SACRED HEART COLLEGE (AUTONOMOUS)

Department of BOTANY

MASTER OF SCIENCE IN BOTANY

Course plan

Academic Year 2015 – 16

Semester III

COURSE PLAN
TAXONOMY OF ANGIOSPERMS

Course Objectives:

1. students would have a basic knowledge in Angiosperm Taxonomy
2. students would be able to identify the economically important crops and their scientific names
3. Students can identify the common angiosperm species of Kerala.
4. Students would able to prepare standard herbarium

References:

1. Hooker J D. (1875-1897)The flora of British India (Vol. I – VII).
2. Gamble J S (1915-1935). Flora of the Presidency of Madras. (Vol. I – III).
3. Heywood V H, Moore D M (Eds) (1984). Current concepts in Plant taxonomy.
4. Sivarajan V V (1991). Introduction to Principles of Plant Taxonomy. Oxford IBH.
5. Singh G (2102). Plant Systematics Theory and Practice (3rd Edn). Oxford & IBH Publishing Co. New Delhi.
6. Battacharya B (2009). Systematic Botany (2nd Edn). Narosa Publishing House.
7. Lawrence H M G (1951). Taxonomy of Vascular Plants. The Macmillan Company. US.
8. Sasidharan N (2012). Flowering Plants of Kerala. KFRI.

Sl. No.	Session	Topic/Module	Method of teaching	Remarks
1	1	Linnaeus System	PPT / Lecture	
2	2	Bentham &Hooker's System	PPT / Lecture	
3	3	De Candolle's System	PPT / Lecture	
4	4	Engler & Prantl System	PPT / Lecture	
5	5	Bessey's System	PPT / Lecture	
6	6	Takhtajan's System	PPT / Lecture	
7	7	APG System	PPT / Lecture	
8	8	Functions of field study	PPT / Lecture	
9	9	Botanical gardens and BSI	PPT / Lecture	
10	10	Taxonomic literature- Floras, Monographs, Journals	PPT / Lecture	
11	11	GIS	PPT / Lecture	
12	12	Construction of taxonomic keys-Indented	PPT / Lecture	
13	13	Construction of taxonomic keys-Brackted	PPT / Lecture	
14	14	Rununculaceae, Magnoliaceae	PPT / Lecture	
15	15	Menispermaceae, Brassicaceae	PPT / Lecture	
16	16	Capparidaceae, Polygalaceae	PPT / Lecture	
17	17	Caryophyllaceae, Guttiferae	PPT / Lecture	
18	18	Dipteriocarpaceae, Tiliaceae	PPT / Lecture	

19	19	Geraniaceae, Rutaceae	PPT / Lecture	
20	20	Vitaceae, Sapindaceae	PPT / Lecture	
21	21	Fabaceae, Caesalpiniaceae	PPT / Lecture	
22	22	Mimosaceae, Rosaceae	PPT / Lecture	
23	23	Lythraceae, Melastomaceae	PPT / Lecture	
24	24	Rhizophoraceae, Combretaceae	PPT / Lecture	
25	25	Myrtaceae, Cucurbitaceae	PPT / Lecture	
26	26	Apiaceae, Aizoaceae	PPT / Lecture	
27	27	Asteraceae, Campanulaceae	PPT / Lecture	
28	28	Myrsinaceae, Loganiaceae	PPT / Lecture	
29	29	Oleaceae, Apocynaceae	PPT / Lecture	
30	30	Asclepiadaceae, Boraginaceae	PPT / Lecture	
31	31	Scrophulariaceae, Bignoniaceae	PPT / Lecture	
32	32	Acanthaceae, Verbenaceae	PPT / Lecture	
33	33	Lamiaceae, Polygonaceae	PPT / Lecture	
34	34	Aristolochiaceae, Piperaceae	PPT / Lecture	
35	35	Lauraceae, Loranthaceae	PPT / Lecture	
36	36	Euphorbiaceae, Moraceae	PPT / Lecture	
37	37	Urticaceae, Orchidaceae	PPT / Lecture	
38	38	Cannaceae, Dioscoriaceae	PPT / Lecture	
39	39	Liliaceae, Zingiberaceae	PPT / Lecture	
40	40	Musaceae, Araceae	PPT / Lecture	
41	41	Cyperaceae, Poaceae	PPT / Lecture	
42	42	Evolution and diversity of woody and seed plants	PPT / Lecture	
43	43	Scope and importance of ethnobotany, sources and methods of ethnobotanical studies	PPT / Lecture	
44	44	Two typical ethno botanical studies from Kerala	PPT / Lecture	
45	45	Bioprospecting, Patenting and Marketing of Plants of Ethnobotanical importance	PPT / Lecture	
46	46	Utility indices of ethnobotanical products	PPT / Lecture	
47	47	Rununculaceae, Magnoliaceae	Practical lab	
48	48	Menispermaceae, Brassicaceae	Practical lab	
49	49	Capparidaceae, Polygalaceae	Practical lab	
50	50	Caryophyllaceae, Guttiferae	Practical lab	
51	51	Dipteriocarpaceae, Tiliaceae	Practical lab	
52	52	Geraniaceae, Rutaceae	Practical lab	
53	53	Vitaceae, Sapindaceae	Practical lab	
54	54	Fabaceae, Caesalpiniaceae	Practical lab	

