SACRED HEART COLLEGE (AUTONOMOUS)

Department of Botany

MASTER IN SCIENCE

Course plan
Academic Year 2018-19
Semester 2

COURSE PLAN (OBE) FOR MSc -SEMESTER 1

PROGRAMME	**M. SC. BOTANY**	SEMESTER	1
COURSE CODE AND TITLE	**BRYOLOGY AND PTERIDOLOGY (16P1BOTT05)**	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	(THEORY 36 + 36 HRS; PRACTICAL 18 + 36 HRS)
FACULTY NAME	**LESLY AUGUSTINE**		

PROGRAMME OUTCOMES

PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and knowhow to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO 5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

PROGRAM SPECIFIC OUTCOMES

PSO 1	Encourage a clear, comprehensive and advanced mastery in the field of Botany.
PSO 2	Comprehend the basic principles of biological sciences with special reference to Botany and its applied branches.
PSO 3	Develop skills in students to explore the intricacies of life forms at cellular, molecular and nano level.
PSO 4	Fuel students' motivation and enthusiasm and to help them not only to appreciate the beauty of different life forms but also to inspire them in the dissemination of the concept of biodiversity conservation.

PSO 5	Develop problem solving skills in students and encourage them to carry out innovative research projects thereby enkindling in them the spirit of knowledge creation.

	COURSE OUTCOMES	PO/ PSO	CL
CO 1	Define the diversity of primitive land plants.	PO1, PO2, PO6, PSO2, PSO3	U
CO 2	Explain the morphological and anatomical features of Bryophytes and Pteridophytes.	PO1, PSO2, PSO3	A
CO 3	Evaluate the main characteristics of Bryophytes and Pteridophytes.	PO1, PO2, PSO1	U
CO 4	Examine the development of land adaptations in the Bryophytes and Pteridophytes.	PO1, PO2, PSO1, PSO2,PSO4	An
CO 5	Analyze various lifecycle events in Bbryophyte and Pteridophytes.	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	U
CO 6	Define the evolutionary trends primitive plant groups.	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	An
CO 7	Develop capacity to identify various Bryophytes and Pteridophytes in their habitats.	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	E

CL* Cognitive Level

BRYOLOGY (Theory 36 hrs; Practical 18 hrs)

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
Introduction to Course				
	(a) General characters, Classification, evolution of bryophytes	PPT/Lecture	Seminar	CO 1
	(b) Morphology, anatomy and reproduction of Riccia, Marchantia & Anthoceros	PPT/Lecture	Seminar	CO 1
	(c) Importance of bryophytes	PPT/Lecture	Seminar	CO 1
MODULE I; General introduction (5 hrs)				
1	Introduction to bryophytes, their fossil history and evolution.	PPT/Lecture		CO 1

2	Concept of algal and pteridophytic originof bryophytes. General characters of bryophytes.	PPT/Lecture		CO 1
3	History of classification of bryophytes. Modern trends in classification of bryophytes.	PPT/Lecture		CO 1
4	DNA barcoding of bryophytes.	PPT/Lecture		CO 1
5	Systematic way of collection, preservation and identification of bryophytes with special reference to mosses. Conservation biology of bryophytes.	PPT/Lecture	Article reading	CO 1
MODULE II, Ecology and Economic importance of bryophytes (5 hrs)				
6	Bryophyte habitats.	PPT/Lecture		CO 1
7	Water relations - absorption and conduction, xerophytic adaptations	PPT/Lecture	video	CO 2
8	Water relations – drought tolerance, desiccation and rehydration, ectohydric, endohydric and myxohydric bryophytes	PPT/Lecture		CO 2
9	Ecological significance of bryophytes - role as pollution indicators.	PPT/Lecture	video	CO 2
10	Economic importance of bryophytes; i) Sphagnum as 'Peat Moss'ii) Medicinal Usesiii) as source of foodiv) as pollution indicators v) in experimental studies vi) Horticultural uses.	PPT/Lecture	video	CO 2
Module 3: Thallus structure (26 hrs)				
11	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
12	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2

13	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
14	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
15	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
16	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
17	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal	PPT/Lecture		CO 2

	mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).			
18	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).	PPT/Lecture		CO 2
19	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture	video	CO 2
20	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture	video	CO 2
21	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture		CO 2

22	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture	video	CO 2
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23	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture		
24	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture		CO 2
25	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture		CO 2

26	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (b) Anthocerotopsida (Anthocerotales).	PPT/Lecture		
27	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2
28	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO2
29	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2

30	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales , and Bryales).	PPT/Lecture		CO 2
31	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2
32	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2
33	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 3

34	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	video	CO 3
35	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	videos	CO 3
36	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of the following groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	video	CO 4
Practical 18 hrs				
Detailed study of the structure of gametophytes and sporophytes of the following genera of bryophytes by suitable micro preparation:				
38	Riccia	Hands-on Session	video	CO 4
39	Targionia	Hands-on Session	video	CO 4
40	Cyathodium	Hands-on Session	video	CO 4

41	Marchantia	Hands-on Session	video	CO 4
42	Lunularia	Hands-on Session	video	CO 4
43	Dumortiera	Hands-on Session	video	CO 4
44	Reboulia	Hands-on Session	video	CO 4
45	Pallavicinia	Hands-on Session	video	CO 4
46	Fossombronia	Hands-on Session	video	CO 4
47	Porella	Hands-on Session	video	CO 4
48	Anthoceros	Hands-on Session	video	CO 4
49	Sphagnum	Hands-on Session	video	CO 4
50	Pogonatum	Hands-on Session	video	CO 4
51	Bryum	Hands-on Session	video	CO 4
52	Fissidens	Hands-on Session		CO 4
53	Hyophila	Hands-on Session		CO 4
54	Students are expected to submit 5 bryophyte specimen's herbarium and also a report of field trip to bryophyte's natural habitats to familiarize with the diversity of bryophytes.	Experiential learning		CO 4

References

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3. Chopra R S, S S Kumar (1981). Mosses of Western Himalayas and adjacent plains. Chronica Botanica.

