Cl+SW+Sl)
	(Cl)	(SW)	(Sl)	、
GPB507.1: The knowledge of this course will expose	5	2	1	8
the student to know about basic developmental				
biochemistry and genetics of nutritional improvement				
of human perspective.				
GPB507.2: The knowledge of this course will expose	17	2	1	20
the student to know about breeding for grain quality				
parameters and its analysis.				
GPB507.3: Student will be able to understand genetic	6	2	1	9
resource management for sustaining nutritive quality in				
crops.				
GPB507.4: The knowledge of this course will expose	19	2	1	22
the student to know about breeding for quality				
improvement, cooking quality and achieve more PUFA				
in oil crops.				
GPB507.5: The knowledge of this course will expose	13	2	1	16
the student to know about genetic engineering protocols				
for quality improvement and nutritional genomics and				
second generation transgenics.				

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks	Total		
		R	U	А	Marks
CO 1	Developmental biochemistry and genetics of nutritional and anti-	3	4	3	10
	nutritional factors.				
CO 2	Breeding for grain quality parameters and its analysis.	4	4	3	11
CO 3	Genetic resource management for sustaining nutritive quality in	3	3	3	9
	crops.				
CO 4	Breeding for quality improvement, cooking quality and achieve	4	3	4	11
	more PUFA in oil crops.				
CO 5	Genetic engineering protocols for quality improvement	5	2	2	9
	transgenics.				
Total		19	16	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Breeding For Quality and Special Traits** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Group Discussion
- 3. Visit to cement plant
- 4. Demonstration
- 5. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)

6. Brainstorming

- 2. Suggested Learning Resources:
- **3. (a) Books:**

S.	Title	Author	Publisher	Edition
No.				& Year
1	L		Biotechnological and Conventional	2002
	procedures of plant breeding"	SS Gnosal.	approaches, Narosa Publications	
2		Chopra VL	Oxford & IBH. 2018	2018
	Oxford & IBH. 2018.			
3	Fibre Science and	Ghosh P.	Tata McGraw Hill.	2004
	Technology.			
4	Advances in	Gupta SK.	Vol. 45 Academic Press	2007
	Botanical Research			
5	Plant Breeding	Singh BD.	Kalyani Publishers, New Delhi	1997
6	Genetic Improvement	Nigam J.	Oxford & IBH.	1996
	of Oilseed Crops			

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Cos, POs and PSOs Mapping
Course Code: GPB 507
Course Title: - Breeding For Quality and Special Traits

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
Outc																	0	1
omes	T	751	T	D'	TT1 '	701	T	T	т	T 1	T	D'	TT1 '	T 1	т	т	T	T 1
	To	The student		Disse	This	The stud	To dev	To	To	The stud	To diss	Dis	Thi	The stud	To dev	To	To	The stud
	•	will be			progr am	ents	elop	gain inte	giv e	ent	emi	sem inat	s pro	ents	elo	gai n	giv e	ent
		familia			will	will	scie	rdis	stu	will	nate	e	gra	will	p	inte	stud	will
	compr			ehensi	provi	deve	ntifi	cipl	den	be	info	com	m	dev	scie	rdis	ents	be
	ehensi	the	about		de	lop a	call	inar	ts a	fam	rma	pre	wil	elop	ntifi	cipl	a	fam
		various			oppor	unde	у	у	со	iliar	tion	hen	1	a	call	inar	co	iliar
	introd		e	cal	tunitie	rstan	trai	und	mp	wit	abo	sive	pro	und	у	у	mpr	wit
	uction	reprod	metho	under	s for	ding	ned	erst	reĥ	h	ut	prac	vid	erst	trai	und	ehe	h
	to	uctive	ds of	standi	stude	and	pers	andi	ens	the	dive	tical	e	andi	ned	erst	nsiv	the
	geneti	system		-	nts to	anal	onn	ng	ive	vari	rse	und	op	ng	pers	and	e	vari
	cs and		g-edge	-	under	yzin	el	of	intr	ous	met	erst	por	and	onn	ing	intr	ous
	^	genetic		hybri	stand	g	for	gen	od	plan	hod	andi	tun	anal	el	of	odu	pla
		diversit			the	pres	com	etic	uct	t	s of	ng	itie	yzin	for	gen	ctio	nt
	•	y, and	e.	on,	major	ent	mu	S	ion	repr	cutt	of	S Com	g	со	etic	n to	repr
	•	breedin	•		constr	diffi aulti	nity	and	to	odu	ing-	cro	for	pres	mm	S	gen	odu
	apply	g and			aints of	culti es in	serv	bree din	gen etic	ctiv	edg	p byb	stu don	ent diffi	unit	and bre	etic	ctiv
	to variou	selecti on	breedi		crop	local	ice, part		s	e syst	e and	hyb ridi	den ts	cult	y serv	edi	s and	e syst
		techniq		opme	produ	and	icul	g tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
	crops.	ues.	resear	-	ction	glob	arly	niq	pla	CIIIS	tive	on,	un	in	part	tech	nt	CIIIS
	crops.	ues.	ch.	and	and	al	in	ues	nt	, gen	gen	in-	der	loca	icul	niq	bre	, gen
				germp	their	agric	rura	for	bre	etic	etic	bre	sta	1	arly	ues	edi	etic
				lasm	soluti	ultur	1	the	edi	dive	S	d	nd	and	in	for	ng	div
				screen	ons.	e	regi	cult	ng	rsit	and	line	the	glo	rura	the	as	ersi
				ing.		and	ons	ivat	as	у,	plan	dev	ma	bal	1	cult	the	ty,
						how	in	ion	the	and	t	elop	jor	agri	regi	ivat	у	and
						they	fiel	of	У	bree	bree	men	con	cult	ons	ion	app	bre
						may	d of	vari	app	din	din	t,	stra	ure	in	of	ly	edi
						impa	agri	ous	ly	g	g	and	ints	and	fiel	vari	to .	ng
						ct	cult	cro	to	and	rese	ger	of	how	d of	ous	vari	and
						futur	ure	ps	var	sele	arch	mpl	cro	they	agri	cro	ous	sele
						e		gro	iou	ctio	•	asm	p	may	cult	ps	cro	ctio
						agric ultur		win a	s cro	n tech		scre enin	pro duc	imp	ure	gro win	ps.	n tech
						e.		g fro	cro ps	niq			tio	act futu				niq
						С.		m	ps.	ues.		g.	n n	re		g fro		ues.
								trad		uco.			and	agri		m		uco.
								itio					the	cult		trad		
								nal					ir	ure.		itio		
								to					sol			nal		
								cont					uti			to		

								emp orar y agri cult ure.					ons			con tem por ary agri cult ure.		
GPB5 07.1: The knowl edge of this course will expos e the studen t to know about basic develo pment al bioche mistry and geneti cs of nutriti onal impro vemen t of human perspe ctive.	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB5 07.2: The knowl edge of this course will expos e the studen t to know	1	2	1	2	2	1	1	2	1	2	3	2	1	1	1	1	1	1

about breedi ng for grain qualit y param eters and its analys is.																		
GPB5 07.3: Stude nt will be able to unders tand geneti c resour ce manag ement for sustai ning nutriti ve qualit y in crops.	1	2	3	2	2	1	1	2	2	2	2	1	1	1	1	1	1	1
GPB5 07.4: The knowl edge of this course will expos e the studen t to know about breedi ng for qualit	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1

y impro vemen t, cooki ng qualit y and achiev e more PUFA in oil crops.																		
GPB5 07.5: The knowl edge of this course will expos e the studen t to know about geneti c engine ering protoc ols for qualit y impro vemen t and nutriti onal geno mics and secon d genera tion transg enics.	2	3	2	3	2	1	1	1	2	2	1	2	1	1	1	1	1	1

