SACRED HEART COLLEGE (AUTONOMOUS)

Department of BOTANY

MASTER OF SCIENCE IN BOTANY

Course plan

Academic Year 2018-19

Semester II

COURSE PLAN

PROGRAMME	**M. Sc. Botany**	SEMESTER	2
COURSE CODE AND TITLE	**BRYOLOGY AND PTERIDOLOGY (16P2BOTT05)**	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	(Theory 36 + 36 hrs; Practical 18 + 36 hrs)
FACULTY NAME	**Lesly Augustine**		

	Programme Outcome
PO 1	The students are capable of exercising their **critical thinking** in creating new knowledge leading to innovation, entrepreneurship and employability
PO 2	The students are able to **effectively communicate** the knowledge of their study and research in their respective disciplines to their employers and to the society at large.
PO 3	The students are able to make choices based on the values upheld by the college, and have the readiness and know-how to preserve environment and work towards **sustainable growth and development**
PO 4	The students possess an **ethical view of life**, and have a broader (global) perspective transcending the provincial outlook
PO 5	The students possess a passion for exploring 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	Understand the diversity of primitive land plants.	PO1, PO2, PO3, PO4; PSO1, PSO3, PSO4, PSO5	E
CO 2	Familiarize with the morphological and anatomical features of Bryophytes and Pteridophytes.	PO1, PO2, PO3, PO4, PSO1, PSO2, PSO3, PSO4	A
CO 3	Identify the main characteristics of Bryophytes and Pteridophytes.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2, PSO4, PSO5	U
CO 4	Chart the development of land adaptations in the Bryophytes and Pteridophytes.	PO1, PO4, PO5, PSO1, PSO2, PSO3, PSO4, PSO5	An
CO 5	Acquaintance with various lifecycle events in the bryophyte and Pteridophytes.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2, PSO3, PSO4, PSO5	An
CO 6	Understand the evolutionary trends primitive plant groups.	PO1, PO3, PO4, PO5, PSO1, PSO3	An
CO 7	Ability to identify various Bryophytes and Pteridophytes in their habitats.	PO1, PO2, PO3, PO4, PO5, PSO2, PSO3	E

CL* Cognitive Level

R- Remember; U- Understand; A- Apply; An- Analyze; E- Evaluate; Cr- Create

CO - PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	2	3	0	2	0	3	2	2
CO 2	2	1	1	3	0	3	3	2	2	1
CO 3	2	2	1	2	2	2	1	0	3	3
CO 4	3	0	0	2	3	1	2	3	3	2
CO 5	3	1	2	2	2	3	1	2	2	2
CO 6	2	0	1	2	2	2	0	3	0	0
CO 7	1	2	3	0	3	0	1	1	2	0

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

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, CO7
2	Concept of algal and pteridophytic originof bryophytes. General characters of bryophytes.	PPT/Lecture		CO 1, CO 6, CO7
3	History of classification of bryophytes. Modern trends in classification of bryophytes.	PPT/Lecture		CO 1, CO 6
4	DNA barcoding of bryophytes.	PPT/Lecture		CO 1, CO 6
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, CO 7
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,CO7
8	Water relations – drought tolerance, desiccation and rehydration, ectohydric, endohydric and myxohydric bryophytes	PPT/Lecture		CO 2,CO7
9	Ecological significance of bryophytes - role as pollution indicators.	PPT/Lecture	video	CO 2,CO7
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,CO7
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	PPT/Lecture		CO 2,CO7

	necessary). (a) Hepaticopsida (Sphaerocarpales, Marchantiales, Metzgeriales, Jungermanniales and Calobryales).			
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,CO7
13	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,CO7
14	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,CO7
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,CO7
16	Comparative structural organization of gametophytes and sporophytes in an	PPT/Lecture		CO 2,CO7

	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).			
17	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,CO7
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,CO7
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,CO7
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	PPT/Lecture	video	CO 2,CO7

	necessary). (b) Anthocerotopsida (Anthocerotales).			
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,CO7
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,CO7
1CIA				
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		CO 2,CO7
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,CO7
25	Comparative structural organization of gametophytes and sporophytes in an	PPT/Lecture		CO 2,CO7

	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).			
26	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,CO7
27	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2,CO7
28	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2,CO7
29	Comparative structural organization of gametophytes and sporophytes in an evolutionary perspective. Asexual and sexual reproductive structures, spore dispersal mechanisms and germination of thefollowing	PPT/Lecture		CO 2,CO7

	groups with reference to the types mentioned in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).			
30	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2,CO7
31	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2,CO7
32	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture		CO 2,CO7
33	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	PPT/Lecture		CO 2,CO7

	in the practical (development of sex organs not necessary). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).			
34	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	video	CO 2,CO7
35	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	videos	CO 2,CO7
36	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). (c) Bryopsida (Sphagnales, Polytrichales, and Bryales).	PPT/Lecture	video	CO 2,CO7
Practical 18 hrs				
Detailed study of the structure of gametophytes and sporophytes of the following genera of bryophytes by suitable micro preparation:				
37 - 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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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,CO7
6	(b) Psilotopsida (i) Psilotales; Psilotum	PPT/Lecture		CO 2,CO7
7	(b) Psilotopsida (i) Psilotales; Psilotum	PPT/Lecture		CO 2,CO7
8	(c) Lycopsida (i) Protolepidodendrales; Protolepidodendron	PPT/Lecture		CO 2,CO7
9	(ii) Lycopodiales; Lycopodium	PPT/Lecture		CO 2,CO7
10	(ii) Lycopodiales; Lycopodium	PPT/Lecture		CO 2,CO7
11	(iii) Isoetales; Isoetes	PPT/Lecture		CO 2,CO7
12	(iii) Isoetales; Isoetes	PPT/Lecture		CO 2,CO7
13	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2,CO7
14	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2,CO7
15	(iv) Selaginellales; Selaginella.	PPT/Lecture		CO 2,CO7
16	(d) Sphenopsida (i) Hyeniales (ii) Sphenophyllales; Sphenophyllum	PPT/Lecture		
17	(iii) Calamitales; Calamites	PPT/Lecture		CO 2,CO7