55	55	Mimosaceae, Rosaceae	Practical lab	
56	56	Lythraceae, Melastomaceae	Practical lab	
57	57	Rhizophoraceae, Combretaceae	Practical lab	
58	58	Myrtaceae, Cucurbitaceae	Practical lab	
59	59	Apiaceae, Aizoaceae	Practical lab	
60	60	Asteraceae, Campanulaceae	Practical lab	
61	61	Myrsinaceae, Loganiaceae	Practical lab	
62	62	Oleaceae, Apocynaceae	Practical lab	
63	63	Asclepiadaceae, Boraginaceae	Practical lab	
64	64	Scrophulariaceae, Bignoniaceae	Practical lab	
65	65	Acanthaceae, Verbenaceae	Practical lab	
66	66	Lamiaceae, Polygonaceae	Practical lab	
67	67	Aristolochiaceae, Piperaceae	Practical lab	
68	68	Lauraceae, Loranthaceae	Practical lab	
69	69	Euphorbiaceae, Moraceae	Practical lab	
70	70	Urticaceae, Orchidaceae	Practical lab	
71	71	Cannaceae, Dioscoriaceae	Practical lab	
72	72	Liliaceae, Zingiberaceae	Practical lab	
73	73	Musaceae, Araceae	Practical lab	
74	74	Cyperaceae, Poaceae	Practical lab	

COURSE PLAN

GYMNOSPERMS, EVOLUTION & PALEOBOTANY

.

Basic Reference

1 Andrews H N Jr (1961). *Studies in Palaeobotany*. John Wiley and sons.

2. Arnold C A (1947). *An introduction to Palaeobotany*. John Wiley and sons.
3. Beck C E (1995). *Gymnosperm Phylogeny*. Bot. Rev. 51-176.
4. Bhatnagar S P, Moitra A (2000). *Gymnosperms*. New Age International Ltd.
5. Chamberlain C J (1935). *Gymnosperms: Structure and Evolution*. University of Chicago Press.
6. Monroe W Strickberger (1990). *Evolution*. Jones and Bartlett publishers.
7. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
8. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.
9. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.

1.	**Date**	**Topic**	**Method**	**Remarks**
1	Session 1	Origin, general characteristics, distribution and classification of Gymnosperms (K R Sporne and C J Chamberlain). Distribution of living gymnosperms in India. DNA barcoding of gymnosperms.	Presentation/Chalk and Board	
2.	Session 2			
3	Session 3	Detailed study of the vegetative morphology, internal structure, reproductive structures, and evolution of the orders and families (with reference to the genera mentioned). (a) Class Progymnospermopsida: Aneurophyton (b) Class Cycadopsida: Heterangium, Lyginopteris,	Presentation/Chalk and Board/Assignment	
4	Session 4			
5	Session 5			
6	Session 6			
7	Session 7			
8	Session 8			
9	Session 9			
10	Session 10			
11	Session 11			
12	Session 12			