Legend: 1- Low,2 – Medium, 3- High

POs & PSOs	COs No.& Titles	SOs	Laboratory	Classroom	Self-
No.		No.	Instruction (LI)	Instruction (CI)	Learning
					(SL)
РО	GPB507.1: The knowledge of this course	SO1.1	Quality	Unit-1.	As
1,2,3,4,5,6,7	will expose the student to know about	SO1.2	parameters	Developmental	mentioned
PSO 1,2, 3,	basic developmental biochemistry and	SO1.3	evaluation in	biochemistry and	in page
4, 5, 6, 7, 8,	genetics of nutritional improvement of		pulses and	genetics of nutritional	number
9, 10, 11	human perspective.		oilseeds.	and anti-nutritional	
				factors. 1.1, 1.2, 1.3	
РО	GPB507.2: The knowledge of this course	SO2.1	Evaluation of	Breeding for grain	As
1,2,3,4,5,6,7	will expose the student to know about	SO2.2	quality	quality parameters and	mentioned
PSO 1,2, 3,	breeding for grain quality parameters and	SO2.3	parameters in	its analysis.	in page
4, 5, 6, 7, 8,	its analysis.	SO2.4	cotton.	•	number
9, 10, 11		SO2.5		2.1, 2.2, 2.3, 2.4, 2.5	
РО	GPB507.3: Student will be able to	SO3.1	Evaluation of	Genetic resource	As
1,2,3,4,5,6,7	understand genetic resource management	SO3.2	quality	management for	mentioned
PSO 1,2, 3,	for sustaining nutritive quality in crops.	SO3.3	parameters in	sustaining nutritive	in page
4, 5, 6, 7, 8,			sugarcane.	quality in crops. 3.3,	number
9, 10, 11				3.2, 3.3	
РО	GPB507.4: The knowledge of this course	SO4.1	Evaluation of	Breeding for quality	As
1,2,3,4,5,6,7	will expose the student to know about	SO4.2	quality	improvement, cooking	mentioned
PSO 1,2, 3,	breeding for quality improvement,		parameters in	quality and achieve	in page
4, 5, 6, 7, 8,	cooking quality and achieve more PUFA		potato.	more PUFA in oil	number
9, 10, 11	in oil crops.			crops.	
				4 1 4 2	
				4.1, 4.2	
РО	GPB507.5: The knowledge of this course	SO5.1	Value addition in	Genetic engineering	As
1,2,3,4,5,6,7	will expose the student to know about	SO5.2	crop plants.	protocols for quality	mentioned
PSO 1,2, 3,	genetic engineering protocols for quality			improvement.	in page
4, 5, 6, 7, 8,	improvement and nutritional genomics				number
9, 10, 11	and second generation transgenics.			5.1, 5.2	

Course Curriculum Map: Breeding For Quality and Special Traits

Semester- III

Course Code: GPB 516

Course Title: Breeding For Stress Resistance and Climate Change

Pre- requisite: To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress tolerant varieties.

Rationale: After completion of this course the student will be able to well verse with the stress and its causes. This will enable the students for the development of RIL, NIL, etc. for pest resistance and Use of standard MAS procedures.

Course Outcomes:

GPB 516.1: Students are able to understand concept and impact of climatic change and breeding for abiotic and biotic stress resistance with their classification.

GPB 516.2: Students will have the ability to apply the knowledge gained about Concept of resistance pathogen invasions- Biochemical and molecular mechanisms, gene-for-gene hypothesis.

GPB 516.3: To understand principles of detection of genetically modified crops and seed treatment, packing and seed storage.

GPB 516.4: Students will get knowledge on about the genetic of abiotic stress resistance, genes and genomics in breeding Utilizing MAS procedures deficiency.

GPB 516.5: Students are gain knowledge about the Use of crop wild relatives as a source of resistance to biotic and abiotic factors in major field crops.

Scheme of Studies:

Board of	Course	Course Title		Scheme of studies (Hours/Week)					Total
Study	Code			CI	LI	SW	SL	Total Study Hours	Credits
								CI+LI+SW+SL	(C)
	GPB 516	Breeding For	Stress	2	1	0	0	3	2+1= 3
		Resistance and	Climate						
		Change							

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

			Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessme	Total Marks (PRA+E
Boar					-		-		nt (ESA)	SA)
	Couse Code	Course Title	Class/Home Assignment 5 number 3 marks each (CA)	best out	Semin ar one (SA)	Activity	Class Attenda nce (AT)	Total Marks (CA+CT +SA+CA T+AT)		

	GPB 516	Breeding For Stress Resistance and Climate Change	15	30	0	0	5	50	50	100	
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Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 516.1: Students are able to understand concept and impact of climatic change and breeding for abiotic and biotic stress resistance with their classification.

Item	Approximate Hours
CI	3
LI	4
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction (LI)		Learning
			(SL)
SO1.1 Students are able to	1. Understanding	Unit-1. Concept and impact of	1 . Plant
explain Concept and impact of	the	climatic change and breeding for	breeding with
climatic change.	climatologically	abiotic and biotic stress	special
SO1.2 Students are able to	parameters and	resistance.	reference to
explain Importance of plant	predisposal of	1. Concept and impact of climatic	biotic and
breeding with special reference	biotic and abiotic	change.	abiotic stress
to biotic and abiotic stress	stress.	2. Importance of plant breeding	resistance.
resistance.	2. Screening	with special reference to biotic and	
SO1.3 Students are able to	crops for drought	abiotic stress resistance.	
explain Classification of biotic	and flood	3. Classification of biotic stresses	
stresses – major pests and	resistance.	- major pests and diseases of	
diseases of economically		economically important crops.	
important crops.		· - •	

SW-1 Suggested Sessional Work (SW):

d. Assignments:

Major pests and diseases of economically important crops.

e. Mini Project:

Classification of biotic and abiotic stresses.

f. Other Activities (Specify):

GPB 516.2: Students will have the ability to apply the knowledge gained about Concept of resistance pathogen invasions- Biochemical and molecular mechanisms, gene-for-gene hypothesis.

Item	Approximate Hours
CI	7
LI	6
SW	2
SL	1
Total	16

Seguian Outcomes (SOs)	Laboratory	Class noom Instruction (CI)	Colf Loonning (CL)
Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-Learning (SL)
	(LI)		
SO2.1. Students are able to	1. factors-	Unit-2. Concept of	1. Host-pathogen
explain Concepts of resistance to	ways of	resistance pathogen	interaction, gene-
insect and pathogen resistance.	combating	invasions and Molecular	for-gene
SO2.2. Students are able to	them for	evidence.	hypothesis.
explain Analysis and inheritance	diseases	1 . Concepts of resistance to	2. Mechanisms
of resistance variation.	caused by	insect and pathogen	against viruses
SO2.3. Students are able to	fungi and	resistance.	and bacteria.
explain Host defence responses	bacteria.	2 . Analysis and inheritance of	
to pathogen invasions-	2.Phenotypic	resistance variation.	
Biochemical and molecular	screening	3 . Host defence responses to	
mechanisms.	techniques for	pathogen invasions-	
SO2.4. Students are able to	sucking pests	Biochemical and molecular	
explain Acquired and induced	and chewing	mechanisms.	
immunity and systemic acquired	pests.	4. Acquired and induced	
resistance (SAR).	3. Breeding	immunity and systemic	
SO2.5. Students are able to	for pest	acquired resistance (SAR).	
explain Host-pathogen	resistance.	5. Host-pathogen interaction,	
interaction, gene-for-gene	Foundation	gene-for-gene hypothesis.	
hypothesis.	and Certified	6 . Molecular evidence for its	
SO2.6. Students are able to	seed	operation and exceptions.	
explain Molecular evidence for	production of	7. Concept of signal	
its operation and exceptions.	Sorghum.	transduction and other host-	
SO2.7. Students are able to		defence mechanisms against	
explain Concept of signal		viruses and bacteria.	
transduction and other host-			
defence mechanisms against			
viruses and bacteria.			

SW-2 Suggested Sessional Work (SW):

c. Assignments:

Host defence responses to pathogen invasions- Biochemical and molecular mechanisms.

d. Mini Project:

Acquired and induced immunity and systemic acquired resistance (SAR).

ci. Other Activities (Specify):

GPB 516.3: To understand principles of detection of genetically modified crops and seed treatment, packing and seed storage.