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15. Srivastava S N (1992). Bryophyta. Pradeep Publications.

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17. Nair M C, Rajesh K P, Madhusoodanan P V (2005). Bryophytes of Wayanad in Western Ghats. Malabar Natural History Society.

PTERIDOLOGY (Theory 36 hrs; Practical 36 hrs)

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
Introduction to Course				
	Introduction to the Course	PPT/Lecture	video	CO 1
	(a) Introduction, general characters, classification and evolution of pteridophytes	PPT/Lecture	Seminar/ videos	CO 1
	(b) Structural organization of sporophyte and gametophyte of pteridophytes with special reference to stellar structure, heterospory and seed habit.	PPT/Lecture	Seminar/ videos	CO 1
Module 1: General introduction and classification (4 hrs)				
1	Introduction, origin, general characteristics	PPT/Lecture	vedio	CO 1
2	History of the classification of pteridophytes.	PPT/Lecture	vedio	CO 1
3	Brief account on Smith's classification (2006).	PPT/Lecture		CO 1
4	DNA barcoding of pteridophytes.	PPT/Lecture		CO 1
Module 2: Structure of the plant body (26 hrs)				
Distribution, habitat, range, external and internal morphology of sporophytes, spores, mechanism of spore dispersal, gametophytic generation, sexuality, embryogeny of the following classes of Pteridophytes with reference to the genera mentioned (development of sex organs is not necessary):				
5	(a) Psilopsida (i) Rhyniales; Rhynia	PPT/Lecture		CO 2
6	(b) Psilotopsida (i) Psilotales; Psilotum	PPT/Lecture		CO 2
7	(b) Psilotopsida (i) Psilotales; Psilotum	PPT/Lecture		CO 2
8	(c) Lycopsida (i) Protolepidodendrales; Protolepidodendron	PPT/Lecture		CO 2
9	(ii) Lycopodiales; Lycopodium	PPT/Lecture		CO 2
10	(ii) Lycopodiales; Lycopodium	PPT/Lecture		CO 2
11	(iii) Isoetales; Isoetes	PPT/Lecture		CO 2
12	(iii) Isoetales; Isoetes	PPT/Lecture		CO 2
13	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2
14	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2
15	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2

16	(d) Sphenopsida (i) Hyeniales (ii) Sphenophyllales; Sphenophyllum	PPT/Lecture		
17	(iii) Calamitales; Calamites	PPT/Lecture		CO 2
18	(iv) Equisetales; Equisetum	PPT/Lecture		CO 2
19	(iv) Equisetales; Equisetum	PPT/Lecture		CO 2
20	(e) Pteropsida (A) Primofilices: (i) Cladoxylales; Cladoxylon (ii) Coenopteridales	PPT/Lecture		CO 2
21	(B) Eusporangiatae: (i) Marattiales; Angiopteris	PPT/Lecture		CO 2
22	(ii) Ophioglossales; Ophioglossum	PPT/Lecture		CO 2
23	(C) Osmundales; Osmunda.	PPT/Lecture		CO 2
24	(C) Osmundales; Osmunda.			CO 2
25	(D) Leptosporangiatae: (i) Marsileales; Marsilea	PPT/Lecture		CO 2
26	(ii) Salviniales; Salvinia	PPT/Lecture		CO2
27	(ii) Salviniales; Azolla	PPT/Lecture		CO 5
28	(ii) Filicales; Pteris,	PPT/Lecture		CO 5
29	(ii) Filicales; Lygodium, Acrostichum,	PPT/Lecture		CO 5
30	(ii) Filicales; Gleichenia, Adiantum.	PPT/Lecture		CO 5
Module 3: Comparative study of Pteridophytes (4 hrs)				
31	Stelar organization, soral and sporangial characters	PPT/Lecture		CO 5
32	Gametophytes and sporophytes of Pteridophytes in an evolutionary perspective	Hands-on Session		CO 5
33	Gametophytes and sporophytes of Pteridophytes in an evolutionary perspective	PPT/Lecture		CO 5
34	An account on DNA barcoding of pteridophytes	PPT/Lecture		CO 5
Module 4: Ecology and Economic importance (2 hrs)				
35	Ecological and economic significance of Pteridophytes.	PPT/Lecture		CO 5
36	Ecological and economic significance of Pteridophytes.	PPT/Lecture		CO 5
Practical				
Study of morphology and anatomy of vegetative and reproductive organs using clear whole mounts/sections of the following genera:				
38	Psilotum	Hands-on Session		CO 4

39	Psilotum	Hands-on Session		CO 4
40	Lycopodium	Hands-on Session		CO 4
41	Lycopodium	Hands-on Session		CO 4
42	Selaginella	Hands-on Session		CO 4
43	Selaginella	Hands-on Session		CO 4
44	Equisetum	Hands-on Session		CO 4
45	Equisetum	Hands-on Session		CO 4
46	Angiopteris	Hands-on Session		CO 4
47	Angiopteris	Hands-on Session		CO 4
48	Ophioglossum	Hands-on Session		CO 4
49	Marsilea	Hands-on Session		CO 4
50	Marsilea	Hands-on Session		CO 4
51	Salvinia	Hands-on Session		CO 4
52	Azolla	Hands-on Session		CO 4
53	Azolla	Hands-on Session		CO 4
54	Lygodium	Hands-on Session		CO 4
55	Lygodium	Hands-on Session		CO 4
56	Acrostichum	Hands-on Session		CO 4
57	Acrostichum	Hands-on Session		CO 4
58	Gleichenia	Hands-on Session		CO 4
59	Gleichenia	Hands-on Session		CO 4