13	Session 13	Lagenostoma, Glossopteris, Medullosa, Caytonia. Bennettites, Williamsoniella, Nilsonia, Cycas, Zamia, Pentoxylon. (c) Class Coniferopsida: General account of families under Coniferales, range of form and structure of stem, leaves; range of form, structure and evolution of female cones in coniferales such as Pinus, Taxodium, Cupressus, Podocarpus, Agathis, Araucaria, Taxus and Ginkgo. (d) Class Gnetopsida: Gnetum.		
14	Session 14			
15	Session 15			
16	Session 16			
17	Session 17			
18	Session 18			
19	Session 19	(a) General account on the male and female gametophyte development in Gymnosperms (Cycas). (b) Economic importance of Gymnosperms	Presentation/Chalk and Board	
20	Session 20			
21	Session 21			
22	Session 22	Abiogenesis, Biogenesis experiment of Miller (1953). Theory of Organic evolution - Biochemical origin of life, place and time of origin and experimental evidences. Concept of Oparin and Haldane.	Presentation/Chalk and Board	
23	Session 23			
24	Session 24			
25	Session 25			
26	Session 26	History of Character Evolution, Patterns of Evolutionary change explained from systematics, Phylogeny and patterns of Evolution, Adaptive radiation, Patterns in genes and genomes	Presentation/Chalk and Board/Assignment	
27	Session 27			
28	Session 28			
29	Session 29			

30	Session 30	Biodiversity, Genetic variation, phenotypic variation, evolution of life histories, Macro evolution; evolution above the species level. Sex and Reproductive success; Paradox of sex, Inbreeding and outcrossing, Concept of sexual selection, sexual selection by mate choice.	Presentation/Chalk and Board	
31	Session 31			
32	Session 32			
33	Session 33			
34	Session 34	Genetic drift - Salient features; species concept; sub-species, sibling species, semi species, demes. Types of speciation - Phyletic speciation and True speciation. Mechanism of speciation - Genetic divergences and isolating mechanisms. Patterns of speciation - allopatric, sympatric, quantum and parapatric speciation.	Presentation/Chalk and Board	
35	Session 35			
36	Session 36			
37	Session 37			
38	Session 38	Natural selection and adaptation; nature of Natural Selection, examples of NS, levels of selection, nature of adaptations, The Genetical theory of natural selection; Fitness, models of selection, polymorphism maintained by balancing selection, multiple outcomes of evolutionary change, the strength of NS, molecular signatures of NS.	Presentation/Chalk and Board	
39	Session 39			
40	Session 40			
41	Session 41	Modern synthetic theory of evolution, molecular evolution, concepts of natural evolution, molecular divergence and molecular clocks; molecular tools in phylogeny.	Presentation/Chalk and Board	
42	Session 42			
43	Session 43			
44	Session 44			
45	Session 45	Techniques in Palaeontology - mega fossils - microfossils -	Presentation/Chalk and Board	Laboratory

46	Session 46	nannofossils - ichnofossils - collection, reformation & illustration - binomial nomenclature. Plant fossils – Preservation, preparation, age determination		
47	Session 47	Palaeobotany: *Lyginopteris, Pentoxylon, Lagenostroma, Cordaites, Cardiocarpus, Calamites, Sphenophyllum, Calamostachys* and *Glossopteris.*	Presentation/Chalk and Board	
48	Session 48			
49	Session 49			
50	Session 50	Fossil record – systematic, reconstruction and nomenclature; Applied aspects of paleobotany	Presentation/Chalk and Board	
51	Session 51			
52	Session 52			
PRACTICALS				
53	Session 53	Study of the morphology and anatomy of vegetative and reproductive parts of Cycas, Zamia, Pinus, Cupressus, Agathis, Araucaria and Gnetum. 2. Study of fossil gymnosperms through specimens and permanent slides. 3.Conduct field trips to familiarise various gymnosperms in nature and field identification of Indian gymnosperms and submit a report.	Laboratory	Laboratory
54	Session 54			
55	Session 55			
56	Session 56			
57	Session 57			
58	Session 58			
59	Session 59			
60	Session 60			
	Session 60	Study of fossil plants based on permanent slides and photographs	Laboratory	
	Session 62			
	Session 63 – 72	Revision		