18	(iv) Equisetales; Equisetum	PPT/Lecture		CO 2,CO7
19	(iv) Equisetales; Equisetum	PPT/Lecture		CO 2,CO7
20	(e) Pteropsida (A) Primofilices: (i) Cladoxylales; Cladoxylon (ii) Coenopteridales	PPT/Lecture		CO 2,CO7
21	(B) Eusporangiatae: (i) Marattiales; Angiopteris	PPT/Lecture		CO 2,CO7
22	(ii) Ophioglossales; Ophioglossum	PPT/Lecture		CO 2,CO7
23	(C) Osmundales; Osmunda.	PPT/Lecture		CO 2,CO7
24	(C) Osmundales; Osmunda.			CO 2,CO7
25	(D) Leptosporangiatae: (i) Marsileales; Marsilea	PPT/Lecture		CO 2,CO7
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		CO 4

		Session		
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

1. Agashe S N (1995). Palaeobotany. Oxford and IBH publishing House.

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14. Smith, Gilbert (1972). Cryptogamic Botany (Vol. II). Tata McGraw Hill publications.

15. Nayar B K, S Kaur (1971). Gametophytes of homosporous ferns. Bot. Rev.

COURSE PLAN

PROGRAMME	M.Sc. BOTANY	SEMESTER	2
COURSE CODE AND TITLE	16P2BOTT06: PLANT ANATOMY, PRINCIPLES OF ANGIOSPERM SYSTEMATICS & MORPHOLOGY	CREDIT	4
HOURS/WEEK	7.5	HOURS/SEM	135
FACULTY NAME	FR. JOSE JOHN		

MASTER OF SCIENCE

	PROGRAMME OUTCOME
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 know-how 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.

MASTER OF SCIENCE [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 and tissue level organization in a detailed manner	PO1, PO3, PSO2, PSO3, PSO4, PSO5	U
CO 2	Know and carry out the plant anatomical specimen preparations	PO1, PSO2, PSO3, PSO5	A
CO 3	Understand the details of wood anatomy, plant fibres and secretory tissues	PO1, PO2, PO5, PSO4	U
CO 4	Compare different wood types looking into anatomical peculiarities	PO1, PO2, PSO1, PSO2, PSO5	E
CO 5	Assess the morphological features of angiosperms	PO1, PO2, PO4, PO5, PSO2, PSO3, PSO5	An
CO 6	Apply the principles of angiosperm systematics	PO1, PO2, PO4, PO5, PSO2, PSO3, PSO5	A

CL* Cognitive Level
R- Remember
U- Understand
A- Apply
An- Analyze
E- Evaluate
Cr- Create

CO - PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	2	1	2	2	2	2	2	3
CO 2	3	0	0	1	1	2	3	2	1	3
CO 3	3	3	1	1	2	1	1	2	2	1
CO 4	2	1	2	0	1	2	1	1	3	3
CO 5	1	1	0	1	3	0	2	1	2	2
CO 6	1	1	0	1	3	0	2	1	2	2

Mapping Strength

0. No Mapping strength
1. Low
2. Medium
3. High

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
MODULE I Introduction				
1	Scope and significance of plant anatomy, interdisciplinary relations	PPT/ Lecturing		CO1
MODULE II Meristems				
2	MERISTEMS - Apical organization: Stages of development of primary meristem and theories of apical organization, origin of branches and lateral roots.	PPT/ Lecturing		CO1, CO2, CO3, CO4
3	MERISTEMS - Apical organization: Stages of development of primary meristem and theories of apical organization, origin of branches and lateral roots.	PPT/ Lecturing		CO1, CO2, CO3, CO4
4-6	Primary thickening meristem (PTM) in monocots. Reproductive apex in angiosperms.	PPT/ Lecturing		CO1, CO2, CO3, CO4
7-9	Secretory tissues in plants: Structure and distribution of secretory trichomes (Drocera, Nepenthes), salt glands, colleters, nectaries, resin ducts and laticifers.	PPT/ Lecturing		CO1, CO2, CO3, CO4
10	Structure of bark and distribution pattern of laticifers in Hevea brasiliensis.	PPT/ Lecturing		CO1, CO2, CO3, CO4
MODULE III Secondary Structure				
11-12	Vascular cambium and cork cambium: Structure and function, factors affecting cambial activity.	PPT/ Lecturing		CO1, CO2, CO3, CO4
13-14	Secondary xylem and phloem: Ontogeny, structure and function. Lignification patterns of xylem.	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4
15-16	Reaction wood: Compression wood and tension wood. Factors affecting reaction wood formation.	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4
17-19	Wood: Physical, chemical and mechanical properties	PPT/ Lecturing		CO1, CO2, CO3, CO4
20-21	Plant fibers: Distribution, structure and commercial importance of coir, jute, and cotton.			CO1, CO2, CO3, CO4
MODULE IV Leaf and Node				
22-23	Leaf: Initiation, plastochronic changes, ontogeny and structure of leaf. Structure, development and	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4

	classification of stomata and trichomes.			
24-25	Krantz anatomy, anatomical peculiarities in CAM plants. Leaf abscission.	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4
26-29	Nodal anatomy: Unilacunar, trilacunar and multilacunar nodes, nodal evolution.	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4
30	Root-stem transition in angiosperms.	PPT/ Lecturing/ Demo		CO1, CO2, CO3, CO4
MODULE V Reproductive Anatomy				
31-33	Floral Anatomy: Anatomy of floral parts - sepal, petal, stamen and carpel; Floral vasculature (*Aquilegia and Pyrola*). Vascular anatomy. Development of epigynous ovary - appendicular and receptacular theory.	PPT/ Lecturing		CO1, CO2, CO3, CO4
34-36	Fruit and seed anatomy: Anatomy of fleshy and dry fruits - follicle, legume, berry. Dehiscence of fruits. Structure of seeds. Anatomical factors responsible for seed dormancy and drought resistance.	PPT/ Lecturing		CO1, CO2, CO3, CO4
MODULE VI Ecological Anatomy				
37-40	Morphological and structural adaptations in different ecological groups - hydrophytes, xerophytes, epiphytes and halophytes.	PPT/ Lecturing		CO1, CO2, CO3, CO4
MODULE VII Applied Anatomy				
41-42	Applications of anatomy in systematics (histotaxonomy) and Pharmacognosy. Research prospects in anatomy.			CO1, CO2, CO3, CO4
PRACTICAL				
43	Study of cambia - non storied and storied.	Lab Work		CO1, CO2, CO3, CO4
44-49	Study of the anomalous primary and secondary features in *Amaranthus*, *Boerhaavia*, *Mirabilis*, *Nyctanthes*, *Piper* and *Strychnos*.			CO1, CO2, CO3, CO4
50-51	Study of stomata, trichomes, and			CO1, CO2,