60	Pteris	Hands-on Session		CO 4
61	Pteris	Hands-on Session		CO 4
62	Adiantum	Hands-on Session		CO 4
63	Adiantum	Hands-on Session		CO 4
64	Polypodium	Hands-on Session		CO 4
65	Polypodium	Hands-on Session		CO 4
66	Study of fossil Pteridophytes with the help of specimens and permanent slides.	Hands-on Session		CO 4
67	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4
68	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4
69	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4
70	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4
71	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4
72	Field trips to familiarize with the diversity of Pteridophytes in natural habitats and preparation of 5 pteridophyte herbarium and submit the report along with the recorded.	Experiential learning		CO 4

References

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COURSE PLAN

PROGRAMME	M.Sc. BOTANY	SEMESTER	2
COURSE CODE AND TITLE	16P2BOTT06: MOLECULAR BIOLOGY AND IMMUNOLOGY	CREDIT	4
HOURS/WEEK	2	HOURS/SEM	Theory 18 hrs; Practical 18 hrs
FACULTY NAME	PRINCY MOL A. P.		

	PROGRAMME OUTCOMES
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and knowhow to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO 5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

M.Sc. BOTANY

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Demonstrate a clear, comprehensive and advanced mastery in the field of Botany.
PSO 2	Understand the basic principles of biological sciences with special reference to Botany and its applied branches.
PSO 3	Explore the intricacies of life forms at cellular, molecular and nano level.
PSO 4	Appreciate the beauty of different life forms, be aware of and disseminate the concept of biodiversity conservation.
PSO 5	Develop problem solving skills and carry out innovative research projects, thereby fostering the spirit of knowledge creation.

	COURSE OUTCOMES	PO/ PSO	CL
CO 1	Define the basic properties, structure and functions of genetic materials.	PO1, PO4, PO5, PSO1, PSO3, PSO5	U
CO 2	Explain the central dogma of molecular biology.	PO1, PO4, PO5, PSO1, PSO3, PSO5	U, A, An
CO 3	Examine gene expression mechanisms.	PO1, PO4, PO5, PSO1, PSO2, PSO3, PSO5	U, A, An
CO 4	Explain the mechanism of DNA repair systems	PO1, PO4, PO5, PSO1, PSO3, PSO5	U, A, An
CO 5	Evaluate the alternate forms of DNA and its significance	PO1, PO4, PO5, PSO1, PSO3, PSO5	R, U
CO 6	Develop strategies to distinguish diverse RNA molecules and its functions in biological systems.	PO1, PO4, PO5, PSO1, PSO3	R, U, A

CL* Cognitive Level

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
	MODULE I			
1	a. Innate and acquired immunity. Cells and molecules involved in innate and acquired immunity	Lecture/ Interaction/ PPT		CO1
2	a. Humoral and cellular immunity, Antigens, Epitopes	Lecture/ Interaction/ PPT		CO1
3	b. Structure, function and types of antibody molecules. Antigen-antibody interactions.	Lecture/ Interaction/ PPT	e-resource	CO1
4	b. Antigen processing and presentation.	Lecture/ Interaction/ PPT		CO1
5	c. Activation and differentiation of B cells – formation, role.	Lecture/ Interaction/ PPT	Video, e-resource	CO1
6	c. T cells – types, roles, T cell receptors.	Lecture/ Interaction/	Video, e-resource	CO1

		PPT/ Audio visual learning/ Practical		
7	d. Primary and secondary immune modulation	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
8	d. complement system, pattern recognition receptors – toll-like receptors.	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
9	d. MHC molecules. Cell-mediated effector functions, inflammation	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
10	Hypersensitivity and autoimmunity, congenital and acquired immunodeficiencies.	Lecture/ Interaction/ PPT/Audio visual learning		CO1
CIA I				
MODULE II				
11	a. Generation of antibody diversity.	Lecture/ Interaction/ PPT	e-resource	CO1
12	b. Production and uses of monoclonal antibodies	Lecture/ Interaction/ PPT/ Assignment		CO1
13	Antibody engineering.	Lecture/ Interaction/ PPT/ Assignment		CO1
MODULE III				
14	a. Vaccines: Basic strategies, inactivated and live attenuated pathogens,	Lecture/ Interaction/ PPT		CO1
15	b. subunit vaccines	Lecture/ Interaction/ PPT	e-resource	CO1
16	recombinant vaccines (e.g., Hepatitis B vaccine)	Lecture/ Interaction/ PPT		CO1

17	DNA vaccines	Lecture/ Interaction/ PPT	e-resource	CO1
18	b. Modern approaches to vaccine development - edible vaccines.	Lecture/ Interaction/ PPT		CO1
PRACTICAL				
19	Virtual lab experiments	Computer based practical		CO1
CIA - II				

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual – Graded)	Nature of Assignment	Course Outcome
1	10/01/2019	Vaccines: Basic strategies, inactivated and live attenuated pathogens,	Review report on recent research works in the respective fields	CO1
2	10/01/2019	Subunit vaccines, recombinant vaccines (e.g., Hepatitis B vaccine)		CO1
3	10/01/2019	Modern approaches to vaccine development - edible vaccines.		CO1

References

1	Goldsby, R. A., Kindt, T. J., Osborne, B. A. and Kuby, J. (2003). Kuby Immunology (5th edition). W H Freeman and Company.
2	Roitt, I. M. and Delves, P. J. (2001). Roitt's Essential Immunology (10th edition). Blackwell Publishing
3	Krebs, J. E., Goldstein, E. S. and Kilpatrick, S. T. (2014) Lewin's Genes XI. Jones & Bartlett learning
4	Talaro, K. P. and Chess, B (2012). Foundations in Microbiology (8th edition). Mc Graw Hill
5	Abbas, A. K. and Lichtman, A. H. (2004) Basic Immunology – Functions and Disorders of the Immune System (2nd edition). Saunders - Elsevier
6	Rabson, A., Roitt, I. M. and Delves, P. J. (2005) Really Essential Medical Immunology (2nd edition). blackwell publishing

COURSE PLAN

PROGRAMME	**M.SC. BOTANY**	SEMESTER	1
COURSE CODE AND TITLE	**16P2BOTT07: PLANT ANATOMY, PRINCIPLES OF ANGIOSPERMS SYSTEMATICS & MORPHOLOGY**	CREDIT	4
HOURS/WEEK	6	HOURS/SEM	THEORY 72 HRS; PRACTICAL 54 HRS
FACULTY NAME	JOSE JOHN, LESLY AUGUSTINE & EBIN P.J.		