COURSE PLAN

PLANT PHYSIOLOGY AND METABOLISM

Basic Reference

1. Lincoln Taiz, Eduardo Zeiger (2002). *Plant physiology* (II Edn). Sinaeur Associates, Inc. Publishers.
2. Bob B Buchanan, Wilhelm Gruissem, Russel L Jones (2000). *Biochemistry and molecular biology of plants*. L K International Pvt. Ltd. , New Delhi
3. Reginald H Garrett, Charles M Grisham (2005). *Biochemistry*. Thomson Brooks/Cole
4. Robert Horton H, Laurence A Moran, Raymond S Ochr, J David Rawn, K Gray Scrimgeour (2002). *Principles of Biochemistry* (III Edn). Prentice Hall , New Jersey.
5. Frank B Salisbury, Cleon W Ross (1992). *Plant Physiology* (IV Edn). Wadsworth Publishing Company. , New York
6. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter (2002). *Molecular biology of the cell* (IV Edn). Garland Science, Taylor and Francis group.
7. Gerald Karp (2008). *Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons.
8. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher,
Hidde Ploegh, Paul Matsudaira (2007). *Molecular cell biology* (VI Edn). W H Freeman & Company.
9. William H Elliott, Daphne C Elliott (2001). *Biochemistry and molecular biology* (II Edn). Oxford
10. Jeremy M Berg, John L Tymoczko, Lubert Stryer, Gregory J Gatto Jr. (2007). *Biochemistry*. W H Freeman and company. , London.

1.	**Date**	**Topic**	**Method**	**Remarks**
1	Session 1	(a) Cell wall and membrane properties in relation with water- Turgor Pressure and Hydraulic conductivicty. Aquaporins. Plant water status and Physiological processes.	Presentation/Chalk and Board/Assignment	
2.	Session 2			
3	Session 3			
4	Session 4	Bulk flow of water. Water absorption by roots- pathways, root pressure and guttation. Water transport through xylem - pressure driven bulk flow. Water movement from the leaf to the atmosphere – hydraulic resistance, driving force of transpiration, pathway resistances. Leaf anatomy for regulating transpiration. Control of stomatal mechanism. Theories of stomatal movement. Soil-plant-atmosphere continuum.	Assignment Presentation/Chalk and Board	
5	Session 5			
6	Session 6			
7	Session 7			

8	Session 8	Classification of mineral nutrients based on biological function. Soil characters influencing nutrient availability – size and charge of soil particles, soil pH. Role of Mycorrhizae in nutrient uptake. Theories of mineral salt absorption.	Presentation/Chalk and Board	
9	Session 9			
10	Session 10			
11	Session 11	Electrical properties of membranes, Membrane potential. Transport across cell membranes: Passive – diffusion, facilitated diffusion, membrane channels; gap junctions, porins, ion channels – gated channels, structure and working of K+ ion channels. Active transport: Carrier proteins; Na+K+ pump, ABC transporters, Inophones, Symport, Antiport.	Presentation/Chalk and Board	
12	Session 12			
13	Session 13			
14	Session 14			
15	Session 15			
16	Session 16	Basic principles of light absorption, excitation energy transfer, mechanism of electron transport. Light harvesting complexes: PS I, PSII; Structure and composition of reaction centers, photooxidation of water, organization of light-absorbing antenna systems, mechanism of chloroplast electron transport- complexes, Proton transport and ATP syntesis. Repair and Regulation of Photosynthetic Machinery- Photoprotection, Photoinhibition.	Presentation/Chalk and Board	
17	Session 17			
18	Session 18			
19	Session 19			
20	Session 20			
21	Session 21	Structure and function of RuBisco.CO2 fixation-Regulation of Calvin cycle. Photorespiration, role of photorespiration in plants.CO2 concentrating mechanisms - C4 cycle, CAM pathway.Synthesis and mobilization of chloroplast starch, starch degradation, Regulation of synthesis and degradation. Biosynthesis of sucrose and signalling.	Presentation/Chalk and Board	
22	Session 22			
23	Session 23		Presentation/Chalk and Board	
24	Session 24			

