



DEPARTMENT OF BOTANY
PG SYLLABUS
(CBCS)

SEMESTER I TO IV

**MOUNT CARMEL COLLEGE,
AUTONOMOUS
58, PALACE ROAD
BENGALURU - 560052**

MOUNT CARMEL COLLEGE, AUTONOMOUS
CBCS SYLLABUS
M.1 Sc. - BOTANY
PROFORMA FOR THE BACHELORS MASTER DEGREE IN BOTANY

FIRST SEMESTER

Code	Title of the Paper	L:T:P	CREDIT	CIA (P+T)	ESE (P+T)	TOTAL
CC-01	Diversity of non-vascular plants Part I (Theory and Practical) (Virus, Bacteria, Fungi and Lichens)	3:0:4	5	15+ 30	35 + 70	150
CC-02	Diversity of non-vascular plants Part II (Theory and Practical) (Cyanobacteria, Algae and Bryophytes)	3:0:4	5	15+ 30	35 + 70	150
CC-03	Diversity of vascular plants and Paleobotany (Theory and Practical) (Pteridophytes, Gymnosperms and paleobotany)	3:0:4	5	15+ 30	35 + 70	150
CC-04	Medicinal Plants and their Application (Theory and Tutorials) (History of medicinal plants,	4:2:0	5	T: 30 + Tut: 50	70	150
AC – 01	Biostatistics	0:0:2	2	25	50	50
AC - 02	Applied Microbiology	0:0:4	2	15	35	50
	TOTAL	31	24			700

SECOND SEMESTER

Code	Title of the Paper	L:T:P	CREDIT	CIA (P+T)	ESE (P+T)	TOTAL
CC-05	Anatomy and Embryology (Theory and Practical)	3:0:4	5	15+ 30	35 + 70	150
CC-06	Ecology and Phytogeography (Theory and Tutorial)	4:2:0	5	T: 30 + Tut: 50	70	150
CC-07	Plant Physiology (Theory and Practical)	3:0:4	5	15+ 30	35 + 70	150
CC-08	Herbal Wealth II (Theory and Practical)	3:0:4	5	15+ 30	35 + 70	150
AC – 03	Analytical Phytochemistry and Cytology	0:0:4	2	15	35	50
AC - 04	Research Methodology	2:0:0	2	15	50	50
	Community Development Programme (CDP)		1			50
	TOTAL	34	25			750

THIRD SEMESTER

Code	Title of the Paper	L:T:P	CREDIT	CIA (P+T)	ESE (P+T)	TOTAL
EC-01	Taxonomy of Angiosperms (Theory and Practical)	3:0:4	5	15+ 30	35 + 70	150
EC-02	Cytogenetics, Plant breeding and Evolution (Theory + Tutorials)	4:2:0	5	T: 30 + Tut: 50	70	150
EC-03	Pharmacognosy (Theory + Practical)	3:0:4	5	15+ 30	35 + 70	150
EC-04	Applied Phycology (Theory + Practical)	3:0:4	5	15+ 30	35 + 70	150
AC – 05	Plant tissue culture technique and Vegetative propagation	0:0:4	1	15	35	50
OE	OPEN ELECTIVE (Non-Botany Students)	0:0:4	1	15	35	50
	Internship		2			50
	TOTAL	34	25			750

FOURTH SEMESTER

Code	Title of the Paper	L:T:P	CREDIT	CIA (P+T)	ESE (P+T)	TOTAL
EC-05	Advanced Plant Physiology (Theory + Practical)	3:0:4	5	15+ 30	35 + 70	150
EC-06	Biotechnology and Molecular Biology (Theory + Tutorials)	4:2:0	5	T: 30 + Tut: 50	70	150
EC-07	Tools and Techniques in Plant Science (Theory)	4:0:0	4	50	50	100
PR	PROJECT	12	8	50	50	200
	TOTAL	29	22			600

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**M. Sc. - BOTANY
SEMESTER I - BATCH 2020-2021**

Code	Paper title	L	T	P
CC-01	DIVERSITY OF NON-VASCULAR PLANTS – PART I	3	0	4

45 hrs

UNIT I

2 hrs

INTRODUCTION AND CLASSIFICATION: General characters of the five kingdoms of living organisms with emphasis on Kingdom Plantae (Whittaker); merits and demerits.