Item	Approximate Hours
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning
	Instruction		(SL)
	(LI)		(~_)
SO3.1. Students are able to explain	1.	Unit 3 Mechanism of	1.Classical and
Types and genetic mechanisms of	Phenotypic	resistance classical and	molecular
resistance to biotic stresses –Horizontal	screening	molecular breeding method.	breeding
and vertical resistance in crop plants.	techniques	1. Types and genetic	methods -
SO3.2. Students are able to explain	for	mechanisms of resistance to	Measuring
Quantitative resistance/ adult plant	nematodes	biotic stresses -Horizontal and	plant
resistance and slow rusting resistance.	and borers;	vertical resistance in crop plants.	resistance
SO 3.3. Students are able to explain	Ways of	2. Quantitative resistance/ adult	using plant
Classical and molecular breeding	combating	plant resistance and slow rusting	fitness.
methods - Measuring plant resistance	them.	resistance.	
using plant fitness.	2.Study	3. Classical and molecular	
SO 3.4. Students are able to explain	about	breeding methods - Measuring	
Students are able to explain	Classical	plant resistance using plant	
Behavioural, physiological and insect	and	fitness.	
gain studies.	molecular	4. Behavioural, physiological	
SO 3.5. Students are able to explain	breeding	and insect gain studies.	
Phenotypic screening methods for	methods	5. Phenotypic screening methods	
major pests and diseases.	3 . Stress	for major pests and diseases.	
SO 3.6. Students are able to explain	due to soil	6. Recording of observations;	
Recording of observations; Correlating	factors and	Correlating the observations	
the observations using marker data -	mineral	using marker data – Gene	
Gene pyramiding methods and their	toxicity.	pyramiding methods and their	
implications.		implications.	
SO 3.7. Students are able to explain		7. Classification of abiotic	
Classification of abiotic stresses -		stresses - Stress inducing factors,	
Stress inducing factors, moisture stress/		moisture stress/ drought and	
drought and water logging and		water logging and submergence,	
submergence, Acidity, salinity/		Acidity, salinity/ alkalinity/	
alkalinity/ sodicity; High/ low		sodicity; High/ low temperature,	
temperature, wind, etc.		wind, etc.	
SO 3.8. Students are able to explain		8. Stress due to soil factors and	
Stress due to soil factors and mineral		mineral toxicity.	
toxicity.		9. Physiological and	
SO 3.9. Students are able to explain		Phenological responses;	
Physiological and Phenological		Emphasis of abiotic stresses in	
responses; Emphasis of abiotic stresses		developing breeding	
in developing breeding methodologies.		methodologies.	

SW-3 Suggested Sessional Work (SW):

c. Assignments:

Stress due to soil factors and mineral toxicity.

- **d. Mini Project:** Gene pyramiding methods and their implications.
- e. Other Activities (Specify):

GPB 516.4: Students will get knowledge on about the genetic of abiotic stress resistance, genes and genomics in breeding Utilizing MAS procedures deficiency.

Item	Approximate Hours
CI	6
LI	6
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-
	Instruction		Learning
	(LI)		(SL)
SO4.1. Students are able to explain	1. Use of	Unit 4. Genetic of abiotic stress	Deficiency
Genetics of abiotic stress resistance.	standard	resistance, genes and genomics.	and
SO4.2. Students are able to explain	MAS	1. Genetics of abiotic stress	pollutants/
Genes and genomics in breeding	procedures.	resistance.	contaminants
cultivars suitable to low water regimes	Breeding	2. Genes and genomics in	in soil, water
and water logging and submergence,	strategies -	breeding cultivars suitable to low	and
high and low/ freezing temperatures.	Weeds –	water regimes and water logging	environment.
SO4.3. Students are able to explain	ecological,	and submergence, high and low/	
Utilizing MAS procedures for	environmenta	freezing temperatures.	
identifying resistant types in important	1 impacts on	3. Utilizing MAS procedures for	
crops like rice, sorghum.	the crops.	identifying resistant types in	
SO4.4. Students are able to explain	2 . Symptoms	important crops like rice,	
Utilizing MAS procedures for	and data	sorghum.	
identifying resistant types in important	recording;	4. Utilizing MAS procedures for	
crops like wheat, cotton.	use of MAS	identifying resistant types in	
SO4.5. Students are able to explain	procedures.	important crops like wheat,	
Breeding for resistance to stresses	3. Traits to be	cotton.	
caused by toxicity.	observed at	5. Breeding for resistance to	
SO4.6. Students are able to explain	plant and	stresses caused by toxicity.	
Deficiency and pollutants/ contaminants	insect level.	6. Deficiency and pollutants/	
in soil, water and environment.		contaminants in soil, water and	
		environment.	

SW-4 Suggested Sessional Work (SW):

d. Assignments:

Breeding for resistance to stresses caused by toxicity.

e. Mini Project:

Utilizing MAS procedures for identifying resistant types

f. Other Activities (Specify):

GPB 516.5: Students are gain knowledge about the Use of crop wild relatives as a source of resistance to biotic and abiotic factors in major field crops.

	Item	Approximat	Approximate Hours					
	CI	5	5					
	LI	8	8					
	SW	2						
	SL	1						
	Total	16						
Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self-Learning					
	Instruction (LI)		(SL)					
SO5.1. Students are able to	1 . Evaluating the	Unit-5. Use of crop wild	1. Biotic and					
explain Use of crop wild relatives	available	relatives as a source of	abiotic					
as a source of resistance.	populations like	resistance and Transgenics in	factors in					
SO5.2. Students are able to	RIL, NIL, etc.	management of biotic and						
explain Biotic and abiotic factors	2. Breeding for	abiotic stresses.	crops.					
in major field crops.	herbicide	1. Use of crop wild relatives as a						
SO5.3. Students are able to	resistance.	source of resistance.						
explain Transgenics in	3. Factors to be	2. Biotic and abiotic factors in						
management of biotic and abiotic	considered and							
stresses.	breeding	3. Transgenics in management of						
SO5.4. Students are able to	strategies.	biotic and abiotic stresses.						
explain Transgenics use of toxins,	4. To study about	4. Transgenics use of toxins,						
protease inhibitors, lectins,	the Quality	protease inhibitors, lectins,						
chitinases.	parameters	chitinases.						
SO5.5. Students are able to	evaluation.	5. Bt for diseases and insect pest						
explain Bt for diseases and insect		management.						
pest management.		-						

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Transgenics in management of biotic and abiotic stresses.

b. Mini Project:

Bt for diseases and insect pest management.

c. Other Activities (Specify):

Course Outcomes	Class	Sessional	Self-	Total hour
	Lecture (Cl)	Work (SW)	Learning (Sl)	(Cl+SW+Sl)
GPB 516.1: Students are able to understand concept and impact of climatic change and breeding for abiotic and biotic stress resistance with their classification.	7	2	1	10
GPB 516.2: Students will have the ability to apply the knowledge gained about Concept of resistance pathogen invasions- Biochemical and molecular mechanisms, gene-for-gene hypothesis.	13	2	1	16
GPB 516.3: To understand principles of detection of genetically modified crops and seed treatment, packing and seed storage.	15	2	1	18
GPB 516.4 : Students will get knowledge on about the genetic of abiotic stress resistance, genes and genomics in breeding Utilizing MAS procedures deficiency.	12	2	1	15
GPB 516.5: Students are gain knowledge about the Use of crop wild relatives as a source of resistance to biotic and abiotic factors in major field crops.	13	2	1	16

Brief of Hours suggested for the Course Outcome

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marl	ks Distr	Total	
		R	U	Α	Marks
CO 1	Concept and impact of climatic change and breeding for abiotic and biotic stress resistance.	3	4	4	11
CO 2	Concept of resistance pathogen invasions and Molecular evidence.	4	3	3	10
CO 3	Mechanism of resistance classical and molecular breeding method.	5	3	2	10
CO 4	Genetic of abiotic stress resistance, genes and genomics.	4	3	2	9
CO 5	Use of crop wild relatives as a source of resistance and Transgenics in management of biotic and abiotic stresses.	3	4	3	10
Total		19	17	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Breeding For Stress Resistance and Climate Change** will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 1. Improved Lecture
- 2. Group Discussion and Demonstration
- **3.** ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)