	PROGRAMME OUTCOMES
PO 1	The students are capable of exercising their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and knowhow to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO 5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

M.Sc. BOTANY

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Demonstrate a clear, comprehensive and advanced mastery in the field of Botany.
PSO 2	Understand the basic principles of biological sciences with special reference to Botany and its applied branches.
PSO 3	Explore the intricacies of life forms at cellular, molecular and nano level.
PSO 4	Appreciate the beauty of different life forms, be aware of and disseminate the concept of biodiversity conservation.
PSO 5	Develop problem solving skills and carry out innovative research projects, thereby fostering the spirit of knowledge creation.

	COURSE OUTCOMES	PO/ PSO	CL
CO 1	Understand the plant cell structure in a detailed manner	PO1, PO4, PO5, PSO1, PSO3, PSO4	U
CO 2	Understand the tissue level organization in plant system	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 3	Define the morphological features of angiosperms	PO1, PO3, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 4	Develop capacity in plant anatomical specimen preparations	PO1, PO3, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 5	Explain the details of wood anatomy, plant fibres and secretory tissues	PO1, PO3, PO4, PO5, PSO1, PSO3, PSO4	R, U
CO 6	Explain different inflorescence and fruit types in plant kingdom	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 7	Evaluate different wood types looking into anatomical peculiarities	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An, C
CO 8	Define floral, nodal and reproductive anatomy of plants	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 9	Explain various underlying principles of angiosperm systematics	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An
CO 10	Develop confidence in using correct systematic terms in publishing validly	PO1, PO4, PO5, PSO1, PSO3, PSO4	U, A, An

CL* Cognitive Level

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
INTRODUCTION TO THE COURSE & Anatomy - MODULE I				
1	Scope and significance of plant anatomy, interdisciplinary relations	Lecture/ Interaction/ PPT		CO1, PSO1
Anatomy - MODULE II Meristems				

2	MERISTEMS - Apical organization: Stages of development of primary meristem and theories of apical organization, origin of branches and lateral roots.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
3	MERISTEMS - Apical organization: Stages of development of primary meristem and theories of apical organization, origin of branches and lateral roots.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
4	MERISTEMS - Apical organization: Stages of development of primary meristem and theories of apical organization, origin of branches and lateral roots.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
5	Primary thickening meristem (PTM) in monocots. Reproductive apex in angiosperms	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
6	Secretory tissues in plants: Structure and distribution of secretory trichomes (Drocera, Nepenthes), salt glands, colleters, nectaries, resin ducts and laticifers.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
7	Secretory tissues in plants: Structure and distribution of secretory trichomes (Drocera, Nepenthes), salt glands, colleters, nectaries, resin ducts and laticifers.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
8	Structure of bark and distribution pattern of laticifers in Hevea brasiliensis.	Lecture/ Interaction/ PPT	Scientific research paper by C.P.Raghu – additional reading	CO1, CO2, CO3, CO4 and, CO5; PSO2, PSO4
Anatomy - MODULE III Secondary Structure				
10	Vascular cambium and cork cambium: Structure and function, factors affecting cambial activity.	PPT/ Lecturing		CO1, CO2, CO3, CO4 and, CO5; PSO4, PSO5
11	Secondary xylem and phloem: Ontogeny, structure and function. Lignification patterns of xylem.	PPT/ Lecturing		CO1, CO2, CO3, CO4 and, CO5; PSO4, PSO5

12	Reaction wood: Compression wood and tension wood. Factors affecting reaction wood formation.	PPT/ Lecturing		CO1, CO2, CO3, CO4 and, CO5; PSO4, PSO5
13	Wood: Physical, chemical and mechanical properties	PPT/ Lecturing	Musical Instruments – Flute and Guitar	CO1, CO2, CO3, CO4 and, CO5; CO7, PSO4, PSO5
14	Wood: Physical, chemical and mechanical properties	PPT/ Lecturing		CO1, CO2, CO3, CO4 and, CO5; CO7, PSO4, PSO5
15	Plant fibers: Distribution, structure and commercial importance of coir, jute, and cotton.	PPT/ Lecturing	Articles made with various plant fibres	CO1, CO2, CO3, CO4 and, CO5; CO7, PSO4, PSO5
Anatomy - MODULE IV Leaf and Node				
16	Leaf: Initiation, plastochronic changes, ontogeny and structure of leaf. Structure, development and classification of stomata and trichomes.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
17	Krantz anatomy, anatomical peculiarities in CAM plants. Leaf abscission.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
18	Nodal anatomy: Unilacunar, trilacunar and multilacunar nodes, nodal evolution.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
19	Root-stem transition in angiosperms.	Lecture/ Interaction/ PPT/		CO1, CO2, CO3, CO4 and, CO5; PSO4, PSO5
Anatomy - MODULE V Reproductive Anatomy				
20	Floral Anatomy: Anatomy of floral parts - sepal, petal, stamen and carpel; Floral vasculature (Aquilegia and Pyrola).	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO5; PSO4, PSO5
21	Floral Anatomy: Anatomy of floral parts - sepal, petal, stamen and carpel; Floral vasculature (Aquilegia and Pyrola).	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5