UNIT II

7 hrs

STUDY OF VIRUSES: General account, classification, structure and types; Cell cultivation (plant and animal cell types), purification (centrifugation), effect of physical and chemical agents on viruses; a brief account of Viroids, Prions and Interferons.

UNIT III

11 hrs

STUDY OF BACTERIA: General characteristics of Archaeobacteria (Mycoplasmas, Rickettsiae, Chlamydia, Spirochaetes, Actinomycetes) and Eubacteria. Ultra - structure of bacterial cell - cell wall (biosynthesis of peptidoglycan), cell membrane, capsule, external appendages, cytoplasmic inclusions, extranuclear genetic elements, endospore and cysts; Bacterial nutrition; Genetic recombination; Drug resistance; Economic importance.

UNIT IV

5 hrs

STUDY OF FUNGI: Classification of Fungi (Alexopoulos and Mims; Ainsworth); Structure including reproduction, phylogeny and interrelationships of various groups; Heterothallism in fungi – sexuality in fungi; parasexuality – sex hormones in fungi; economic importance of fungi.

UNIT V

9 hrs

FUNGI: General characters, structure and life cycle of Myxomycotina (*Plasmodiophora*), Mastigomycotina (*Saprolegnia*), Zygomycotina (*Rhizopus*), Ascomycotina (*Peziza*, *Erysiphe*), Basidiomycotina (*Puccinia*, *Polyporus*, *Ustilago*) and Deuteromycotina (*Alternaria*, *Fusarium*)

UNIT VI

3 hrs

FUNGAL ASSOCIATION AND ITS APPLICATION: Lichens - classification, structure, reproduction and economic importance; Mycorrhiza- structure and applications; Cultivation of mushrooms – *Pleurotus*.

UNIT VII**5 hrs**

PLANT PATHOLOGY: Host-pathogen interaction, defense mechanism in host, plant disease epidemiology, plant disease management - physical, chemical and biological control; Plant quarantine.

UNIT VIII**3 hrs**

FUNGAL DISEASES: General account; Symptoms, etiology, epidemiology and control measures of Late blight of Potato, Ergot of Bhajra, Smut of Sorghum, Rice blast and White rust of Crucifer.

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**PRACTICAL PAPER
CC – 01- DIVERSITY OF NON-VASCULAR PLANTS – PART I**

1. Viruses and Cyanobacteria - TMV – Tobacco and Papaya (Herbarium);
 2. Study of microbes (Bacteria and fungi) in Soil, water and air – solid- serial dilution.
+ plating
 3. Fungi – *Plasmodiophora*, *Saprolegnia*, *Rhizopus*;
 4. *Peziza* – External, L.S. of Apothecia (Slide); *Erysiphae*;
 5. *Puccinia* – primary and secondary host; *Polyporus* – external features;
 6. *Ustilago* – external and spores;
 7. *Alternaria*; *Fusarium*.
 8. Lichens – types and reproductive body; Cultivation of mushrooms – *Pleurotus*
 9. Pathology – late blight of Potato, Ergot of Bhajra, Smut of Sorghum, Rice blast and white rust of Crucifer.
 10. Revision and attestation of records
 11. Pre-final exam
 12. Final exam
- Submission: 5 specimen (Pathology 4; lichens 1) – 5 marks

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Code	Paper title	L	T	P
CC-02	DIVERSITY OF NON-VASCULAR PLANTS – PART II	3	0	4

45 hrs

UNIT I

3 hrs

STUDY OF CYANOBACTERIA: Distribution, cell structure, heterocyst and akinetes and their significance, chromatic adaptations and reproduction. *Spirulina*, *Microcystis* and *Oscillatoria*.