- 4. Brainstorming
- 5. Smart Board

Suggested Learning Resources:

(a) Books:

S.	Title	Author	Publisher	Edition
No.				& Year
1	Plant Breeding for Stress Environments.	Blum A.	CRC Press.	2017
2	Breeding Plants for Less Favorable	Christiansen M.N. &	Wiley	1982
	Environments.	Lewis C.F.	International.	
3	Plant Resistance to Herbivores and Pathogens:	Fritz R.S. & Simms	The University of	1992
	Ecology, Evolution and Genetics.	E.L. (Eds.).	Chicago Press	
4	Plant Cold Hardiness and Freezing Stress	Li PH & Sakai A	Academic Press	1982
5	Developing Resistant Plants - The Ideal	Luginpill P.	Forgotten Books	2019
	Method of Controlling Insects			
6	Breeding Plants Resistant to Insects.	Maxwell FG &	John Wiley &	1980
		Jennings PR. (Eds.).	Sons.	
7	Insect Resistance in Crop Plants	Painter RH.	MacMillan, New	1968
			York	
8	Plant Breeding for Pest and Disease	Russel GE.	Butterworths	1978
	Resistance			
9	Frost Survival of Plants	Sakai A & Larcher W	Springer Berlin,	2012
			Heidelberg	
10	Adaptation of Plants to Water and High	Turener NC &	John Wiley &	1980
	Temperature Stress	Kramer PJ.	Sons.	
11	Host-Pathogen Interactions in Plant Disease	Van der Plank JE	Academic Press	1982

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Cos, POs and PSOs Mapping Course Code: GPB 516 Course Title: - Breeding For Stress Resistance and Climate Change

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
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		various	divers	practi	oppor	unde	у	у	со	iliar	tion	hen	1	a	call	inar	со	iliar
	introd	plant	e	cal	tunitie	rstan	trai	und	mp	wit	abo	sive	pro	und	у	у	mpr	wit
	uction	reprod			s for	ding	ned	erst	reh	h	ut	prac	vid	erst	trai	und	ehe	h
	to	uctive		standi	stude	and	pers	andi	ens	the	dive	tical	e	andi	ned	erst	nsiv	the
	-	system		-	nts to	anal	onn	ng	ive	vari	rse	und	op	ng	pers	and	e	vari
	cs and		g-edge	-	under	yzin	el for	of	intr	ous	met	erst	por	and	onn	ing of	intr	ous
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	to	selecti		line	of	es in	ice,	din	etic	e	e	ĥyb	den	diffi	у	bre	s	e
	variou	on	breedi	devel	crop	local	part	g	S	syst	and	ridi	ts	cult	serv	edi	and	syst
	S	techniq	ng	opme	produ	and	icul	tech	and	ems	crea	zati	to	ies	ice,	ng	pla	ems
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								orar y agri cult ure.								tem por ary agri cult ure.		
GPB 516.1: Stude nts are able to unders tand conce pt and impact of climat ic chang e and breedi ng for abiotic stress resista nce with their classif ication	1	2	1	1	2	1	1	2	3	3	2	2	1	1	1	1	1	1
GPB 516.2: Stude nts will have the ability to apply the knowl edge gained about Conce pt of	1	2	1	2	2	1	1	2	3	2	3	2	1	1	1	1	1	1

resista nce patho gen invasi ons- Bioch emical and molec ular mecha nisms, gene- for- gene hypot hesis.																		
GPB 516.3: To unders tand princi ples of detecti on of geneti cally modifi ed crops and seed treatm ent, packin g and seed storag e.	1	2	3	2	2	1	1	2	2	3	2	1	1	1	1	1	1	1
c. GPB 516.4: Stude nts will get knowl edge on	3	2	2	2	1	1	1	3	1	2	1	1	2	1	1	1	1	1

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516.5:																		
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Stude nts are gain knowl edge about the Use of crop wild relativ es as a source of resista nce to biotic and abioti c factor s in major																		
Stude nts are gain knowl edge about the Use of crop wild relativ es as a source of resista nce to biotic and abioti c factor s in																		

Legend: 1- Low,2 – Medium, 3- High

POs & PSOs No.	Course Curriculum Map: Breeding COs No.& Titles	SOs No.	Laboratory Instruction (LI)		Self- Learning
		1.00			(SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 516.1: Students are able to understand concept and impact of climatic change and breeding for abiotic and biotic stress resistance with their classification.	SO1.1 SO1.2 SO1.3	Evaluating the available populations like RIL, NIL, etc.	Unit-1. Concept and impact of climatic change and breeding for abiotic and biotic stress resistance. .1.1, 1.2, 1.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 516.2: Students will have the ability to apply the knowledge gained about Concept of resistance pathogen invasions- Biochemical and molecular mechanisms, gene-for-gene hypothesis.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2 . Breeding for herbicide resistance.	Concept of resistance pathogen invasions and Molecular evidence. 2.1, 2.2, 2.3, 2.4, 2.5	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 516.3: To understand principles of detection of genetically modified crops and seed treatment, packing and seed storage.	SO3.1 SO3.2 SO3.3	3 . Factors to be considered and breeding strategies.	Mechanism of resistance classical and molecular breeding method. 3.3, 3.2, 3.3	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 516.4 : Students will get knowledge on about the genetic of abiotic stress resistance, genes and genomics in breeding Utilizing MAS procedures deficiency.	SO4.1 SO4.2	4 . To study about the Quality parameters evaluation	Genetic of abiotic stress resistance, genes and genomics. 4.1, 4.2	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 516.5: Students are gain knowledge about the Use of crop wild relatives as a source of resistance to biotic and abiotic factors in major field crops.	S05.1 S05.2	Path coefficient analysis and interpretation.	Use of crop wild relatives as a source of resistance and Transgenics in management of biotic and abiotic stresses 5.1, 5.2	As mentioned in page number

Course Curriculum Map: Breeding For Stress Resistance and Climate Change

Semester- III

Course Code: GPB 591

Course Title: Master Seminar

Pre- requisite: Students should have knowledge about basic and futuristic technologies subjected to ICT technology and Genetics and Plant Breeding.

Rationale: Student will become familiar with fundamental application of ICT technologies related with Genetics and Plant Breeding that will support students in their career skills and leadership development in order to shape tomorrow's social and educational development in Genetics and Plant Breeding sector.

Course Outcomes:

GPB 591.1.Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Genetics and Plant Breeding.

Scheme of Studies:

Doord of	Course			Sch	eme of	studi	es (Hours/Week)	Total
Board of Study	Course Code	Course Title	CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	Credits (C)
	GPB 591	Master Seminar	0	2	1	1	4	(0+1) = 1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

				Scheme of Assessment (Marks) Progressive Assessment (PRA)								
Boa rd of Stu dy	Cour se Code	Course Title	Class/Home Assignment 5 number3 markseach(CA)	bestout of3)10	Semina rone	Class Activi tyany one(C AT)		Total Marks _{(CA} +CT+SA+ CAT+AT)	ent	Marks(P		
	GPB 591	Master Seminar	0	0	0	0	0	0	100	100		

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should show case their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Genetics and Plant Breeding.

Approximate Hours

	rr · · · · ·
Item	Approximate Hours
CI	0
LI	30
SW	0
SL	2
Total	32

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
students to work with ICT technologies in Genetics and Plant Breeding. SO1.2. Research seminar helps the	collection of presentation materials by using the ICT tools		 Finding the topic related material. Preparation of PPT related to concerned topic.