	laticifers. Determination of stomatal index.			CO3, CO4
52-53	Study of the anatomical peculiarities of C4 and CAM plants (Leaf/Stem).			CO1, CO2, CO3, CO4
54-56	Study of nodal patterns.			CO1, CO2, CO3, CO4
57	Preparation of a histotaxonomic key.			CO1, CO2, CO3, CO4
58-59	Study of the pericarp anatomy of a legume, follicle and berry.			CO1, CO2, CO3, CO4
60	Identification of wood - soft wood and hard wood.			CO1, CO2, CO3, CO4

ASSIGNMENTS AND SEMINARS				
	Topic	Nature of Assignment		
1	Secondary Xylem and Phloem: Ontogeny, Structure and Function; Lignification patterns of Xylem	Written and Seminar Presentation		CO1, CO2, CO3, CO4
2	Comparison of Anomalous Secondary Thickening in Nyctanthes, Piper and Strychnose stems	Written and Seminar Presentation		CO1, CO2, CO3, CO4
3	Vascular Cambium	Written and Seminar Presentation		CO1, CO2, CO3, CO4
4	Plant Fibres - Disrtibution, Structure and Importnace of Coir, Jute and Cotton	Written and Seminar Presentation		CO1, CO2, CO3, CO4
5	Comparison of Anomalous Secondary Thickening in Boerhaavia, Mirabilis and Amaranthus stems	Written and Seminar Presentation		CO1, CO2, CO3, CO4

TEXT BOOKS AND 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. Ella Werker (1997). Seed Anatomy. Borntreager. University of Michigan
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

10. Reghu C P (2002). Structural features of Rubber wood. Rubberwood Processing and utilization in India.Ganesh Publications, Bangalore
11. Wardrop A B (1964). Reaction wood Anatomy in Arborescent angiosperms. Formation of wood in forest trees (Ed, Zimmerman). Academic press, New York.
12. Wardrop A B (1961). The structure and formation of reaction wood in Angiosperm: Problems of tree physiology. Recent advances in Botany (Vol II). University of Toronto press.

PRINCIPLES OF ANGIOSPERM SYSTEMATICS & MORPHOLOGY

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
PRINCIPLES OF ANGIOSPERM SYSTEMATICS & MORPHOLOGY				
MODULE I				
37	Historical background of classification - Artificial, natural and phylogenetic systems	PPT/Lecture		CO6
38	Importance of taxonomy	PPT/Lecture	e- resource	CO6
MODULE II				
39	Species/Genus/Family and other categories	PPT/Lecture		CO6
40	Species concept and intraspecific categories - subspecies, varieties and forms	PPT/Lecture	Quiz	CO6
MODULE III				
41	Plesiomorphic and Apomorphic characters	PPT/Lecture	video	CO6
42	Homology and Analogy	PPT/Lecture		CO6
43	Parallelism and Convergence	PPT/Lecture	e- resource	CO6
44	Monophyly, Paraphyly and Polyphyly	PPT/Lecture		CO6
45	Phylogenetic tree - Cladogram	PPT/Lecture		CO6
46	Phylogenetic tree - Phenogram	PPT/Lecture	Quiz	CO6
MODULE IV				
47	Sources of taxonomic characters - Anatomy & Cytology	PPT/Lecture		CO6
48	Sources of taxonomic characters - Phytochemistry	PPT/Lecture		CO6
49	Sources of taxonomic characters - Molecular taxonomy	PPT/Lecture	Quiz	CO6
MODULE V				
50	Phenetic - Numerical Taxonomy - principles	PPT/Lecture		CO6
51	Numerical Taxonomy- methods	PPT/Lecture	e- resource	CO6
52	Cladistic - Principles	PPT/Lecture		CO6
53	Cladistic - methods	PPT/Lecture		CO6

MODULE VI				
54	History of ICN	PPT/Lecture	e- resource	CO6
55	ICN - aims and Principles	PPT/Lecture		CO6
56	ICN - rules and recommendations	PPT/Lecture		CO6
57	Rules of priority, typification, author citation	PPT/Lecture		CO6
58	Retention, rejection and changing of names	PPT/Lecture		CO6
59	Effective and valid publication	PPT/Lecture	Quiz	CO6
MODULE VII				
60	Chemotaxonomy - Theory	PPT/Lecture		CO6
61	Chemotaxonomy - Applications	PPT/Lecture	video	CO6
62	DNA barcoding - Procedure	PPT/Lecture		CO6
63	DNA barcoding - Applications	PPT/Lecture	e- resource	CO6
MODULE VIII				
64	Habitat and habit			CO5
65	Morphology of root	PPT/Lecture		CO5
66	Morphology of stem	PPT/Lecture		CO5
67	Morphology of leaf,	PPT/Lecture		CO5
68	bract and bracteoles	PPT/Lecture		CO5
69	inflorescence	PPT/Lecture		CO5
70	Flowers	PPT/Lecture		CO5
71	Fruits	PPT/Lecture		CO5
72	Seeds	PPT/Lecture	Quiz	CO5
PRINCIPLES OF ANGIOSPERM SYSTEMATICS & MORPHOLOGY - PRACTICAL				
109	1. Morphology of leaf: Leaf attachment, Stipules, Patterns of leaf, Phyllotaxy, Shapes of leaf lamina, bases, margins and tips, Venation. 2. 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. 3. Morphology of stamens: Mono- , Di- and Polyadelphous; Epipetalous,	Hands -on		CO5, CO6
110		Hands -on		CO5, CO6
111		Hands -on		CO5, CO6
112		Hands -on		CO5, CO6
113		Hands -on		CO5, CO6
114		Hands -on		CO5, CO6
115		Hands -on		CO5, CO6
116		Hands -on		CO5, CO6
117		Hands -on		CO5, CO6
118		Hands -on		CO5, CO6
119		Hands -on		CO5, CO6
120		Hands -on		CO5, CO6
121		Hands -on		CO5, CO6
122		Hands -on		CO5, CO6
123		Hands -on		CO5, CO6