25	Session 25	Materials translocated in the phloem- Sucrose and other materials. Mechanism of phloem translocation - Pressure flow model of phloem transport. Phloem loading and unloading. Photosynthate allocation and partitioning.	Assignment	
26	Session 26			
27	Session 27	(a) Three stages of respiratory metabolism. (brief study only).. Gluconeogenesis. Pentose phosphate pathway and its regularion. (b) Mitochondrial electron transport and ATP synthesis – structure of electron transfer complexes (complex I – IV). ATPase - detailed structure of F1 and F0 subunits, Chemiosmotic hypothesis, binding change mechanism of ATP synthesis.	Presentation/Chalk and Board/Assignment	
28	Session 28			
29	Session 29			
30	Session 30			
31	Session 31	Comparison of mitochondrial and chloroplast ATP synthesis. Mechanisms that lower ATP yield- alternative oxidase, Uncoupling proteins, Rotenone-Insensitive NADH dehydrogenase. Lipid metabolism: glyoxylate cycle.	Presentation/Chalk and Board	
32	Session 32			
33	Session 33			
34	Session 34			
35	Session 35			
36	Session 36	N cycle. Nitrate assimilation- nitrogen reductase. Ammonium assimilation, Aminoacid biosynthesis, Biological Nitrogen fixation - free living and symbiotic. Symbiotic N fixation – nodule formation, leghaemoglobin. Process of N fixation and structure of nitrogenase enzyme complex. Transport of amides and ureides.	Presentation/Chalk and Board	
37	Session 37			
38	Session 38			
39	Session 39			
40	Session 40			
41	Session 41			
42	Session 42			
43	Session 43	Response of plants to biotic (pathogen and insects) and abiotic (water, temperature – low and high, salt, oxygen deficiency, heavy metal and air pollution) stresses. Mechanisms of resistance to biotic stress and tolerance to abiotic stress.	Presentation/Chalk and Board	
44	Session 44			
45	Session 45			
46	Session 46			
47	Session 47			
48	Session 48			

49	Session 49	Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins. Responses to UV radiation. Photoperiodism and biological clocks – circadian rhythms. Vernalization. Floral induction and development.	Presentation/Chalk and Board	
50	Session 50			
51	Session 51			
52	Session 52	Biosynthesis, storage, breakdown, transport, physiological effects, and mechanism of action of plant growth hormones; Auxin, Cytokinin, Gibberellins, Abscisic acid, Brassinosteroids. Elicitors.	Presentation/Chalk and Board	
53	Session 53			
54	Session 54			
55	Session 55			
56	Session 56	1. Preparation of Molal, Molar and Percentage solutions. 2. Estimation of proline in plant tissues under various abiotic stresses. 3. Estimation of phenol in plant tissues affected by biotic stress. 4. Determination of peroxidase activity in plant tissues affected by biotic/abiotic stresses. 5. Estimation of free amino acids in senescing leaves to understand the source to sink transformation phenomenon. 6. Determination of osmotic potential by tissue weight method. 7. Separation of photosynthetic pigments by TLC/paper chromatography and calculating the Rf value. 8. Demonstration of amylase activity and GA effect in germinating cereal seeds. 9. Estimation of pigment composition of a leaf. 10. Separation and collection of leaf pigments by silica gel column chromatography. 11. Determination of nitrate reductase activity. 12. Extraction and estimation of leghaemoglobin from root nodules.	Laboratory/Demonstration	
57	Session 57			
58	Session 58			
59	Session 59			
60	Session 60			
61	Session 61			
62	Session 62			
63	Session 63			
64	Session 64			
65	Session 65			
66	Session 66 – 72	Revision		

COURSE PLAN

PLANT REPRODUCTIVE BIOLOGY, PALYNOLOGY AND PLANT BREEDING

.