UNIT II

8 hrs

PHYCOLOGY I - Classification and general account of algae (according to Fritsch); Distribution and diversity in vegetative structure (Thallus organization).
Algal cell structure - Pigmentation, plastids, flagellation, storage products and cell wall composition of various divisions of algae

UNIT III

11 hrs

PHYCOLOGY II – Distribution, thallus organization, cell structure, reproduction and life cycle pattern with reference to Chlorophyceae (*Hydrodictyon*), Charophyceae (*Chara*), Bacillariophyceae (Diatoms), Xanthophyceae (*Vaucheria*), Phaeophyceae (*Dictyota*, *Sargassum*) and Rhodophyceae (*Gracilaria*).

UNIT IV

4 hrs

ECONOMIC IMPORTANCE OF ALGAE: Algae as environmental indicators, algae in agriculture, algae as sources of food, animal feed and pharmaceuticals; algal blooms, fossil algae.

UNIT V

5 hrs

BRYOPHYTES – History and classification (Proskauer, 1957); Diversity in structure of gametophytes and sporophytes, reproduction – asexual & sexual and life cycle.

UNIT VI

8 hrs

BRYOPHYTES - Structure, reproduction, sporophytes, spore dispersal mechanism and life history of Hepaticopsida – Marchantiales (*Riccia*), Sphaerocarpaceae, Jungermanniales (*Porella*), Calobryales; Anthocerotopsida – Anthocerotales (*Anthoceros*); Bryopsida – Sphagnales (*Sphagnum*), Funariales (*Funaria*), Polytrichales (*Polytrichum*).

UNIT VII**3 hrs**

ECONOMIC AND ECOLOGICAL IMPORTANCE OF BRYOPHYTES: Economic importance of bryophytes – direct and indirect uses (ethnomedicinal uses, phytoindicators and other uses); recent experimental work on bryophytes (ultra structure, chemical constituents and regeneration studies).

UNIT VIII**3 hrs**

PHYLOGENY OF BRYOPHYTES – Origin, evolution and interrelationship of bryophytes, evolution of sporophytes of bryophytes, fossil bryophytes.

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**PRACTICAL PAPER
CC – 02 - DIVERSITY OF NON-VASCULAR PLANTS – PART II**

1. Cyanobacteria – *Spirulina*, *Microcystis* and *Oscillatoria*.
2. Algae – *Volvox*, *Hydrodictyon*, *Chara*,
3. *Diatoms*, *Vaucheria*,
4. *Dictyota*, *Sargassum*
5. *Gracilaria* (Mounting/sectioning of algal material)
6. Bryophytes – *Porella*, *Riccia*
7. *Anthoceros*,
8. *Sphagnum* and
9. *Polytrichum* (Thallus T/S, Reproduction and sporophytes; sectioning)
10. Revision and attestation of records
11. Pre-final exam
12. Final exam

Submission: 5 specimen (Algae – 3; Bryophytes - 2) – 5 marks

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Code	Paper title	L	T	P
CC-03	DIVERSITY OF VASCULAR PLANTS (PTERIDOPHYTES GYMNOSPERMS) AND PALEOBOTANY	3	0	4

45 hrs

UNIT I

4 hrs

PTERIDOPHYTES I - General characteristics and classification of Pteridophytes (Reimer, 1954); Origin of Pteridophytes and Relationship of Pteridophytes with Bryophytes and Gymnosperms; Stelar evolution in pteridophytes; Heterospory and seed habit.

UNIT II

8 hrs

PTERIDOPHYTES II: Diversity in morphology, reproduction and life history of the following: **Psilotopsida** – Psilotales; **Lycopsida** – Lycopodiales, Isoetales, Selaginellales; **Sphenopsida** – Equisetales; **Pteropsida** – **Eusporangiate** - Ophioglossales, Marattiales, Osmudidae – Osmundales; **Leptosporangiate** - Filicales (Schizaeaceae, Polypodiaceae, Adiantaceae, Gleicheniaceae, Cyatheaceae, Hymenophyllaceae Aspleniaceae and Dryopteridaceae), Marsileales and Salviniaceae.