124	Syngenesious, Synandrous, Polyandrous, Didynamous, Tetradynamous, Basifixed, Dorsifixed, Versatile. 4. Morphology of carpels: Apocarpous, Syncarpous, Gynostegium. Placentation - Marginal, Parietal, Axile, Free central, Basal and Pendulous. 5. Morphology of fruits: Berry, Drupe, Hesperidium, Pepo, Balausta, Amphisarca, Achene, Follicle, Capsule, Legume, Lomentum, Nut, Caryopsis, Cypsela, Samara, Cremocarp, Siliqua, Carcerule, Regma. 6. Aggregate fruits; Composite fruits - Sorosis and Syconus; Pome. 7. Draw the L.S and floral diagram of at least 10 flowers having different ovary positions - hypogyny, perigyny and epigyny. 8. Workout nomenclatural problems regarding priority and author citations.	Hands -on		CO5, CO6
125		Hands -on		CO5, CO6
126		Hands -on		CO5, CO6
127		Hands -on		CO5, CO6
128		Hands -on		CO5, CO6
129		Hands -on		CO5, CO6
130		Hands -on		CO5, CO6
131		Hands -on		CO5, CO6
132		Hands -on		CO5, CO6
133		Hands -on		CO5, CO6
134		Hands -on		CO5, CO6
135		Hands -on		CO5, CO6

ASSIGNMENT /SEMINAR

Sl. No.	Topic	Nature of Assignment	Course Outcome
1	Collection and identification of vegetative and reproductive structures of angiosperms	Collection and submission of specimens	CO 5, CO 6
2	Interdisciplinary approach of taxonomy	Written and Seminar Presentation	CO 5, CO 6

References

1. Lawrence George H M (1951). Taxonomy of vascular plants. Oxford and IBH Publ. Co. Pvt. Ltd.

2. Jeffrey C (1968). An Introduction to principles of Plant Taxonomy.

3. Cole A J (1969). Numerical Taxonomy. Academic Press.

4. Davis P H, Heywood V M (1973). Principles of Angiosperm Taxonomy. Robert E Kereiger Publ.

5. Harrison H J (1971). New Concepts in Flowering Plant Taxonomy. Heiman Educational Books Ltd.

6. Cronquist A (1981). An Integrated system of classifications of flowering plants. Columbia University Press.
7. Heywood V H, D M Moore (Eds) (1984). Current concept in Plant Taxonomy.
8. Naik V V (1984). Taxonomy of Angiosperms. Tata McGraw Hill Publ. Co. Ltd.
9. Radford A E (1986). Fundamentals of Plant Systematics. Harper & Row Publ.
10. Davis P H, V H Heywood (1991). Principles of Angiosperm Taxonomy. Today and Tomorrow Publications.
11. Stace C A (1989). Plant Taxonomy and Biosystematics. Etwaed Arnold.
12. Woodland D W (1991). Contemporary Plant Systematics. Prentice Hall.
13. Sivarajan V V (1991). Introduction to Principles of Plant Taxonomy. Oxford IBH.
14. Takhtajan A L (1997). Diversity and Classification of Flowering Plants. Columbia Univ. Press.
15 Taylor D V, L J Hickey (1997). Flowering plants: Origin, evolution and phylogeny. CBS Publishers & Distributors.
16. Stuessy T F (2002). Plant taxonomy: The systematic Evaluation of comparative data. Bishen Singh, Mahendra Pal Singh. Dehradun.
17. Gurcharan Singh (2004). Plant Systematics: Theory and practice. Oxford and IBH Publishing.
18. Wendy B Zomlefer (2006). Guide to Flowering Plant Families. Overseas Press India Private Ltd.
19. International Code of Botanical Nomenclature (latest)
20. Henry A N, Chandrabose M (1980). An aid to the International Code of Botanical Nomenclature.

COURSE PLAN

PROGRAMME	M.Sc. BOTANY	SEMESTER	2
COURSE CODE AND TITLE	16P2BOTT07: MOLECULAR BIOLOGY AND IMMUNOLOGY	CREDIT	4
HOURS/WEEK	5.5	HOURS/SEM	Theory 54+18 hrs; Practical 9+18 hrs
FACULTY NAME	PRINCY MOL A. P.		

Programme Outcome

	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	The students are able to effectively communicate the knowledge of their study and research in their respective disciplines to their employers and to the society at large.
PO 3	The students are able to make choices based on the values upheld by the college, and have the readiness and know-how to preserve environment and work towards sustainable growth and development
PO 4	The students possess an ethical view of life, and have a broader (global) perspective transcending the provincial outlook
PO 5	The students possess a passion for exploring 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	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	Explain the basic properties, structure and functions of genetic materials.	PO1, PO2, PO4, PO5, PSO1, PSO2, PSO3, PSO5	U
CO 2	Explain the central dogma of molecular biology.	PO1, PO3, PO4, PO5, PSO1, PSO2, PSO3, PSO5	U, A, An
CO 3	Develop a thorough knowledge in gene expression mechanisms.	PO1, PO2, PO4, PO5, PSO1, PSO2, PSO3, PSO5	U, A, An
CO 4	Explain the mechanism of DNA repair systems	PO1, PO2, PO4, PO5, PSO1, PSO2, PSO3, PSO4, PSO5	U, A, An
CO 5	Compare the alternate forms of DNA and its significance	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2, PSO3, PSO5	R, U
CO 6	Compare the diversity of RNA molecules and its diverse functions in biological systems.	PO1, PO4, PO5, PSO1, PSO3	R, U, A

CL* Cognitive Level

R - Remember

U - Understand

A - Apply

An - Analyze

E - Evaluate

Cr - Create

CO - PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2		2	3	3	2	3		2
CO 2	1		1	2	2	2	2	1		3
CO 3	3	2		3	2	2	2	3		3
CO 4	1	1		1	2	3	1	3	1	2
CO 5	1	2	2	2	3	3	2	3		1
CO 6	2			3	2	2		3		