SW-1 Suggested Sessional Work (SW):

- g. Assignments:
- h. Mini Project:
- i. Other Activities (Specify)

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Sessional	Self -	Total hour
	Lecture		Learning	(Cl+SW+Sl)
	(Cl)	(SW)	(Sl)	
GPB591.1.Students will design professional orientation on				
the topic with their choice of interest which will helps in	30	0	n	32
development of academic and social sector pertaining to	30	U	2	32
Genetics and Plant Breeding.				

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks	Total		
		R	U	Α	Marks
CO 1	Students will design professional orientation on the topic	-	-	100	100
	with their choice of interest which will helps in				
	development of academic and social sector pertaining to				
	Genetics and Plant Breeding.				

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Master Seminar** will be 100 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment. Suggested Instructional/Implementation Strategies:

- 1. PPT Presentation
- 2. Group Discussion
- 3. Demonstration
- 4. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 5. Brainstorming
- 6. Smart board

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			
8	As per directions of course			
	instructor.			

Curriculum Development Team:

- 1. Dr. S.S. Tomar, DEAN, Faculty of Agriculture Science and Technology, AKS University.
- 2. Dr. Neeraj Verma, PG Coordinator, Faculty of Agriculture Science and Technology, AKS University.
- 3. Dr. Abhishek Singh, HOD, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
- 4. Dr. Ayodhya Prasad Pandey, Assistant Professor, Dept. of G&PB, Faculty of Agriculture Science and Technology AKS University.

Cos, POs and PSOs Mapping Course Code: GPB 591 Course Title: - Master Seminar

Course	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
Outco	101	101	100		100	100	107	01	02	03	04	05	06	07	08	09	01	01
mes								-	-		-						0	1
	Studen	Student	The	The	Stude	Stud	Stu	Stu	Stu	Stu	Stu	Stu	Aft	Stu	Stu	Stu	Stu	Stu
	t will	will	studen	stude	nt	ent	dent	dent	den	dent	dent	dent	er	dent	den	den	den	den
	identif	experti	t will	nt	will	will	will	will	t	will	will	will	gai	will	t	t	t	t
	y the	se in	have	will	plan	appl	und	iden	wil	reco	appl	und	nin	reco	will	will	will	will
	curren	latest	expert	have	about	У	erst	tify	1	gniz	У	erst	g	gniz	pra	app	app	app
	t	vegeta		^	the	vario	and	diff	pra	e	diff	and	exp	e	ctic	ly	ly	ly
	scenar		nurser		big	us	abo	eren	ctic	diff	eren	role	eri	diff	e	vari	basi	basi
		product	-	differ	scale	statis	ut	t	e	eren	t	of	enc	eren	turf	ous	c	с
	crop		raising		comm	tical	libr	cool	diff	t	veg	mic	e,	t	gras	info	con	stati
		technol			ercial	meth	ary	seas	ere	und	etab	rocl	the	flo	s,	rma	cept	stic
	ty,	ogies,	ques	ic	projec	ods	tech	on,	nt	erut	le	ima	У.,	wer,	ind	tion	s in	al
		vegeta		condit	t and	to	niq	war	bre	ilize	proc	te in	wil	orna	oor	serv	lab	tool
	с		protec		also	anal	ues,	m	edi	d	essi	veg	1	men	pla	ices	orat	S 1
	<u>^</u>	breedin		requir	mana	yze	tech	seas	ng	veg	ng	etab	get	tal	nt	, 	ory	duri
	ement	•	cultiva		ge the	their	nica	on	tec hni	etab	and	le	the	crop	and	tech	tech	ng thei
		techniq			resear ch	mast	l writ	and und		le and	post -	and flo	pos itio	s and	inte rios	nica 1	niq	thei r
		ues and post-	-		trails	er		erut	que s		- harv	wer		thei	capi	writ	ues duri	r
	ng techni	harvest		veget able	under	resea rch	ing skill	ilize	s use	spic e	est-	crop	ns of	r	<u>^</u>	ings		rese arc
	ques	manag		as	veget	work	SKIII	d	d	crop	han	pro	spe	nurs	ng ma	and	ng thei	h
	of	ement		well	able	WOIK	, IPR	veg	in	s	dlin	duct	cial	ery	nag	co	r	wor
	differe	of	crops.	as	and		шĸ	etab	veg	5	g	ion	ists	man	eme	mm	rese	k
	nt	vegeta		under	flowe		, labo	le	eta		met	und	for	age	nt	uni	arc	n
	vegeta	-		utilize	r		rato	crop	ble		hod	er	han	men		cati	h	
	ble			d	crops		ry	S	and		S	diff	dli	t		on	wor	
	and			veget	1		tech		flo		for	eren	ng			skil	k	
	flower			able			niq		we		veg	t	pla			ls in		
	crops.			cultiv			ues		r		etab	prot	nta			thei		
	_			ation.			and		pro		les	ecte	tio			r		
							rese		duc		and	d	n,			aca		
							arch		tio		flo	stru	nur			de		
							ethi		n		wer	ctur	seri			mic		
							cs				S	es	es			S		
							in						and					
							man						oth					
							uscr						er					
							ipt						pro					
							writ						tect					
							ing						ed					
													cul					
													tiv					
													ati					

													on pro ject s					
VSC 591.1 Student s will design professi onal orientat ion on the topic with their choice of interest which will helps in develop ment of academ ic and social sector pertaini ng to vegetab le science.	3	3	2	3	3	1	1	3	3	3	3	3	2	1	1	1	1	1
· · · · ·						-		1 T					•	-	-	•		

Legend: 1- Low,2 – Medium, 3- High

PSO 1,2, 3, 4, 5, 6,design professional orientation on theSO1.2presentation materials by using the ICT toolsin page	POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
topic with their choice of interest which will helps in development of academic and social sector pertaining to vegetable science.SO1.3related to the vegetable science on selected topic.Interest with wegetable science on selected topic.1.2Presentation of 	PSO 1,2, 3, 4, 5, 6,	Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to		 and collection of presentation materials by using the ICT tools related to the vegetable science on selected topic. 1.2 Presentation of acquired material in	Unit-1.0	mentioned in page number

Course Curriculum Map: Master Seminar

Semester- III

Course Code: GPB 599

Course Title: Master's Research (Research/Thesis)

Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Genetics and Plant Breeding.

Rationale: The basic purpose of master's research is to understand the application of research methodology tools to do research on particular topic related to vegetable science and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

GPB 599.1. Prepare various research activities related to Genetics and Plant Breeding field and compose manuscript i.e., synopsis related to particular topic.

Scheme of Studies:

Doord of	Course			Sch	eme of	studi	es (Hours/Week)	Total
Board of Study	Course Code	Course Title	CI	LI	SW	SL	Total Study HoursCI+LI+SW+SL	Credits (C)
	GPB 599	Master Research	0	30	0	0	30	(0+15) = 15

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

				Progressiv			essment ((PRA)	Marks)		
Boa rd of Stu dy	Cour se Code	Course Title	Class/Home Assignment 5 number3 marks each (CA)	Class Test 2(2 best out	Semin ar one	Class Activit v anv	Class Attenda nce (AT)	Total Marks (CA+CT+ SA+ CAT+AT)	End Semeste r Assessm ent (ESA)	Total Marks (PRA + ESA)
	GPB 599	Master Research	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 599.1. Prepare various research activities related to Genetics and Plant Breeding field and compose manuscript i.e., synopsis related to particular topic.