22	Vascular anatomy. Development of epigynous ovary - appendicular and receptacular theory.	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
23	Fruit and seed anatomy: Anatomy of fleshy and dry fruits - follicle, legume, berry. Dehiscence of fruits	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
24	Structure of seeds. Anatomical factors responsible for seed dormancy and drought resistance	Lecture/ Interaction/ PPT		CO1, CO2, CO3, CO4 and, CO6; CO8, PSO4, PSO5
Anatomy - MODULE VI Ecological Anatomy				
25	Morphological and structural adaptations in different ecological groups - hydrophytes, xerophytes	Lecture/ Interaction		CO1, CO2, CO3, CO4 and, CO6; PSO4, PSO5
26	Morphological and structural adaptations in different ecological groups - hydrophytes, xerophytes	Lecture/ Interaction		CO1, CO2, CO3, CO4 and, CO6; PSO4, PSO5
27	Morphological and structural adaptations in different ecological groups - epiphytes and halophytes	Lecture/ Interaction		CO1, CO2, CO3, CO4 and, CO6; PSO4, PSO5
28	Morphological and structural adaptations in different ecological groups - epiphytes and halophytes	Lecture/ Interaction		CO1, CO2, CO3, CO4 and, CO6; PSO4, PSO5
Anatomy - MODULE VII Applied Anatomy				
29	Applications of anatomy in systematics (histotaxonomy) and Pharmacognosy. Research prospects in Anatomy	PPT/ Lecturing		CO1, CO2; PSO2, PSO3, PSO4, PSO5
30	Applications of anatomy in systematics (histotaxonomy) and Pharmacognosy. Research prospects in Anatomy	PPT/ Lecturing		CO1, CO2; PSO2, PSO3, PSO4, PSO5
31	Assessment Test	MCQ	Class Test	
Angiosperm Systematics – MODULE I Scope and significance of Taxonomy				
36	Historical background of classification - Artificial, natural and phylogenetic systems. Importance of taxonomy	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Angiosperm Systematics – MODULE II Concepts of Taxonomic hierarchy				
37	Species/Genus/Family and other categories; species concept and intraspecific categories - subspecies, varieties and forms	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5

Angiosperm Systematics – MODULE III Phylogeny of Angiosperms				
38	Important phylogenetic terms and concepts: Plesiomorphic and Apomorphic characters;	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
39	Homology and Analogy; Parallelism and Convergence;	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
40	Monophyly, Paraphyly and Polyphyly.	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
41	Phylogenetic tree - Cladogram and Phenogram.	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Angiosperm Systematics – MODULE IV Data sources of Taxonomy				
42	Concepts of character; Sources of taxonomic characters - Anatomy, Cytology	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
43	Sources of taxonomic characters - Phytochemistry and molecular taxonomy.	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Angiosperm Systematics – MODULE V Concept and principles of assessing relationships				
44	Phenetic - Numerical Taxonomy - principles and methods	PPT/ Lecturing/ Computer		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
45	Cladistic - Principles and methods	PPT/ Lecturing/ Computer		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Angiosperm Systematics – MODULE VI Botanical nomenclature				
46	History of ICN	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
47	Aims and principles	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
48	Rules and recommendations: rule of priority, typification, author citation, retention, rejection and changing of names, effective and valid publication	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5

49	Rule of priority, typification, author citation, retention, rejection and changing of names, effective and valid publication	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
50	Rule of priority, typification, author citation, retention, rejection and changing of names, effective and valid publication	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
51	Effective and valid publication	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Angiosperm Systematics – MODULE VII Synthetic approaches to the systematics of Angiosperms				
52	Chemotaxonomy	PPT/ Lecturing		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
53	Basic concepts of genome analysis	PPT/ Lecturing/ICT		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
54	DNA bar coding.	PPT/ Lecturing/ ICT		CO1, CO2, CO9, CO10; PSO2, PSO4, PSO5
Morphology of Angiosperms				
55	Habitat and habit	PPT/ Lecturing/Demo	Field visit	CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
56	Morphology of root	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
57	Morphology of stem	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
58	Morphology of leaf, bract and bracteoles	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
59	Morphology of inflorescence	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5

60	Morphology of flowers	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
61	Morphology of fruits	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
62	Morphology of seeds	PPT/ Lecturing/Demo		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
	Assessment Test	MCQ/ Quiz	Class Test	
63	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
64	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
65	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
66	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
67	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
68	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
69	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
70	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1,

				PSO2, PSO4, PSO5
71	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
72	Revision and Clarification Discussions	Group Discussion		CO1, CO3, CO6, CO8; PSO1, PSO2, PSO4, PSO5
PRACTICAL				
1	Study of cambia - non storied and storied	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
2	Study of the anomalous primary and secondary features in *Amaranthus*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
3	Study of the anomalous primary and secondary features in *Boerhaavia*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
4	Study of the anomalous primary and secondary features in *Mirabilis*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
5	Study of the anomalous primary and secondary features in *Nyctanthes*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
6	Study of the anomalous primary and secondary features *Piper*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
7	Study of the anomalous primary and secondary features in *Strychnos*	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
8	Study of stomata, Determination of stomatal index.	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
9	Study of trichomes	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
10	Study of laticifers	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5

11	Study of the anatomical peculiarities of C4 and CAM plants (Leaf)	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
12	Study of the anatomical peculiarities of C4 and CAM plants (Leaf)	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
13	Study of the anatomical peculiarities of C4 and CAM plants (Stem)	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
14	Study of the anatomical peculiarities of C4 and CAM plants (Stem)	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
15	Study of nodal patterns - Unilacunar	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
16	Study of nodal patterns - Trilacunar	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
17	Study of nodal patterns - Multilacunar	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
18	Preparation of a histotaxonomic key	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
19	Study of the pericarp anatomy of a berry	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
20	Study of the pericarp anatomy of a legume	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
21	Study of the pericarp anatomy of a follicle	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
22	Identification of wood - soft wood	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
23	Identification of wood - hard wood	Lab work		CO1,CO2,CO4, CO5,CO7; PSO3,PSO4,PSO5
24-26	Morphology of leaf: Leaf attachment, Stipules, Patterns of leaf, Phyllotaxy, Shapes of leaf lamina, bases, margins and tips, Venation.	Field Visit & Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5

