

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Major Core 5	20P2BMC5	Genetics, Plant Breeding and Evolution	4	5	25	75	100

Nature of Course			
Knowledge and skill	✓		Employability oriented
Skill oriented	✓		Entrepreneurship oriented

Objectives

1. To study the principles and various patterns of inheritance
2. To explain the regions of gene recombination and mutational significance
3. To demonstrate the physical and genetic mapping of chromosomes
4. To understand the conventional and modern plant breeding methods
5. To comprehend the principles and mechanisms of evolution

S.No.	Units	CLO	K Level	Hours
1	Genetics: Mendel's Laws of inheritance. Gene interactions and modified dihybrid ratios (complementary, epistasis, hypostasis, lethal genes). Quantitative inheritance. Sex determination in plants and theories of sex determination. Sex linked inheritance. Sex influenced and sex limited characters. Chromosome theory of inheritance. Multiple alleles and pseudoalleles. Extrachromosomal inheritance. Cytoplasmic male sterility in plants. Population genetics - gene frequencies, mutation, selection, migration and genetic drift.	CLO 1	Up to K4	15
2	Gene concept - Factor concept of Mendel, One gene -One enzyme hypothesis. Benzer's concepts of Cistron, muton and recon. Types and description of gene family (housekeeping genes, transposons overlapping genes, pseudogenes, gene cluster). Gene mutation- Molecular basis of mutation, physical and chemical mutagens and their mode of action. Detection of mutation by CLB and Muller methods – Biochemical mutants in bacteria and <i>Neurospora</i> .	CLO 2	Up to K4	15
3	Bateson's concept of coupling and repulsion. Morgan's concept of linkage, linear arrangement of genes, linkage groups, complete and partial linkage, linkage maps, three point test crosses, interference coefficient of coincidence and negative interference. Recombination in fungi (tetrad analysis in <i>Neurospora</i>) Molecular mechanism of recombination. Molecular markers and construction of linkage maps. Correlation of genetic and physical maps. QTL mapping.	CLO 3	Up to K4	15

4	Plant Breeding: Centers of origin of cultivated plants. Domestication syndrome in cultivated plants. Breeding plants for improving yield, quality and resistance to insect pests and diseases. Plant breeding work in India with special reference to Rice, cotton and Sugar cane. Role of polyploidy in plant improvement. Heterosis breeding with examples. Application of Tissue culture techniques in plant breeding. Role of molecular markers in plant breeding- RAPD, RFLP, VNTR, SSR, and ISSR. Marker assisted selection. Germplasm maintenance of rice and sugarcane. Role of IBPGR, Italy and NBPGR, New Delhi in germplasm conservation.	CLO 4	Up to K4	15
5	Evolution: Darwin concept of variation, adaptation, struggle, fitness and natural selection. Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers, Concept of Oparin and Haldane, Experiment of Miller. The first cell. Origin of prokaryotic and eukaryotic cells. Evolution of unicellular eukaryotes. Concepts of neutral evolution, molecular divergence and molecular clocks – Micro and macro evolution. Concept of Wallace and his contributions.	CLO 5	Up to K4	15

Text Books

- Allard R W (2010). Principles of Plant Breeding (2nd Edn.). John Wiley and Sons, Inc.
- Benjamin A Pierce (2008). Genetics: A conceptual approach (4th Edn). W H Freeman and Company. Company Ltd.
- Brian K H and Benedict H (2014) Evolution (5th Edn). Jones & Bartlett Publishers.
- Daniel L Hartl. (2017). Genetics: Analysis of genes and genomes (8th Edn). Jones and Bartlett publishers.
- David R Hyde (2010). Genetics and molecular biology (1st Edn.). Tata McGraw Hill.
- Gardener, E.J. 8th Ed. Principles of Genetics, Johanwiley, New York.
- Ghahal G S and Gosal S S (2002). Principles and procedures of Plant Breeding. Narosa Publishing House.
- Gupta, P.K. (2007). Genetics. Rastogi Publication, Meerut, India.
- Hartl, .D.L & Jones E. W. 2000.Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
- Maxtoshi Nei, Sudhir Kumar (2000). Molecular Evolution and phylogenetics. Oxford University Press.