Mapping Strength

0- No Mapping strength

1- Low

2- Medium

3- High

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
MOLECULAR BIOLOGY				
MODULE I - Genetic material and its molecular structure				
1	Alternative conformations of DNA – A-DNA, Z-DN, C-DNA, E – DNA, triplex DNA, H-DNA and quadruplex DNA Circular and linear DNA, Single-stranded DNA.	PPT/Lecture		CO1, CO5
2		PPT/Lecture	e-resource	CO1, CO5
3		PPT/Lecture		CO1, CO5
4		PPT/Lecture		CO1, CO5
5		PPT/Lecture		CO1, CO5
6	Structure and function of different types of RNA - mRNA, tRNA, rRNA, SnRNA, and Micro RNA. RNA tertiary structures.	PPT/Lecture		CO1, CO6
7		PPT/Lecture		CO1, CO6
8		PPT/Lecture	e-resource	CO1, CO6
9		PPT/Lecture		CO1, CO6
10	Ribozymes – Hammerhead ribozymes.	PPT/Lecture		CO1
11	C-value paradox, DNA renaturation kinetics, Tm, Cot curve.	PPT/Lecture		CO1

12	Unique and Repetitive DNA – mini- and microsatellites	PPT/Lecture		CO1
MODULE II - DNA replication, repair and recombination				
13	DNA replication: Unit of replication, enzymes and proteins involved in replication (in both procaryotes and eucaryotes). Structure of the replication origin (in both procaryotes and eucaryotes), priming (in both procaryotes and eucaryotes), replication fork, fidelity of replication. Process of replication – initiation, elongation and termination. Replication in the telomere - telomerase.	PPT/Lecture	e-resource	CO1, CO2
14		PPT/Lecture	video	CO1, CO2
15		PPT/Lecture		CO1, CO2
16		PPT/Lecture		CO1, CO2
17	DNA repair mechanisms: Direct repair, excision repair – base excision repair and nucleotide excision repair (NER), eucaryotic excision repair – GG-NER, TC-NER. Mismatch repair, Recombination repair – homologous recombination repair, nonhomologous end joining, SOS response – Transletion DNA polymerase.	PPT/Lecture	video	CO1, CO4
18		PPT/Lecture		CO1, CO4
19		PPT/Lecture		CO1, CO4
20	Recombination: Homologous and nonhomologous recombination, molecular mechanism of homologous recombination. Site-specific recombination.	PPT/Lecture	e-resource	CO1
21		PPT/Lecture		CO1
22	Transposable elements: General features, Types of transposons, Cut and paste transposons- IS Elements, Composite Transposons, Ac and Dselements, P Elements. Replicative transposon- Tn3 Elements. Retrotransposons- retrovirus like elements: Ty1 Element, Retroposons- LINEs, SINEs.	PPT/Lecture	e-resource	CO1
23		PPT/Lecture		CO1
24		PPT/Lecture		CO1
25		PPT/Lecture		CO1
MODULE III - Gene expression				
26	Gene: Concept of gene; structural and genetic definitions – complementation test.	PPT	video	CO 1
27		PPT/Lecture		CO 1
28		PPT/Lecture		CO 1

29		PPT/Lecture	e-resource	CO 1
30	Transcription in procaryotes: Initiation – promoter structure, structure of RNA polymerase, structure and role of sigma factors. Elongation – elongation complex, process of RNA synthesis. Termination – rho-dependent and rho-independent termination.	PPT/Lecture		CO 1
31		PPT/Lecture		CO 1
32		Lecture		CO 1
33		Lecture		CO 1
34		Lecture		CO 1
35		Lecture		CO 1
36	Transcription in eucaryotes: Types, structure and roles of RNA polymerases. Promoters – important features of class I, II, & III promoters. Enhancers and silencers. General transcription factors and formation of pre-initiation complex. Elongation factors, structure and function of transcription factors. Post-transcriptional events: Split genes, splicing signals, splicing mechanisms of group I, II, III, and tRNA introns. Alternative splicing, exon shuffling, cis and transsplicing. Structure, formation and functions of 5' cap and 3' tail of mRNA, RNA editing, mRNA export. rRNA and tRNA synthesis and processing.	PPT/Lecture		CO 1
37		PPT/Lecture		CO 1
38		PPT/Lecture		CO 1
39		PPT/Lecture		CO 1
40		PPT/Lecture		CO 2
41		Lecture		CO 2
42		Lecture		CO 2
43		Lecture		CO 2
44		Lecture		CO 2
45		PPT/Lecture		CO 2
46	Translation: Important features of mRNA – ORF, RBS. Fine structure, composition and assembly of procaryotic and eukaryotic ribosomes. tRNA charging, initiator tRNA. Stages in translation: Initiation – formation of initiation complex in procaryotes and eucaryotes, initiation factors in procaryotes and eucaryotes, Kozak sequence.	PPT/Lecture		CO 2
47		PPT/Lecture		CO 2
48		PPT/Lecture		CO 2
49		Lecture		CO 2
50		Lecture		CO 2
51	Elongation – process of polypeptide synthesis, active centers in ribosome - 3-site model, peptidyl transferase, elongation factors. Termination – process of	Lecture		CO 2
52		Lecture		CO 2
53		PPT/Lecture		CO 2
54		PPT/Lecture		CO2