27-30	Inflorescence: Racemose - Simple raceme, Compound raceme, Spike, Spikelet, Catkin, Spadix, Corymb, Simple umbel, Compound umbel, Panicle, Capitulum. Cymose - Solitary cyme, Mono-, Di-and polychasial cyme. Special types - Cyathium, Verticillaster, Hypanthodium, Coenanthium.	Field Visit & Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
31-33	Morphology of stamens: Mono-, Di- and Polyadelphous; Epipetalous, Syngenesious, Synandrous, Polyandrous, Didynamous, Tetradynamous, Basifixed, Dorsifixed, Versatile.	Field Visit & Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
34-36	Morphology of carpels: Apocarpous, Syncarpous, Gynostegium. Placentation - Marginal, Parietal, Axile, Free central, Basal and Pendulous.	Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
37-40	Morphology of fruits: Berry, Drupe, Hesperidium, Pepo, Balausta, Amphisarca, Achene, Follicle, Capsule, Legume, Lomentum, Nut, Caryopsis, Cypsela, Samara, Cremocarp, Siliqua, Carcerule, Regma.	Field Visit & Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
41	Aggregate fruits; Composite fruits - Sorosis and Syconus; Pome.	Field Visit & Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
42-44	Draw the L.S and floral diagram of at least 10 flowers having different ovary positions - hypogyny, perigyny and epigyny.	Lab work		CO3,CO6,CO8; PSO3,PSO4,PSO5
45	Workout nomenclatural problems regarding priority and author citations.	Lab Work		CO9,CO10; PSO3,PSO4,PSO5

CIA – Model				
46	Revision			
47	Revision			
48	Revision			

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines - Anatomy & Systematics

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group - Written/Presentation – Graded or Non-graded etc)	Nature of Assignment	Course Outcome
1	15/1/2019	Compare and contrast the anomalous secondary thickening in Nyctanthes, Piper and Strychnos stem	Review report on recent research works in the respective fields of Plant Anatomy and Angiosperm Systematics	CO1, CO3 & CO4
2	15/1/2019	Compare and contrast the anomalous secondary thickening in Amaranthes, Mirabilis and Boerhavia		CO4
3	15/1/2019	Recent understanding on Vascular Cambiua and their ontogeny		CO1 & CO4
4	15/1/2019	Plant Fibres: their distribution and structure; special reference to Coir, Jute and Cotton		CO1, CO3 & CO4
5	15/1/2019	Modern trends in angiosperm systematics: role of molecular taxonomy in solving problems		CO1 & CO4
6	15/1/2019	Mophology v/s Molecular data – merits and demerits with respect to taxonomy		CO3 & CO4

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines - Morphology

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Nature of Assignment	Course Outcome
1	15/2/2019	Collect and prepare a well-documented herbarium on different phyllotaxy	Prepare and submit a collection of materials, properly preserved; report of the field work	CO1, CO3 & CO4; PSO1, PSO4, PSO5
2	15/2/2019	Make an exhibition on various types of dry fruits with amble description and uses		CO1, CO3 & CO4; PSO1, PSO4, PSO5

3	15/2/2019	Prepare a virtual tour on various types of inflorescences with help of original videos and photographs.		CO1, CO3 & CO4; PSO1, PSO4, PSO5
4	15/2/2019	Conduct a digital photo exhibition on various types of flowers and vegetative structures that are curious to the eyes. Add some additions with rare flowers and fleshy fruits	web resources	CO1, CO3 & CO4; PSO1, PSO4, PSO5

References

1	Eames A J, McDaniel (1976). An introduction to plant Anatomy. Tata McGraw-Hill, New Delhi
2	Edred John, Henry Corner (1976). The seeds of dicotyledons (Vol. I, II). Cambridge University Press.
3	Ella Werker (1997). Seed Anatomy. Borntreager. University of Michigan
4	Elizabeth G Cutter (1978). Plant Anatomy Part I & II. Clive and Arnald Ltd.
5	Elizabeth G Cutter (1978). Applied Plant Anatomy. Clive and Arnald Ltd.
6	Esau K (1965). Vascular differentiation in plants. Rirehant and Winston, Inc.
7	Esau K (1977). Anatomy of seed plants. Wiley and sons.
8	Fahn A. (1997). Plant anatomy. Aditya Publishers. New Delhi
9	Metcalf C R, Chalk L (1983). Anatomy of the dicotyledons: Wood structure and conclusion of the general introduction. Oxford University press
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11	Wardrop A B (1964). Reaction wood Anatomy in Arborescent angiosperms. Formation of wood in forest trees (Ed, Zimmerman). Academic press, New York.
12	Lawrence George H M (1951). Taxonomy of vascular plants. Oxford and IBH Publ. Co. Pvt. Ltd.
13	Jeffrey C (1968). An Introduction to principles of Plant Taxonomy.
14	Cole A J (1969). Numerical Taxonomy. Academic Press.
15	Davis P H, Heywood V M (1973). Principles of Angiosperm Taxonomy. Robert E Kereiger Publ
16	Harrison H J (1971). New Concepts in Flowering Plant Taxonomy. Heiman Educational Books Ltd.
17	Cronquist A (1981). An Integrated system of classifications of flowering plants. Columbia University Press

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19	Naik V V (1984). Taxonomy of Angiosperms. Tata McGraw Hill Publ. Co. Ltd
20	Davis P H, V H Heywood (1991). Principles of Angiosperm Taxonomy. Today and Tomorrow Publications.
21	Stace C A (1989). Plant Taxonomy and Biosystematics. Etwaed Arnold
22	Sivarajan V V (1991). Introduction to Principles of Plant Taxonomy. Oxford IBH.
23	Taylor D V, L J Hickey (1997). Flowering plants: Origin, evolution and phylogeny. CBS Publishers & Distributors.
24	International Code of Botanical Nomenclature (latest)
25	Henry A N, Chandrabose M (1980). An aid to the International Code of Botanical Nomenclature.
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COURSE PLAN