	Approximate Hours
Item	Approximate Hours
CI	0
LI	30
SW	0
SL	30
Total	60

Session Outcomes (SOs)	Laboratory Instruction	Class room	Self-Learning
	(LI)	Instruction (CI)	(SL)
SO1. Plan the proposal of research	1. Submission of research		1. Finding of
related to the topic taken with the help	proposal consisting concern		reviews related
of guide	programme		with the topic
SO2. Design the layout according to	2. Explain definition of the		of research.
topic	problems reference to topic		2. Preparation
SO3. Describe the terminology related	3 . Explanation of results		of manuscripts
to the topic	4. Arrange the references of		related to
SO4. Plan the methodology to conduct	past work of 10 years		concerned
the research on the topic	5. Collection of data by		topic.
SO5. Select the data to be taken during	focusing their objectives and		_
research	observations to be taken		
	mentioned in their synopsis		

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instructio n (LI)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
GPB 599.1. Prepare various research activities related to Genetics and Plant Breeding field and compose manuscript i.e., synopsis related to particular topic.		30	30	60
Total		30	30	60

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment. Suggested Instructional/Implementation Strategies:

- 7. Improved Lecture
- 8. Group Discussion
- 9. Demonstration
- 10. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			

Curriculum Development Team:

- a. Dr. S.S. Tomar, DEAN, Faculty of Agriculture Science and Technology, AKS University.
- b. Dr. Neeraj Verma, PG Coordinator, Faculty of Agriculture Science and Technology, AKS University.
- c. Dr. Abhishek Singh, HOD, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
- d. Dr. Doomar Singh, HoD, Plant Pathology
- e. Dr. Ayodhya Prasad Pandey, Assistant Professor, Dept. of G&PB, Faculty of Agriculture Science and Technology AKS University.

Cos, POs and PSOs Mapping Course Code: GPB 599 Title: - Master's Research (Research

	Course Code: GPB 599 Course Title: - Master's Research (Research/Thesis)																	
Course	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
Outco								01	02	03	04	05	06	07	08	09	01	01
mes																	0	1
	Studen	Student	The	The	Stude	Stud	Stu	Stu	Stu	Stu	Stu	Stu	Aft	Stu	Stu	Stu	Stu	Stu
	t will	will	studen	stude	nt will	ent	dent	dent	den	dent	dent	dent	er	dent	den	den	den	den
	identif	experti	t will	nt will	plan	will	will	will	t	will	will	will	gai	will	t	t	t	t
	y the	se in	have	have	about	appl	und	iden	wil	reco	appl	und	nin	reco	will	will	will	will
	current		-	^	the	У	erst	tify	1	gniz	У	erst	g	gniz	pra	app	app	app
	scenari	vegeta			big	vario	and	diff	pra	e	diff	and	exp	e	ctic	ly	ly	ly
	o, crop		nurser	differ	scale	us	abo	eren	ctic	diff	eren	role	eri	diff	e	vari	basi	basi
	diversi	product	•	ent	comm	statis	ut	t	e	eren	t	of	enc	eren	turf	ous	с	с
	ty,		-	climat	ercial	tical	libr	cool	diff	t	veg	mic	е,	t	gras	info	con	stati
		technol			projec	meth	ary	seas	ere	und	etab	rocl	the	flo	s,	rma	cept	stic
	с	ogies,	-	condit	t and	ods	tech	on,	nt	erut	le	imat	У	wer,	ind	tion	s in	al
	-	vegeta		ions	also	to	niqu	war	bre	ilize	proc	e in	wil	orna	oor	serv	lab	tool
	ment	ble	^	requir	mana	anal	es,	m	edi	d	essi	veg	1	men	pla	ices	orat	S
		breedin		ed for	ge the	yze	tech	seas	ng	veg	ng	etab	get	tal	nt	, , ,	ory	duri
	breedi	-			resear	their	nica	on	tec	etab	and	le	the	crop	and	tech	tech	ng
	Ũ	techniq			ch	mast	1	and	hni	le	post	and	pos	S	inte	nica	niq	thei
		ues and	-	-	trails	er	writ	und	que	and	- howy	flo	itio	and	rios	1	ues	r
	ques of	post-	bles	able	under	resea rch	ing skill	erut ilize	S	spic	harv	wer	ns of	thei r	capi	writ	duri	rese
		harvest manag		as well	veget able	work	SKIII	d	use d	e crop	est- han	crop		r nurs	ng ma	ings and	ng thei	arc h
	nt	ement		as	and	WOIK	, IPR	u veg	in	s	dlin	pro duct	spe cial	ery	nag	co	r	wor
	vegeta		crops.	under	flowe		пк	etab	veg	3	g	ion	ists	man	eme	mm	rese	k
	ble	vegeta		utilize	r		, labo	le	eta		met	und	for	age	nt	uni	arc	ĸ
	and	bles		d	crops		rato	crop	ble		hod	er	han	men		cati	h	
	flower	0105		veget	er op s		ry	s	and		s	diff	dli	t		on	wor	
	crops.			able			tech		flo		for	eren				skil	k	
	1			cultiv			niqu		we		veg	t	pla			ls in		
				ation.			es		r		etab	prot	nta			thei		
							and		pro		les	ecte	tio			r		
							rese		duc		and	d	n,			aca		
							arch		tio		flo	stru	nur			de		
							ethi		n		wer	ctur	seri			mic		
							cs				s	es	es			s		
							in						and					
							man						oth					
							uscr						er					
							ipt						pro					
							writ						tect					

							ing						ed cul tiv ati on pro ject s					
GPB 599 .1.Prepa re various researc h activitie s related to concern field and compos e manusc ript i.e., synopsi s related to particul ar topic.	2	2	2	3	2	3	2	3	2	2	1	2	2	1	1	2	2	3
GPB 599 • Propose researc h method ology tools for conduct	2	2	2	1	3	3	2	1	3	3	2	2	2	1	1	1	2	3

ing		[
researc										
h on										
selected										
topic of										
vegetab										
le										
science										
field of										
horticul										
ture and										
prepare										
Final										
manusc										
ript i.e.,										
Thesis										

Legend: 1- Low,2 – Medium, 3- High

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 599 .1. Prepare various research activities related to concern field and compose manuscript i.e., synopsis related to particular topic.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	 1.1Submission of research proposal consisting concern programme 1.2 Explain definition of the problems reference to topic 1.3 Explanation of results 1.4 Arrange the references of past work of 10 years 1.5 Collection of data by focusing their objectives and observations to be taken mentioned in their synopsis 		As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB 599 .2. Propose research methodology tools for conducting research on selected topic of vegetable science field of horticulture and prepare Final manuscript i.e., Thesis	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	 1.1 Perform research work as per their topic by using various tools and production technology methods in particular season of crop. 1.2 Collection of data 1.3 Analysis and interpretation of data 1.4 Submission of final thesis based on the research topic 		As mentioned in page number

Semester III

Course Code: - PGS 505

Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Pre requisite: -Student should have basic knowledge of agricultural research, research ethics, and agricultural history along with fellowship program, rural development programme.

Rationale: - The students studying agricultural research and research ethics should possess understanding about method of research application, research ethics and fellowship for research and other scholars in construction agricultural development. This encompasses familiarity with the invention and evolution of agricultural research and development of agricultural programme, students ought to acquire fundamental insights into various agricultural technologies, their applications, as well as the Indian needs in agricultural developments.

Course Outcomes:

PGS 505.1: Identify the history, levels of research, economic and social welfare through research programme.

PGS 505.2: Apply the functioning, role and significant of regional, national and international research.

PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.

PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development

PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Scheme of studies

Categories	Course	Course Title	5	Scheme of studies (Hours/Week)						
of course	Code		C 1	LI	SW	SL	Total Study	Cred		
							Hours	its		
							(CI+LI+SW+S	(C)		
							L)			
Non credit	PGS 505	Agricultural Research,	01	00	02	01	04	01		
course		Research Ethics and								
(NCC)		Rural Development								
		Programmes								

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C: Credits.**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

				Scheme of Assessment (Marks)						
				Progressi	ve Ass	essmen	t (PRA)		End	Total
Catego	Cour		Class/	Class Test	Somin	Class	Class	Total	End Semester	Mar
ries of	se	Course Title	Home	2	Semm	Activit	Class Attenda	Vorze	Assessme	KS
course	Code		Assign	(2 best out		y any	Attenua	(CA+C		(PR
			ment 5	of 3)	(SA	one	nce (AT)	T+SA+	nt (ESA)	A+
			numbe	10 marks)	(CA	(\mathbf{AI})	CAT+A	(ESA)	ESA

			r 3 marks each (CA)	each (CT)		T)		T))
(NCC)	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	15	30	00	00	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 505 CO-1 Identify the history, levels of research, economic and social welfare through research programme

Approximate Hours AppX Hrs

Item	AppX Hrs
C 1	3
LI	0
SW	2
SL	1
Total	06

Laboratory	Class room Instruction	Self-Learning
Instruction	(CI)	(SL)
(LI)		
	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 (NARS) and Regional Agricultural Research Institutions; 1.1- History of agriculture in brief 1.2-Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment 1.3- National Agricultural Research	1.1- Prepare the assignment on Global agricultural research system
	Instruction (LI)	Instruction (LI)(CI)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 (NARS) and Regional Agricultural Research Institutions;1.1- History of agriculture in brief 1.2-Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment

Regional Agricultural Research Institutions.	Systems (NARS) and Regional Agricultural Research Institutions	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Global agricultural research system

- b. Mini Project: -
- c. Other Activities (Specify):

PGS 505 CO 2: Apply the functioning, role and significant of regional, national and international research.