55	termination, release factors, ribosome recycling	PPT/Lecture		CO 2
56	revision			
CIA I				
57	Genetic code: Cracking the genetic code – simulation synthetic polynucleotides and mixed copolymers, synthetic triplets. Important features of the genetic code, proof for the triplet code, Exceptions to the standard code. Protein sorting and translocation: Cotranslational and posttranslational – signal sequences, SRP, translocon.	PPT/Lecture		CO 3
58		PPT/Lecture		CO 3
59		PPT/Lecture		CO 3
60		Lecture	Quiz	CO 3
61		Lecture	Q & Ans Session	CO 4
62		PPT/Lecture		CO 4
63	Membrane insertion of proteins. Post-translational modification of proteins. Protein folding – self-assembly, role of chaperones in protein assembly	PPT/Lecture		CO 4
64		PPT/Lecture		CO 4
MODULE IV - Control of gene expression				
65	Viral system: Genetic control of lytic and lysogenic growth in λ phage, lytic cascade Procaryotic system: Transcription switches, transcription regulators. Regulation of transcription initiation; Regulatory proteins - activators and repressors. Structure of Lac operator, CAP and repressor control of lac genes. Regulation after transcription initiation – regulation of amino acid biosynthetic operons- attenuation of trp operon, riboswitches.	PPT/Lecture		CO 4
66		Lecture		CO 4
67		PPT/Lecture		CO 4
68		PPT/Lecture		CO 4
69		PPT/Lecture		CO 4
70	Eucaryotic system: Changes in chromatin and DNA structure – chromatin compaction, transcriptional activators and repressors involved in chromatin remodelling, gene amplification, gene rearrangement, alternate splicing, gene silencing by heterochromatization, and DNA methylation. Effect of regulatory	PPT/Lecture		CO 4
71		PPT/Lecture		CO 4
72		PPT/Lecture		CO 4

	transcription factors on transcription. Post-transcriptional control – mRNA stability, RNA interference. Role of small RNA in heterochromatization and gene silencing. RNA interference- Discovery, RNAi path way, miRNA, siRNA, piwiRNA			
IMMUNOLOGY				
MODULE I				
73	a. Innate and acquired immunity. Cells and molecules involved in innate and acquired immunity	Lecture/ Interaction/ PPT		CO1
74	a. Humoral and cellular immunity, Antigens, Epitopes	Lecture/ Interaction/ PPT		CO1
75	b. Structure, function and types of antibody molecules. Antigen-antibody interactions.	Lecture/ Interaction/ PPT	e-resource	CO1
76	b. Antigen processing and presentation.	Lecture/ Interaction/ PPT		CO1
77	c. Activation and differentiation of B cells – formation, role.	Lecture/ Interaction/ PPT	Video, e-resource	CO1
78	c. T cells – types, roles, T cell receptors.	Lecture/ Interaction/ PPT/ Audio visual learning/ Practical	Video, e-resource	CO1
79	d. Primary and secondary immune modulation	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
80	d. complement system, pattern recognition receptors – toll-like receptors.	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
81	d. MHC molecules. Cell-mediated effector functions, inflammation	Lecture/ Interaction/ PPT/Audio visual learning	e-resource	CO1
82	Hypersensitivity and autoimmunity, congenital and acquired immunodeficiencies.	Lecture/ Interaction/ PPT/Audio visual learning		CO1
MODULE II				
83	a. Generation of antibody diversity.	Lecture/ Chalk and board/ Interaction/ PPT	e-resource	CO1
84	b. Production and uses of monoclonal antibodies	Lecture/ Interaction/ PPT/		CO1

		Assignment		
85	Antibody engineering.	Lecture/ Interaction/ PPT/ Assignment		CO1
MODULE III				
86	a. Vaccines: Basic strategies, inactivated and live attenuated pathogens,	Lecture/ Interaction/ PPT		CO1
87	b. subunit vaccines	Lecture/ Interaction/ PPT	e-resource	CO1
88	recombinant vaccines (e.g., Hepatitis B vaccine)	Lecture/ Interaction/ PPT		CO1
89	DNA vaccines	Lecture/ Interaction/ PPT	e-resource	CO1
90	b. Modern approaches to vaccine development - edible vaccines.	Lecture/ Interaction/ PPT		CO1
PRACTICAL				
91	Molecular Biology Problems	Demonstration		CO6
92	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	02/01/2020	Viral System		CO 2
2	28/01/2020	Genetic code		CO 3
3	14/02/2020	Vaccines: Basic strategies, inactivated and live attenuated pathogens,	Review report on recent research works in the respective fields	CO1
4	14/02/2020	Subunit vaccines, recombinant vaccines (e.g., Hepatitis B vaccine)		CO1
5	14/02/2020	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.
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4	Talaro, K. P. and Chess, B (2012). Foundations in Microbiology (8th edition). Mc Graw Hill
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	Disorders of the Immune System (2nd edition). Saunders - Elsevier
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7	Wayne M Becker, Lewis J Kleinsmith, Jeff Hardin (2007). *The world of the cell* (VI Edn). Pearson.
8	Geoffrey M Cooper, Robert E Hausman (2009). *The Cell: A molecular approach* (V Edn). Sinaeur.
9	Harvey Lodish, Arnold Berk, Lawrence Zipursky, Paul Matsudaira, David Baltimore, James Darnell (2000). *Molecular cell biology* (IV Edn). W H Freeman & Company.
10	Gerald Karp (2008). *Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons.
11	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.
12	Robert J Brooker (2009). *Genetics: analysis and principles* (III Edn). McGraw Hill.
13	Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick (2011). *Lewin's Genes X*. Jones and Bartlett Publishers.
14	Bob B Buchanan, Wilhelm Gruissem, Russel L Jones (2000). *Biochemistry and Molecular biology of plants*. I K International Pvt. Ltd.
15	Daniel L Hartl, Elizabeth W Jones (2012). *Genetics: Analysis of genes and genomes* (VII Edn). Jones and Bartlett publishers.
16	James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine, Richard Losick (2009). *Molecular biology of the gene* (V Edn). Pearson.

COURSE PLAN

PROGRAMME	MASTERS IN BOTANY	SEMESTER	2
COURSE CODE AND TITLE	16P2BOTT08: GENETICS AND BIOCHEMISTRY	CREDIT	3
HOURS/WEEK	6	HOURS/SEM	108
FACULTY NAME	EBIN PJ		

PROGRAMME OUTCOME	
PO 1	Students are capable of exercising their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Students are able to effectively communicate the knowledge of their study and research in their respective disciplines to their employers and to the society at large.
PO 3	Students are able to make choices based on the values upheld by the college, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO 4	Students possess an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Students possess a passion for exploring 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	
PSO1	Understand functional and theoretical concepts of the biological world and their relative role in the sustainability of natural habitats and biodiversity
PSO2	Possess knowledge on the evolutionary relationships among the plant
PSO3	Understand the applications of plant biology in various desciplines and communicate effectively with the society.
PSO4	Perform laboratory procedures as per ethics and following standard protocols
PSO5	Synthesize the scientific character of observation, reasoning and apply the knowledge in designing of experiments