UNIT III

5 hrs

FOSSIL PTERIDOPHYTES: Systematic position, structure of the sporophyte and gametophyte of Psilophytales – *Rhynia*; Lepidodendrales – *Lepidodendron*, *Lepidostrobus*, *Lepidocarpon*; Calamitales – *Calamites*

UNIT IV

5 hrs

GYMNOSPERMS I – General Structure, reproduction, evolution, relationship with Pteridophytes and Angiosperms and classification of gymnosperms (K. R. Sporne, 1954); Phylogeny of Gymnosperms, Origin and evolution of ovule; Economic importance of gymnosperms

UNIT V

8 hrs

GYMNOSPERMS II - Diversity in the structure, anatomy, reproduction, life history and phylogeny of the orders Cycadales, Coniferales, Ginkgoales, Taxales and Gnetales.

UNIT VI**5 hrs**

FOSSIL GYMNOSPERMS: Systematic position, structure of the sporophyte and reproduction in Pteridospermales – *Medullosa*, Bennettitales – *Willamsoinii*, Pentoxylales – *Pentoxylon*, Cordaitales – *Cordaites*

UNIT VII**6 hrs**

PALEOBOTANY - Introduction, scope and objectives, Geological time scale and geological age determination; Fossilization - Ideal environment for preservation of plants as fossils, factors affecting fossilization, method of fossilization; types of fossils – impression, petrification, compression, mould, cast, amber, coal balls, nodules and pseudofossils; Brief account on techniques to study fossils - Ground thin section, Film or Peel technique, Maceration technique and Transfer technique. Paleobotanical nomenclature and provision made in ICBN for naming fossil plants.

UNIT VIII**4 hrs**

FLORA AND APPLICATION OF PALEOBOTANY - Gondwana flora of India; Contribution of Birbal Sahni; Applications of Paleobotany - fossils for fuel (oil) and as industrial raw material (coal).

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PRACTICAL PAPER

CC – 03 - BIODIVERSITY OF VASCULAR PLANTS AND PALEOBOTANY

1. Pteridophytes – Diversity of forms upto order level - *Psilotum*, *Lycopodium*, –
Thallus, T.S. rhizome, cones - L.S. and T.S.
2. *Equisetum*, *Ophioglossum*
3. *Osmunda*, *Salvinia*
4. *Marsilea* (Thallus T.S., Cones – T.S. and L.S) and other forms
5. Gymnosperms – Diversity of forms upto order level - *Cycas*,
6. *Cupressus*
7. *Taxus*
8. *Ephedra*
9. *Gnetum* – (Habit, Root (corolloid), stem, leaves, T.S. of sporangia, ovule (L.S.),
microspores) and other forms
10. Revision and attestation of records
11. Pre-final exam
12. Final exam

Submission: 1 slide submission (Pteridophyte / Gymnosperm) and two herbarium
(Pteridophyte / Gymnosperm) – 2 + (1 ½ x 2) = 5 marks

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Code	Paper title	L	T	P
CC-04	MEDICINAL PLANTS AND THEIR APPLICATION	4	2	0

52 hrs

UNIT I

6 hrs

HISTORY OF MEDICINAL AND AROMATIC PLANTS: - History of medicinal and aromatic plants - some important terms used in herbal medicine; Herbal industry; WTO Indian scenario- Prospects and constraints, export and import status; AAYUSH – Amchi (Tibetian), Ayurveda, Unani, Siddha and Homoeopathy; Chinese; Bach’s flower remedy; Aromatherapy.

UNIT II

6 hrs

IMPORTANCE OF MEDICINAL PLANTS: Relevance of herbal medicine as primary health care package; sources of information on medicinal plants; Organization of information in database (national and international); Causes for the decline and the current scenario in Indigenous systems of medicine; a comparative evaluation of accessibility and benefits of different systems of medicine

UNIT III

10 hrs

POISONOUS AND ALLERGIC PLANTS: Poisonous plants – classification; chemical constituents, symptoms, treatment and systematic description of some poisonous plants - *Papaver somnifera*, *Calotropis gigantea*, *Gloriosa superba*, *Digitalis purpurea*, *Datura metel*, *Strychnos nux-vomica*

Plant Allergens – Types and classification; description, symptoms, chemical constituents and treatment of the following allergic plants - *Parthenium hysterophorus*, *Urtica* sp., *Acacia* sp., *Eucalyptus globulus*, *Arachis hypogaea* and *Solanum*.