Α	pproximate Hours
Item	AppX Hrs
C 1	3
LI	0
SW	1
SL	2
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning (SL)
SO2.1 introduce to the		Unit-II Consultative Group on	2.1 – Prepare
Consultative Group on		International Agricultural Research	the
International Agricultural		(CGIAR): International Agricultural	assignment
Research (CGIAR)		Research Centres (IARC),	on
SO2.2 learned about the		partnership with NARS, role as a	partnership
International Agricultural		partner in the global agricultural	with NARS,
Research Centers (IARC),		research system, strengthening	role as a
SO2.3 Briefing the partnership		capacities at national and regional	partner in the
with NARS, role as a partner in		levels; International fellowships for	global
the global agricultural research		scientific mobility	agricultural
system		2.1 Consultative Group on International	research
SO2.4 Briefing the strengthening		Agricultural Research (CGIAR):	system
capacities at national levels;		International Agricultural Research	
International fellowships for		Centers (IARC)	
scientific mobility		2.2 Partnership with NARS, role as a	
SO2.5 Discuss to the		partner in the global agricultural	
strengthening capacities at		research system.	
regional levels; International		2.3 Strengthening capacities at national	
fellowships for scientific		and regional levels; International	
mobility.		fellowships for scientific mobility.	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system.

b. Mini Project: , c. Other Activities (Specify):

PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory. Approximate Hours

Approximate Hours			
Item	AppX Hrs		
C 1	3		
LI	0		
SW	2		
SL	1		
Total	06		

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self-Learning (SL)
	(LI)		
SO3.1 Identify to the Research		Unit-3	3.1 Prepare the
ethics		Research ethics: research integrity,	assignment on
SO3.2 Discuss to the research		research safety in laboratories, welfare	Research ethic
integrity, research safety in		of animals used in research, computer	and research
laboratories		ethics, standards and problems in	integrity.
SO3.3 Apply the welfare of		research ethics	
animals used in research		3.1- Research ethic and research integrity	
SO3.4 Discuss to computer		3.2- Research safety in laboratories,	
ethics and standards		welfare of animals used in research.	
SO3.5 Describe the problems		3.3- Computer ethics, standards and	
in research ethics		problems in research ethics.	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Research ethic and research integrity

b. Mini Project:

PGS 505 CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development

Approximate Hours

Item	App X Hrs
Cl	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes	Laboratory	Class room Instruction	Self-
(SOs)	Instruction	(CI)	Learning
	(LI)		(SL)
SO1.1 Identify the Concept		Unit-4.0 - I Concept and connotations of	1.1- Prepare
and connotations of rural		rural development, rural development	the
development.		policies and strategies. Rural development	assignment
SO1.2 Apply the rural		programmes: Community Development	on
development policies and		Programme, Intensive Agricultural	Community
strategies		District Programme, Special group – Area	Development
SO1.3 Asses the Rural		Specific Programme, Integrated Rural	Programme.
development programmes:		Development Programme (IRDP)	

Community Development	4.1 Concept and connotations of rural
Programme, Intensive	development, rural development policies and
Agricultural District	strategies
Programme.	4.2 Rural development programmes:
SO1.4 Describes the Special	Community Development Programme,
group – Area Specific	Intensive Agricultural District Programme
Programme.	4.3 Special group – Area Specific
SO1.5 Brief the Integrated	Programme, Integrated Rural Development
Rural Development	Programme (IRDP)
Programme (IRDP)	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Community Development Programme

b. Mini Project: Prepare a project report of leadership styles and influence process; leadership theories, leadership styles and effective leader

c. Other Activities (Specify):

PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Approximate Hours									
Item	AppX Hrs								
Cl	06								
LI	00								
SW	02								
SL	02								
Total	10								

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Indentify Panchayati Raj		Unit-5.0 Panchayati Raj Institutions,	1.1 - Prepare
Institutions and Co-operatives.		Co-operatives, Voluntary	the assignment
SO1.2 Identify the Voluntary		Agencies/Non-Governmental	on Panchayati
Agencies SO1.3- Identify the		Organisations. Critical evaluation of	Raj
Non-Governmental		rural development policies and	Institutions,
Organisations		programmes. Constraints in	
SO1.4 Discuss the , Critical		implementation of rural policies and	
evaluation of rural development		programmes.	
policies		5.1 Panchayati Raj Institutions, Co-	
SO1.5 Briefs the programmes.		operatives, Voluntary Agencies/Non-	
Constraints in implementation		Governmental Organisations	
of rural policies and		5.2 Critical evaluation of rural	
programmes		development policies and programmes	
		5.3 Constraints in implementation of	
		rural policies and programmes	

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Panchayati Raj Institutions,

b. Mini Project:

c. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

	Course Outcomes	Class Lecture	Laborator y Lecture	Sessional Work	Self Learning	Total hour (C l + LI+
		(C l)	(L I)	(SW)	(S I)	SW +S1)
	5.1 Identify the history, levels					
	earch, economic and social	3	0	2	1	06
	through research programme					
	5.2: Apply the functioning,	2	0			0.5
	nd significant of regional,	3	0	2	1	06
	l and international research.					
	5.3: Asses the agricultural	2	0		1	0.6
research	·	3	0	2	1	06
	ng and safety of laboratory.					
	5.4: Analyze the various ment programmes and their					
	ning with its impact on	3	0	2	1	06
	ural development					
	5.5: Evaluate the role and					
	ning of panchayati raj, NGO					
	valuation of different rural	3	0	2	1	06
	oment program.					
	ed Specification Table (For ESA	A)				
СО	Unit title		Ma	arks Distribu	tion	Total
			R	U	Α	Marks
CO-1	Identify the history, levels of r		02	02	00	0.5
	economic and social welfare the	rough	02	03	00	05
CO-2	research programme.	4				
CO-2	Apply the functioning, role and significant of regional, national		02	05	03	10
	international research.		02	05	05	10
CO-3	Asses the agricultural research	, research				
	ethics with operating and safet	y of	00	08	07	15
	laboratory.	-				
CO-4		velopment				
	programmes and their function	oning with	02	05	08	15
	its impact on agricultural devel	•				
CO-5	Evaluate the role and funct	•				
	panchayati raj, NGO and eva	luation of	00	03	02	05
			l l			
	different rural development pro					

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 17. Improved Lecture
- 18. Tutorial

- 19. Group Discussion
- 20. Visit to Industry
- 21. Demonstration
- 22. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Face book, Twitter, Whatsapp, Mobile, Online sources)
- 23. Brainstorming

Suggested Learning Resources:

S.	Title	Author	Publisher	Edition &
No.				Year
01	Indian Agriculture - Four	Bhalla GS & Singh	Sage Publ	2001
	Decades of Development	G.		
02	Manual on International	Punia MS	CCS, Haryana	
	Research and Research Ethics		Agricultural University,	
			Hisar.	
03	Rural Development Strategies	Rao BSV.	Mittal Publ	2007
	and Role of Institutions Issues,			
	Innovations and Initiatives.			
	Rural Development -	Singh K.	Sage Publ	1998.
	Principles, Policies and			
	Management			