	COURSE OUTCOMES	PO/ PSO	CL
CO 1	Define Mendelian and Non-Mendelian modes of inheritance that governs passage of genetic traits across generation.	PO 1, PO5, PSO2, PSO1	R
CO 2	Explain the Hardy-Weinberg equilibrium.	PO1 , PO4, PO5, PSO1, PSO3, PSO5	U
CO 3	Analyse and solve problems related to map distance, gene order, coefficient of coincidence, interference and population genetics	PO1, PO2, PSO1, PSO3, PSO5	An
CO 4	Identify and compare the structure and functions of biomolecules.	PO1, PSO2, PO3, PO5, PSO1, PSO3, PSO5	A
CO 5	Explain genetics behind cancer, enzymology, nucleotide metabolism and secondary metabolites.	PO1, PO2 PSO1, PSO3, PSO4, PSO5	U
CO 6	Perceive detailed account on enzymology, nucleotide metabolism and secondary metabolites.	PO1, PO3, PSO1, PSO3, PSO4, PSO5	E

CL* Cognitive Level; R- Remember, U- Understand, A-Apply, An- Analyze, E- Evaluate, Cr- Create

CO - PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	0	0	0	3	3	1	0	0	0
CO 2	3	0	0	3	2	3	0	2	0	3
CO 3	3	1	0	0	0	3	0	2	0	3
CO 4	3	0	3	0	0	3	2	2	0	3
CO 5	3	2	0	0	0	3	0	2	3	3
CO 6	3	0	2	0	2	3	0	2	3	3

Mapping Strength

0- No Mapping strength
1- Low
2- Medium
3- High

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
GENETICS				
Module 1: History of Genetics (3 hrs)				
Session 1	Transmission genetics, Molecular genetics and Population genetics (brief introduction). Mendelism – basic principles (brief study).	PPT/Lecture	Seminar	CO 1
Session 2	Extensions of Mendelism, penetrance and expressivity of genes.	PPT/Lecture		CO 1
Session 3	Nonmendelian inheritance – cytoplasmic inheritance. Sex determination in animals and plants.	PPT/Lecture	Seminar	CO 1
Module 2: Linkage and genetic mapping (6 hrs)				
Session 4	Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments	PPT/Lecture	Video	CO3
Session 5	single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order,	PPT/Lecture		CO3
Session 6	interference and co efficient of coincidence.	PPT/Lecture		CO3
Session 7	Haploid mapping (Neurospora)	PPT/Lecture	video	CO3
Session 8	Mapping in bacteria and bacteriophages	PPT/Lecture	Seminar	CO3
Session 9	Inheritance of traits in humans; pedigree analysis, determination of human genetic diseases by pedigree analysis, genetic mapping in human pedigrees.	PPT/Lecture		CO3
Module 3: Quantitative genetics (2 hrs)				
Session 10	Polygenic inheritance, QTL,	PPT/Lecture		CO1, CO3
Session 11	effect of environmental factors and artificial selection on polygenic inheritance.	PPT/Lecture		CO1, CO3
Module 4: Population genetics (7hrs)				
Session 12	Gene pool, allele and genotype frequency	PPT/Lecture		CO2
Session 13	Hardy-Weinberg law and its applications	PPT/Lecture		CO2

Session 14	estimation of allele and genotype frequency of dominant genes, co-dominant genes, sex-linked genes and multiple alleles	PPT/Lecture		CO2
Session 15	Genetic equilibrium, genetic polymorphism.	PPT/Lecture		CO2
Session 16	(b) Factors that alter allelic frequencies; (i) mutation (ii) genetic drift - bottle neck effect and founder effect	PPT/Lecture		CO2
Session 17	migration (iv) selection (v) nonrandom mating, inbreeding coefficient	PPT/Lecture		CO2
Session 18	Balancing of evolutionary forces	PPT/Lecture	Seminar	CO2
Genetics Practical (18 hrs)				
Session 19	problems related to linkage, crossing over and gene mapping, human pedigree analysis.	hands-on		CO1, CO3
Session 20		hands-on		CO1, CO3
Session 21		hands-on		CO1, CO3
Session 22		hands-on		CO1, CO3
Session 23		hands-on		CO1, CO3
Session 24		hands-on		CO1, CO3
Session 25		hands-on		CO1, CO3
Session 26		hands-on		CO1, CO3
Session 27		hands-on		CO1, CO3
Session 28	problems related to population genetics - gene and genotype frequency, Hardy Wienberg equilibrium	hands-on		CO2
Session 29		hands-on		CO2
Session 30		hands-on		CO2
Session 31		hands-on		CO2
Session 32		hands-on		CO2
Session 33		hands-on		CO2

Session 34		hands-on		CO2
Session 35		hands-on		CO2
Session 36		hands-on		CO2
BIOCHEMISTRY (Theory 54 hrs; Practical 18 hrs)				
Module 1: pH and Buffer (5 hrs)				
Session 37	Acids and bases, strength of acids – strong acids, weak acids	PPT/Lecture	Seminar	CO4
Session 38	Ionization of water – Kw, pH. Dissociation of acids – pKa, Henderson-Hasselbalch equation	PPT/Lecture	Seminar	CO4
Session 39	Buffers – definition, chemical composition, requirements for a good buffer	PPT/Lecture	Seminar	CO4
Session 40	buffer action, buffer capacity	PPT/Lecture	Seminar	CO4
Session 41	Measurement of pH – colorimetric methods and electrometric methods	PPT/Lecture	Seminar	CO4
Module 2: Carbohydrates (3 hrs)				
Session 42	Sugar derivatives:Glycoproteins	PPT/Lecture		CO4
Session 43	proteoglycans, mucoproteins	PPT/Lecture		CO4
Session 44	Lectins.	PPT/Lecture		CO4
Module 3: Lipids (3 hrs)				
Session 45	Structural lipids – membrane lipids	PPT/Lecture		CO4
Session 46	Lipid biosynthesis	PPT/Lecture		CO4
Session 47	fat breakdown – β oxidation	PPT/Lecture	Video	CO4
Module 4: Amino acids (3 hrs)				
Session 48	Structure of amino acids	PPT/Lecture		CO4
Session 49	Classification of amino acids	PPT/Lecture		CO4
Session 50	Biosynthesis of amino acids	PPT/Lecture		CO4
Module 5: Proteins (8 hrs)				
Session 51	Classification of proteins based on structure and function.	PPT/Lecture	Video	CO4
Session	Oligo- and polypeptides	PPT/Lecture		CO4