PROGRAMME	MASTER OF SCIENCE BOTANY	SEMESTER	2
COURSE CODE AND TITLE	16P2BOTT08: GENETICS AND BIOCHEMISTRY	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME			

	PROGRAMME OUTCOMES
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large

PO 3	Make choices based on the values upheld by the institution, and have the readiness and knowhow to preserve the environment and work towards sustainable growth and development.
PO 4	**Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
PO5	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO 6	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
MODULE I				
1.	Genetics- general introduction- Transmission genetics, Molecular genetics and Population genetics	PPT		CO 1
2.	Mendelism –basic principles	PPT/Lecture		CO 1
3.	Extensions of Mendelism	PPT/Lecture		CO 1
4.	Penetrance and expressivity of genes	PPT/Lecture		CO 1
5.	Nonmendelian inheritance – cytoplasmic inheritance	PPT/Lecture		CO 1
6.	Sex determination in animals and plants	PPT/Lecture		CO 1
MODULE II				
7.	Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments	Lecture		CO 3
8.	Single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order, interference and co efficient of coincidence	Lecture		CO 3
9.	Haploid mapping (Neurospora)	Lecture		CO 3
10.	Mapping in bacteria and bacteriophages	PPT/Lecture		CO 3
11.	Inheritance of traits in humans; pedigree analysis, determination of human genetic diseases by pedigree analysis	PPT/Lecture		CO 3
MODULE III				
12.	Polygenic inheritance, QTL			CO 1
13.	Effect of environmental factors and artificial selection on polygenic inheritance.	PPT/Lecture		CO 1

MODULE IV				
14.	Gene pool, allele and genotype frequency	Lecture		CO 2
15.	Hardy-Weinberg law and its applications	Lecture		CO 2
16.	Estimation of allele and genotype frequency of dominant genes, co-dominant genes, sex-linked genes and multiple alleles	Lecture		CO 2
17.	Genetic equilibrium, genetic polymorphism	PPT/Lecture		CO 2
18.	Factors that alter allelic frequencies-mutation, genetic drift, migration, selection, nonrandom mating	PPT/Lecture		CO 2
Practicals				
19.	Problems related to linkage, crossing over and gene mapping	Hands on session		CO3
20.	Problems related to linkage, crossing over and gene mapping	Hands on session		CO3
21.	Problems related to linkage, crossing over and gene mapping	Hands on session		CO3
22.	Problems related to linkage, crossing over and gene mapping	Hands on session		CO 1
23.	Problems related to pedigree analysis	Hands on session		CO 1
24.	Problems related to pedigree analysis	Hands on session		CO 1
25.	Problems related to pedigree analysis	Hands on session		CO 1
26.	Problems related to pedigree analysis	Hands on session		CO 1
27.	Problems related to pedigree analysis	Hands on session		CO 1
28.	Problems in population genetics - gene and genotype frequency	Hands on session		CO 2
29.	Problems in population genetics - gene and genotype frequency	Hands on session		CO 2
30.	Problems in population genetics - gene and genotype frequency	Hands on session		CO 2
31.	Problems in population genetics - gene and genotype frequency	Hands on session		CO 2
32.	Problems in population genetics - gene and genotype frequency	Hands on session		CO 2

33.	Problems in population genetics - Hardy Wienberg equilibrium	Hands on session		CO 2
34.	Problems in population genetics - Hardy Wienberg equilibrium	Hands on session		CO 2
35.	Problems in population genetics - Hardy Wienberg equilibrium	Hands on session		CO 2
36.	Problems in population genetics - Hardy Wienberg equilibrium	Hands on session		CO 2
BIOCHEMISTRY MODULE I				
37.	Acids and bases, strength of acids – strong acids, weak acids. Ionization of water – Kw, pH. Dissociation of acids – pKa, Henderson-Hasselbalch equation.	PPT/Lecture		CO 4
38.	Buffers–definition,chemical composition, requirements for a good buffer, buffer action, buffer capacity.	PPT/Lecture		CO 4
39.	Measurement of pH – colorimetric methods and electrometric methods.	PPT/Lecture		CO 4
40.	Preparation of questions by students itself, within the class room & its discussion.	PPT/Lecture		CO 4
41.	Exam- Module 1			
MODULE II				
42.	Carbohydrates: Structure and Biological Functions. Monosaccharides: Classification, structure	PPT/Lecture		CO 4
43.	Oligosaccharides: Structure, formation; common examples – sucrose, lactose. Polysaccharides: Classification, functions – structure of cellulose, starch and glycogen.	PPT/Lecture		CO 4
44.	Carbohydrates Sugar derivatives: Glycoproteins, proteoglycans, mucoproteins. Lectins.	PPT/Lecture		CO 4
MODULE III				
45.	Lipids: Classification, properties, functions. Structure of fatty acids, essential fatty acids. Storage lipids – triglycerols**.**	PPT/Lecture		CO 4
46.	Structural lipids – membrane lipids. Lipid biosynthesis, fat breakdown – β oxidation	PPT/Lecture		CO 4