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Cos, POs and PSOs Mapping
Course Code: PGS 505
Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Cour	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS	PS
se								01	02	03	04	05	06	07	08	09	01	01
Outc																	0	1
omes																		
	a 1	G 1	701	751	0.1	0.1	<u> </u>	<u>a</u> .	a .	a	a.	a.	4.6	a .	a.	G .	a.	<u> </u>
		Studen		The	Stude	Stud	Stu	Stu	Stu	Stu	Stu	Stu	Aft	Stu	Stu	Stu	Stu	Stu
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		experti			will	will	will	will	t	will	will	will	gai	will	t	t	t	t
	y the	se in	have	will	plan	appl	und	iden	wil	reco	appl	und	nin	reco	will	will	will	will
	curren		expert		about	У.	erst	tify	1	gniz	У	erst	g	gniz	pra	app	app	app
	t	vegeta		-	the	vario	and	diff	pra	e	diff	and	exp	e	ctic	ly	ly	ly
	scenar		nurser		big	us .	abo	eren	ctic	diff	eren	role	eri	diff	e	vari	basi	basi
	io,	produc	•	differ	scale	statis	ut	t .	e	eren	t	of	enc	eren	turf	ous	с	c
	crop	tion	raisin		comm	tical	libr	cool	diff	t,	veg	mic	e,	t	gras	info	con	stat
		technol	U	climat	ercial	meth	ary	seas	ere	und	etab	rocl	the	flo	s,	rma	cep	isti
	ty,	ogies,			projec	ods	tech	on,	nt	erut	le	ima	У	wer	ind	tion	ts	cal
		vegeta	-	condit	t and	to	niq	war	bre	ilize	pro	te	wil	,	oor	ser	in	tool
	с	ble	and	ions	also	anal	ues,	m	edi	d	cess	in	1	orn	pla	vic	lab	S
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	ng	and		veget	trails	resea	ing	erut	S	spic	har	flo	ns	and	capi	writ	que	rese
	techni	. *	vegeta		under	rch	skill	ilize	use	e	vest	wer	of	thei	ng	ing	S	arc
	•	harvest	-	as	veget	work	,	d	d	cro	-	cro	spe	r	ma	S	duri	h
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PGS 505 CO-1 Ident ify the histo ry, level s of resea rch, econ omic and socia 1 welfa re throu gh resea rch progr amm e	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	2	1	2
PGS 505 CO 2: Appl y the	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	2	1	2

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PGS	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	2	1	2
505	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	2	1	2
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Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Agricultural Research, Research Ethics and Rural Development Programmes

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 505 CO-1 Identify the history, levels of research, economic and social welfare through research programme	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 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 (NARS) and Regional Agricultural Research Institutions 1.1, 1.2, 1.3.	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 505 CO 2: Apply the functioning, role and significant of regional, national and international research.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2.0 – Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (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 2.1, 2.2, 2.3.	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3.0 Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics	As mentioned in page number

			3.1, 3.2, 3.3.	
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 505 CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development	SO1.2 SO1.3	Unit-4.0Conceptandconnotationsofruraldevelopment, rural developmentpolicies and strategies. Ruraldevelopmentprogrammes:CommunityDevelopmentProgramme,IntensiveAgricultural District Programme,Special group – Area SpecificProgramme,Integrated RuralDevelopment Programme,Integrated RuralAutorial District Programme,SpecificProgramme,Integrated RuralDevelopment Programme (IRDP)4.1, 4.2, 4.3.	As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	S01.1 S01.2 S01.3 S01.4 S01.5	Unit-5.0PanchayatiRajInstitutions,Co-operatives,VoluntaryAgencies/Non-GovernmentalOrganisations.Criticalevaluationofruraldevelopmentpoliciesprogrammes.Constraintsimplementationofruralpoliciesand programmes5.1, 5.2, 5.3.	As mentioned in page number

Semester- IV

Course Code: GPB 599

Course Title: Research/Thesis

Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Genetics and Plant Breeding.

Rationale: The basic purpose of master's research is to understand the application of research methodology tools to do research on particular topic related to Genetics and Plant Breeding and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

GPB 599 Propose research methodology tools for conducting research on selected topic of Genetics and Plant Breeding field and prepare Final manuscript i.e. Thesis

Scheme of Studies:

Doord of	Course			Sch	eme of	studi	es (Hours/Week)	Total
Board of Study	Course Code	Course Title	CI	LI	SW	SL	Total Study HoursCI+LI+SW+SL	Credits (C)
	GPB 599	Master Research	0	30	0	0	30	(0+15) = 15

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)**SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:**Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

				Progres	Scheme sive Asse		ssment (N PRA)	(larks)		
Boa rd of Stu dy	Cour se Code	Course Title	Class/Home Assignment 5 number3 markseach(CA)	bestout of3)10	Semina rone			Total Marks _{(CA} +CT+SA+ CAT+AT)	ent	Marks(P
	GPB 599	Master 0 Research		0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GPB 599 Propose research methodology tools for conducting research on selected topic of Genetics and Plant Breeding field and prepare Final manuscript i.e. Thesis.

	Approximate Hours
Item	Approximate Hours
CI	0
LI	30
SW	0
SL	30
Total	60

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
 SO1. Choose the topic and objectives for the research. SO2. Select the suitable data during the research. SO3. Assemble the data taken during the research for interpretation. SO4. Arrange the whole work with the interpretate data. SO5. Formulate the hypothesis according the final composition. 	 methods in particular season of crop. 2. Collection of data 3. Analysis and interpretation of data 4. Submission of final thesis based 		 Finding of reviews related with the topic of research. Preparation of manuscripts related to concerned topic.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instructio n (LI)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
GPB 599 Propose research methodology tools for conducting research on selected topic of Genetics and Plant Breeding field and prepare Final manuscript i.e. Thesis		30	30	60
Total		60	60	60

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

- 6. Improved Lecture
- 7. Group Discussion
- 8. Demonstration
- 9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			

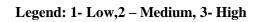
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- 4. Dr. Doomar Singh, HoD, Plant Pathology
- 5. Mr. Ayodhya Prasad Pandey Assistant Professor, Dept. of G&PB, Faculty of Agriculture Science and Technology AKS University.

								Co	urse (Code: ()s Map GPB 59	9						
Course Outco mes	PO 1	PO 2	PO-3	PO-4	PO-5	PO-6	PO 7	Course PS O1	PS O2	: - Res PS O3	earch/ PS O4	<u>Fhesis</u> PS O5	PS O6	PS O7	PS O8	PS O9	PS 01 0	PS 01 1
	0, 1	<u>0. 1</u>		751	0.1	0, 1	<u> </u>	C.	G (<u></u>	<u></u>	<u>a</u>	A. C.	<u></u>	<u></u>	C .	<u></u>	C .
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GPB- 599.1.P repare various researc h activitie s related to concern field and compos e manusc ript i.e., synopsi s related to particul ar topic.	2	2	2	3	2	3	2	3	2	2	1	2	2	1	1	2	2	3
GPB- 599.2. Propose researc h method ology tools for conduct ing	2	2	2	1	3	3	2	1	3	3	2	2	2	1	1	1	2	3

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Course Curriculu	n Map: Master Seminar
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POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB-599.1. Prepare various research activities related to concern field and compose manuscript i.e., synopsis related to particular topic.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	 1.1Submission of research proposal consisting concern programme 1.2 Explain definition of the problems reference to topic 1.3 Explanation of results 1.4 Arrange the references of past work of 10 years 1.5 Collection of data by focusing their objectives and observations to be taken mentioned in their synopsis 		As mentioned in page number
PO 1,2,3,4,5,6,7 PSO 1,2, 3, 4, 5, 6, 7, 8, 9, 10, 11	GPB-599.2. Propose research methodology tools for conducting research on selected topic of vegetable science field of horticulture and prepare Final manuscript i.e., Thesis	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	 1.1 Perform research work as per their topic by using various tools and production technology methods in particular season of crop. 1.2 Collection of data 1.3 Analysis and interpretation of data 1.4 Submission of final thesis based on the research topic 		As mentioned in page number