52				
Session 53	Primary structure – peptide bond.	PPT/Lecture		CO4
Session 54	Secondary structure – Ramachandran plots, α-helix, β sheet.	PPT/Lecture		CO4
Session 55	Tertiary structure – forces that stabilize tertiary structure	PPT/Lecture		CO4
Session 56	Quaternary structure, domains, motif and folds	PPT/Lecture		CO4
Session 57	Protein sequencing – Edman method.	PPT/Lecture		CO4
Session 58	Functions of proteins.	PPT/Lecture		CO4
Module 6: Protein turnover and amino acid catabolism (5 hrs)				
Session 59	Degradation of proteins to amino acids	PPT/Lecture		CO4
Session 60	Protein turnover and its tight regulation	PPT/Lecture		CO4
Session 61	steps involved in amino acid degradation.	PPT/Lecture		CO4
Session 62	Structure of Proteasome complex	PPT/Lecture		CO4
Session 63	working mechanism of Proteasome complex	PPT/Lecture	Video	CO4
Module 7: Enzymes (15 hrs)				
Session 64	Principles of catalysis: Activation energy of a reaction	PPT/Lecture		CO5, CO6
Session 65	General characters of enzymes - specificity, catalytic power, regulation.	PPT/Lecture		CO5, CO6
Session 66	IUB system of enzyme classification and naming.	PPT/Lecture	Seminar	CO5, CO6
Session 67	Mechanism of enzyme activity: Formation of ES complex	PPT/Lecture		CO5, CO6
Session 68	acid-base catalysis, covalent catalysis, metal ion catalysis	PPT/Lecture		CO5, CO6
Session 69	proximity and orientation effect, strain and distortion theory.	PPT/Lecture		CO5, CO6
Session 70	Factors affecting enzyme activity	PPT/Lecture		CO5, CO6
Session 71	Enzyme Kinetics: Michaelis-Menton kinetics	PPT/Lecture		CO5, CO6

Session 72	Lineweaver-Burk plot.	PPT/Lecture		CO5, CO6
Session 73	Mechanism of multi substrate reaction – Ping Pong, Bi-Bi mechanism.	PPT/Lecture		CO5, CO6
Session 74	Regulation of enzyme activity: Allosteric effect, control proteins, reversible covalent modification, proteolytic activation	PPT/Lecture		CO5, CO6
Session 75	Enzyme inhibition – reversible and irreversible inhibition, competitive, noncompetitive, uncompetitive inhibition, dixon plot	PPT/Lecture		CO5, CO6
Session 76	Cofactors and coenzymes: Essential ions, Coenzymes; structure and role of metabolite coenzymes – ATP;	PPT/Lecture	Seminar	CO5, CO6
Session 77	structure and role of vitamin derived coenzymes – NAD+, NADP+, FAD, FMN, TPP, PLP	PPT/Lecture	Seminar	CO5, CO6
Session 78	Biotin. Isozymes.	PPT/Lecture		CO5, CO6
Module 7:Nucleotide metabolism (4 hrs)				
Session 79	Structure of nucleotides	PPT/Lecture		CO4
Session 80	Functions of nucleotides	PPT/Lecture		CO4
Session 81	nucleotide biosynthesis by de novo pathway	PPT/Lecture		CO4
Session 82	nucleotide biosynthesis by salvage pathways	PPT/Lecture		CO4
Module 8:Secondary metabolites (6 hrs)				
Session 83	Classification of secondary metabolites	PPT/Lecture	Seminar	CO4
Session 84	biosynthesis and functions of terpenoids	PPT/Lecture		CO4
Session 85	biosynthesis and functions of alkaloids	PPT/Lecture		CO4
Session 86	biosynthesis and functions of phenolics	PPT/Lecture		CO4
Session 87	biosynthesis and functions of flavonoids	PPT/Lecture		CO4
Session 88	biosynthesis and functions of coumarins	PPT/Lecture		CO4
Biochemistry Practical (18 hrs)				
Session	Preparation of buffers of various	hands-on		CO4, CO5,

89	strength and pH			CO6
Session 90		hands-on		CO4, CO5, CO6
Session 91	Differentiating sugars based on osazone formation.	hands-on		CO4, CO5, CO6
Session 92		hands-on		CO4, CO5, CO6
Session 93	Quantitative estimation of reducing sugar using Dinitro salicylic acid (DNS) or Anthrone.	hands-on		CO4, CO5, CO6
Session 94		hands-on		CO4, CO5, CO6
Session 95	Separation and analysis of lipids and amino acids by TLC.	hands-on		CO4, CO5, CO6
Session 96		hands-on		CO4, CO5, CO6
Session 97	Quantitative estimation of protein by Lowry's method.	hands-on		CO4, CO5, CO6
Session 98		hands-on		CO4, CO5, CO6
Session 99	Preparation of molal, molar, normal and percentage solutions and their dilutions.	hands-on		CO4, CO5, CO6
Session 100		hands-on		CO4, CO5, CO6
Session 101	Estimation of purity of DNA (By DNA protein ratio).	hands-on		CO4, CO5, CO6
Session 102		hands-on		CO4, CO5, CO6
Session 103	Estimation of catalase activity.	hands-on		CO4, CO5, CO6
Session 104		hands-on		CO4, CO5, CO6
Session 105	Isolation and assay of amylase enzyme from germinating Pea seeds/appropriate plant material.	hands-on		CO4, CO5, CO6
Session 106		hands-on		CO4, CO5, CO6

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Course Outcome
1	By February	Enzyme mechanism	CO 5, CO 6
2		Hardy-Weinberg law	CO 2

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1. Benjamin Lewin (2000). Genes VII. Oxford university press.
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5. Carl Branden, John Tooze (1999). Introduction to protein structure (II Edn). Garland Publishing.
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