Basic Reference

1. Scott F Gilbert (2000). Developmental Bilogy(IX Edn). Sinauer Associates. (available online).
2. TwymanR M (2001). Instant notes in Developmental Biology. Viva Books Private Limited.
3. Lincoln Taiz, Eduardo Zeiger (2002). Plant physiology (II Edn). Sinaeur Associates, Inc. Publishers.
4. Robert J Brooker (2009). Genetics: analysis & principles (III Edn.). McGraw Hill
5. Bob B Buchanan, Wilhelm Gruissem, Russel L Jones (2000). Biochemistry and Molecular biology of Plants. L K International Pvt. Ltd.
6. Faegri, K., and Iversen, J. (1989 (also reprinted in 2000)). Textbook of Pollen Analysis, 4th Edn. Blackburn Press, Caldwell, NJ
7. Kapp R O, Davis O K, & King J E (2000). Guide to Pollen and Spores. (2nd Edn, 3rd printing). AASP Press, Dallas.
8. Allard R W (1995). Principles of Plant Breeding. John Wiley and Sons, Inc.
9. Ghahal G S and Gosal S S (2002). Principles and procedures of Plant Breeding. Narosa Publishing House.
10. Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd.
11. Singh B D (1996). Plant Breeding: Principles and methods. Kalyani Publications

1.	**Date**	**Topic**	**Method**	**Remarks/Reference**
1	Session 1	An overview of plant and animal development, Potency, Commitment, Specification, Induction, Competence.	Presentation/Chalk and Board	
2.	Session 2	Applications of reproductive biology (research, agriculture, Industry, Forensic & Horticulture).	Presentation/Chalk and Board	
3	Session 3		Presentation/Chalk and Board/Assignment	
4	Session 4			

5	Session 5	Sexuality of flowers and plants. Pollination agents and floral adaptations. Pollination syndromes; study of common pollinators from each syndromes. Breeding systems in plants, Types of pollen; wet and dry, types of stigma; wet and dry types (along with significance of each types)		
6	Session 6	Pollen pistil interactions; pollen on stigma, pollen tube trough style, pollen tube entry to the ovule. Fertilization: Double fertilization; Embryogenesis - different types, Origins of polarity, factors influencing embryogenesis.	Presentation/Chalk and Board/Assignment	
7	Session 7			
8	Session 8			
9	Session 9			
10	Session 10			
11	Session 11	Endosperm-development and function, types of endosperm, endosperm haustoria. Apomixis and Polyembryony and their applications in agri-horticulture	Presentation/Chalk and Board	
12	Session 12			
13	Session 13			
14	Session 14	Breeding system: Outbreeding devises and their efficacy	Presentation/Chalk and Board	
15	Session 15			
16	Session 16			

		Self-incompatibility: Genetic basis of SI. Gametophytic and sporophytic SI Physiology and Biochemistry of incompatibility. Biological significance of incompatibility. Methods to overcome SI and interspecific incompatibility.		
17	Session 17	Seed development, Classification of Seeds, Importance of seeds, Seed dispersal; significance, agents and ecology of dispersal, Seed dormancy, Methods of breaking seed dormancy,soil seed banks, seed germination. Millennium seed project Jack Heslop-Harrison, W A Jenson & P. Maheswari, K.R. Shivanna	Presentation/Chalk and Board	
18	Session 18			
19	Session 19			
20	Session 20			
21	Session 21			
22	Session 22			
23	Session 23			
24	Session 24			
25	Session 25			
26	Session 26	Introduction to pollen analysis, :History and scope of palynology, Terminologies used in spore and pollen description, forensic palynology, paleopalynology	Presentation/Chalk and Board/Assignment	
27	Session 27			
28	Session 28	Development of pollen grains, Pollen morphology- Shape and size, apertures types and ornamentation in pollination ecology, Special ornamentation features- bladders, viscin threads, spines, lipids	Presentation/Chalk and Board	
29	Session 29			
30	Session 30			