Reference Books

- Roderic D M Page, Edward C Holmes (1998). Molecular Evolution: A phylogenetic approach. Blackwell Science Ltd.
- Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers
- Singh B D (2015). *Plant Breeding: Principles and methods*. Kalyani Publications.
- Snustad, D. P. & Simmons M.J. 2003. Principles of Genetics. John Hailey & Sons Inc. U. S.A.
- William S Klug, Michael R Cummings (2018). *Concepts of Genetics* (12th Edn). Pearson Education Pvt. Ltd., Singapore.

Rationale for Nature of the Course

This course will enable the students to know the principles of inheritance, genetic recombination, molecular basis of mutation, chromosome mapping, plant breeding methods and various concepts of evolution.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge acquired by the students will help them to understand the concept of genetics, conduct various plant breeding methods for crop improvement and know the evolutionary mechanisms.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer:

Prof. V. Meenakshi Sundaram, Assistant Professor

Lecture Schedule

Unit	Description	Hours	Mode
1	a) Introducing the genetic terms	1	Chalk and talk PPT, LMS and Group discussion
	b) Mendel's laws of inheritance	2	
	c) Gene interactions and modified dihybrid ratios	3	
	d) Sex linked inheritance	2	
	e) Chromosome theory and Multiple alleles	2	
	f) Extrachromosomal inheritance	2	
	g) Population genetics	3	
2	a) Gene concept	2	Chalk and talk PPT, LMS and Group discussion
	b) Benzers concept of Cistron, muton and recon. Gene components	3	
	c) Mutation – types	2	
	d) Mutation – molecular basis	3	
	e) Mutation – mode of action	3	
	f) Mutation – detection tests	2	
3	a) Linkage – introduction and types	1	Chalk and talk PPT, LMS and Group discussion
	b) Linkage – Batesons concept of coupling and repulsion	2	
	c) Crossing over	2	
	d) Tetrad analysis	2	
	e) Molecular mechanisms of recombination	2	
	f) Linkage maps – genetic and physical	2	
	g) QTL mapping	2	
4	a) Centres of origin of cultivated plants.	2	Chalk and talk PPT, LMS and Group discussion
	b) Breeding for yield and quality	2	
	c) Breeding for diseases resistant.	2	
	d) Plant breeding work in India	2	
	e) Heterosis	2	
	f) Role of molecular markers	3	
	g) Role of plant breeding institutions in germplasm conservation	2	
5	a) Darwin concept	3	Chalk and talk PPT, LMS and Group discussion
	b) Origin of biomolecules	2	
	c) Origin of cell	2	
	d) Evolution of unicellular eukaryotes	2	
	e) Concepts of neutral evolution	1	
	f) Molecular divergence and clock	2	
	g) Micro and macro evolution	1	
	h) Concept of wallace	2	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse and evaluate

CLOs	CLO Statement	Knowledge Level
CLO 1	The inheritance basis of qualitative and quantitative characters in a population and deviation from the common pattern of inheritance	Up to K4
CLO 2	Concept of modern gene concept and the molecular mechanisms of mutation and its respective biochemical responses	Up to K4
CLO 3	The Linkage and crossing over, various methods of chromosome mapping using crossing over and molecular markers	Up to K4
CLO 4	The methods in conventional and modern breeding techniques for crop improvement and conservation of species and genetic diversity	Up to K4
CLO 5	The various concepts of origin of cell and evolution	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2	3	3	1	2
CLO 2	2	3	3	2	2
CLO 3	1	3	3	2	3
CLO 4	1	2	3	2	2
CLO 5	1	2	3	2	3

PG Botany BluePrint

Test	10 marks	As per table below
Assignment	5 marks	K4
Seminar	5 marks	K4
Quiz	5 marks	K4

**Learning Outcome Based Education (LOBE) & Assessment
Formative – Blue Print**

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No. of Questions	K- Level		
1	CLO x	Up to K3	2	K2,K3	2 (K3&K3)	2 (K2,K3)
2	CLO y	Up to K4	3	K2, K2, K3	2 (K4&K4)	1 (K3/K4)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each question			2		5	10
Total Marks for each section			10		10	20

**Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print**

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K-Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%