47.	Exam Module 2 & 3			
MODULE IV				
48.	Structure and classification of amino acids.	Lecture		CO 4
49.	Biosynthesis of amino acids	PPT/Lecture		CO 4
50.	Exam Module 4			
MODULE V				
51.	Classification of proteins based on structure and function. Oligo- and polypeptides.	PPT/Lecture		CO 4
52.	Primary structure – peptide bond. Secondary structure – Ramachandran plots, α-helix, β sheet	PPT/Lecture		CO 4
53.	Tertiary structure – forces that stabilize tertiary structure.	PPT/Lecture		CO 4
54.	Quaternary structure, domains, motif and folds.	Lecture		CO 4
55.	Protein sequencing – Edman method. Functions of proteins.	Lecture		CO 4
MODULE VI				
56.	Protein turnover and amino acid catabolism Degradation of proteins to amino acids, Protein turnover and its tight regulation	Lecture		CO 4
57.	steps involved in amino acid degradation.	PPT/Lecture		CO 4
58.	Revision- Module 5	PPT/Lecture		CO 4
59.	Revision- Module 6	PPT/Lecture		CO 4
MODULE VII				
60.	Principles of catalysis: Activation energy of a reaction. General characters of enzymes -specificity, catalytic power, regulation.	PPT/Lecture		CO 5
61.	IUB system of enzyme classification and naming.	PPT/Lecture		CO 5
62.	Mechanism of enzyme activity: Formation of ES complex, acid-base catalysis, covalent catalysis, metal ion catalysis	PPT/Lecture		CO 5
63.	proximity and orientation effect, strain and distortion theory. Factors affecting enzyme activity.	PPT/Lecture		CO 5

64.	Enzyme Kinetics: Michaelis-Menton kinetics, Lineweaver-Burk plot.	PPT/Lecture		CO 5
65.	Mechanism of multi substrate reaction – Ping Pong, Bi-Bi mechanism.	PPT/Lecture		CO 5
66.	Regulation of enzyme activity: Allosteric effect, control proteins,	PPT/Lecture		CO 5
67.	reversible covalent modification, proteolytic activation.	PPT/Lecture		CO 5
68.	Enzyme inhibition – reversible and irreversible inhibition, competitive, noncompetitive, uncompetitive inhibition, dixon plot	PPT/Lecture		CO 5
69.	Cofactors and coenzymes: Essential ions, Coenzymes; structure and role of metabolite coenzymes – ATP	PPT/Lecture		CO 5
70.	structure and role of vitamin derived coenzymes – NAD+, NADP+, FAD, FMN, TPP, PLP,	PPT/Lecture		CO 5
71.	Biotin. Isozymes	PPT/Lecture		CO 5
MODULE VIII				
72.	nucleotide biosynthesis by de novo pathway	PPT/Lecture		CO 5,6
73.	nucleotide biosynthesis by salvage pathways	PPT/Lecture		CO 5, 6
MODULE IX				
74.	Secondary metabolites, Classification, biosynthesis, and functions of terpenoids	PPT/Lecture		CO 5
75.	Classification, biosynthesis, and functions of alkaloids.	PPT/Lecture		CO 5
76.	Classification, biosynthesis, and functions of flavonoids	PPT/Lecture		CO 5
PRACTICAL				
77.	Preparation of buffers of various strength and pH	Hands on session		CO 4,5,7
78.	Differentiating sugars based on osazone formation.	Hands on session		CO 4,5,7
79.	Separation and analysis of lipids and amino acids by TLC.	Hands on session		CO 4,5,7
80.	Quantitative estimation of protein by Lowry's method.	Hands on session		CO 4,5,7

81.	Estimation of purity of DNA (By DNA protein ratio).	Hands on session		CO 4,5,7
82.	Estimation of catalase activity.	Hands on session		CO 4,5,7
83.	Isolation and assay of amylase enzyme from germinating Pea seeds/appropriate plant material	Hands on session		CO 4,5,7

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Demonstrate a clear, comprehensive and advanced mastery in the field of Botany.
PSO 2	Understand the basic principles of biological sciences with special reference to Botany and its applied branches
PSO 3	Explore the intricacies of life forms at cellular, molecular and nano level.
PSO 4	Appreciate the beauty of different life forms, be aware of and disseminate the concept of biodiversity conservation.
PSO5	Develop problem solving skills and carry out innovative research projects, thereby fostering pirit of knowledge creation.

	COURSE OUTCOMES	**PO/ PSO**	**CL**
CO 1	Explain the Mendelian and Non-Mendelian modes of inheritance that governs passage of genetic traits across generation.	PO1,PO2, PO6, PSO2, PSO3	U
CO 2	Define the Hardy-Weinberg equilibrium.	PO1, PSO2, PSO3	A
CO 3	Explain linkage and crossing over mechanisms	PO1, PO2, PSO1	U
CO 4	Evaluate structure and functions of biomolecules.	PO1, PO2, PSO1, PSO2,PSO4	A
CO 5	Explain enzymology, nucleotide metabolism and secondary metabolites.	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	U
CO 6	Evaluate map distance, gene order, coefficient of coincidence and interference.	PO1, PO2, PSO1, PSO2,PSO4	S
CO 7	Develop capacity the structure and function of various biomolecules in living systems	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	A

CL* Cognitive Level

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Couse Outcome
1	4/1/2018	Ramachandran plot	CO 4
2	28/1/2018	Recent trends in Genetic mapping	CO 6

References

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W H Freeman and company.

5. Donald Voet, Judith G Voet (2011). *Biochemistry* (IV Edn). John Wiley & Sons Inc.

6. Carl Branden, John Tooze (1999*). Introduction to protein structure* (II Edn). Garland Publishing.

7. Reginald H Garrett, Charles M Grisham (2005). *Biochemistry*. Thomson Brooks/Cole.

8. Robert K Murray, David A Bender, Kathleen M Botham, Peter J Kennelly, Victor W Rodwell, P Anthony Weil (2009). *Harper's Illustrated Biochemistry* (XXVIII Edn). Mc Graw Hill.

9. H Robert Horton, Laurence A Moran, Raymond S Ochr, J David Rawn, K Gray Scrimgeour (2002). *Principles of Biochemistry* (III Edn). Prentice Hall.

10. Bob B Buchanan, Wilhelm Gruissem, Russel L Jones (2000). *Biochemistry and molecular biology*
of plants. L K International Pvt. Ltd.

11. S Sadasivam, A Manickam (1996). *Biochemical methods* (II Edn). New age international Publishers.