31	Session 31	The pollen wall - Pollen wall development and formation, Pollen wall structure, Surface ornamentation and its importance. Pollen wall chemical composition and its relationship to pollen preservation. Pollen apertures - Inaperturate grain, simple and compound, Types, function and arrangement. Role and use in pollen identification may come under pollen morphology	Presentation/Chalk and Board	
32	Session 32			
33	Session 33			
34	Session 34	Laboratory techniques: Methods to find pollen in sediments, forensic samples, honey, rocks, archaeological sites and shipwrecks, etc., Production and Dispersal of pollen grains, where pollen is deposited. Purpose of Pollen collection and storage. Pollenviability- factors that affect pollen viability. Viability Test: - Germination assay, in vitro, in vivo. Non Germination assay FCR Test, FDA test (both are same).,Acetocarmine test for assessing sterility. R values and pollen coefficients (correcting for over and under production and dispersal of pollen). Factors affecting pollen deposition.	Presentation/Chalk and Board	
35	Session 35			
36	Session 36			
37	Session 37			
38	Session 38	Palynology and Systematics, Pollen sampling and data gathering (how many samples to be collected and what to collect) Modern pollen rain sampling and collecting important floral data,	Presentation/Chalk and Board	
39	Session 39			
40	Session 40			

		Stratigraphic sampling of geologic terrestrial deposits (i.e., natural vs. artificial levels), Sampling lake and underwater archaeological deposits, Terrestrial archaeological site sampling, Forensic samples, Entomo-palynological samplingMelisso-palynology sampling, The statistical validity of using multiple vs. single samples from given locations, Tools and methods used for pollen sampling. Sampling of deposits for pollen; Uses of pollen in pharmaceuticals,Nutrition and in Cosmetics. Pollen allergy.		
41	Session 41	Objectives of plant breeding, important achievements and future prospects. Genetic variability and its role in plant breeding. Domestication and centers of origin of cultivated plants.	Presentation/Chalk and Board	
42	Session 42			
43	Session 43			
44	Session 44	Reproductive systems and pollination control mechanisms; Sexual reproduction - Cross and self-pollination; asexual reproduction, Incompatibility and Male sterility, their types.	Presentation/Chalk and Board	
45	Session 45			
46	Session 46			
47	Session 47	Hybridization - role and methods, Inter-varietal, inter specific and inter generic crosses. Back-cross breeding. Heterosis, Inbreeding depression.	Presentation/Chalk and Board	
48	Session 48			
49	Session 49			
50	Session 50			

51	Session 51	Breeding for biotic (disease) and abiotic (drought) stresses; loss due to diseases, disease development, disease escape, disease resistance, vertical and horizontal resistances of biotic stress; methods of breeding for disease resistance.	Presentation/Chalk and Board	
52	Session 52			
53	Session 53	Mutagens and crop improvement. Spontaneous and induced mutations, effects of mutation. Physical and chemical mutagens; principles and working of Gamma gardens, methods of mutation breeding, mutations in oligogenic traits, mutations in polygenic traits, limitations of mutation breeding, achievements of mutation breeding. Role of mutations in Plant Breeding.	Presentation/Chalk and Board	
54	Session 54			
55	Session 55			
56	Session 56			
57	Session 57	Modern trends in plant breeding; Modern agricultural techniques and practices like poly house farming, hydroponics, aquaponics and precision farming.	Presentation/Chalk and Board	
58	Session 58			
PRACTICALS				
59	Session 59	1. Embryo excision from young seeds. 2. Pollen germination study. 3. Breeding system experiments; Apomixes, Autogamy, Geitonogamy and Xenogamy. 4. Collection of data on pollination under openfield conditions and (correlate the	Laboratory	
60	Session 60			
61	Session 60			
62	Session 62			
63	Session 63			

		same with geitonogamy or xenogamy?). 5. Perform the pollen sterilitytest by Acetocarmine and viability test by in vitro germination (Impatiens, Crotolaria, Cucurbits etc.) 6. Identification of different types of embryos, polyembryony, endosperm types, types of pollen grains, anther growth stages and types using permanent slides. 7. Tests for breaking dormancy in different seeds.		
64	Session 64	1. Morphology of Pollen grains. 2. Make a key based on external characters of pollen grains of a family or genus of known plants. 3. Hybridization techniques in self and cross pollinated plants 4. Visit a plant breeding station to familiarize with breeding programmes. Submit a report of the visit.	Laboratory	
65	Session 65			
66	Session 66			
67	Session 67			
68	Session 68 – 72	Revision		