UNIT IV

5 hrs

REMEDIAL PLANTS: or heart, respiratory, skin, cancer, autoimmune, and liver diseases; nutraceuticals and cosmeceuticals; Vrikshayurveda - herbal remedies for plant disease

UNIT V

4 hrs

PSYCHOACTIVE PLANTS – classification; stimulants, nootropic plants (Plants for mental health), hallucinogens, depressants and anti-depressants.

UNIT VI

5 hrs

MARINE DRUGS, NATURAL PESTICIDES AND ANTIBIOTICS

Marine Drugs – Introduction, Classification – antimicrobial, anti-inflammatory, antispasmodic, antiparasitic, anticancer, cardiovascular, insecticide, anticoagulants, marine toxins.

Natural pesticides – introduction, method of pest control, classification, essentials of a good pesticide, pesticide and environment, examples – *Pyrethrum* (flowers), *Derris* (root), *Nicotiana and Azadirachta* (leaf) and *Cymbopogon* (Citronella oil).

Antibiotics – Introduction and classification – Aminoglycosides, Cephalosporins, Tetracyclines and Pencillins.

UNIT VII

9 hrs

TRADE AND COMMERCE OF MEDICINAL PLANTS OF INDIA – Potentials of medicinal plants – WHO and Indian Scenario; herbal medicine – a natural resource; commercial and medicinal uses of medicinal plants in India; Study of few commercial /raw drugs/ medicinal plants - *Usnea*; *Drynaria*; *Pinus*; *Vinca rosea*; *Rauwolfia serpentina*; *Withania somnifera*; *Coleus forskohlii*; *Emblica officinalis*; *Saraca asoca*; *Aloe vera*; *Glycyrrhiza glabra*; *Commiphora mukul*, *Boswellia serrata*.

UNIT VIII

7 hrs

ETHNOBOTANY – History, significance, scope and objectives of Ethnobotany, branches of ethnobotany; ethnomedicine in India; Tribes of India (Soliga and Kani – Western Ghats)

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Code	Paper title	L	T	P
AC-01	BIOSTATISTICS	2	0	0

26 hrs

Learning outcomes

Univariate data analysis

Students should be able to: Construct and analyze diagrammatic and graphical displays to summarised data. Compute and interpret measures of center and spread of data.

Bivariate data analysis

Students should be able to: Calculate, interpret and communicate the simple correlation and simple linear regression.

Probability and Theoretical distributions

Students should be able to: Utilize basic concepts of probability to calculate, interpret and communicate event probabilities. Determine the appropriate probability distribution based on experimental conditions and assumptions to evaluate probability.

Testing of hypothesis

Understand the goal of hypothesis testing and the basic structure of a hypothesis test, basic terminology including how to set up the null and alternative hypotheses, how to determine the possible outcomes of a hypothesis test and how to decide between these possible outcomes.

Module 1

Univariate Data Analysis (7 hours)

Types of data, summarization of data through frequency distributions, bar diagrams and histograms.

Measures of central tendency – mean, median, mode.

Measures of dispersion – range, variance, standard deviation, coefficient of variation.

Module 2

Bivariate Data Analysis (3 hours)

Scatter plot, Karl Pearson's correlation, fitting linear regression.

Module 3

Probability and Theoretical Distributions (6 hours)

Probability - Basic terminology, classical definition, conditional probability, independence.

Random variables – discrete and continuous.

Binomial, Poisson and normal distributions-important properties and problems.

Module 4

Sampling (2 hours)

Meaning. Probability and non probability sampling techniques discussion through examples. Types of sampling - simple random sampling, stratified random sampling, systematic sampling and cluster sampling.

Module 5

Testing of Hypothesis (8 hours)

Random samples, parameter and statistic, types of hypothesis: null, alternative, simple, composite, one-sided, two-sided, types of errors, critical and acceptance regions. Large sample test for proportion, equality of proportions, t-test for single mean and equality of means, chi-square test for independence of attributes, ANOVA for one-way classified data.

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Code	Paper title	L	T	P
AC-01	APPLIED MICROBIOLOGY	0	0	4

1. Gram staining of bacteria
2. Staining of Capsule
3. Staining of Endospore
4. Study of bacterial motility and Micrometry
5. Estimation of Lactic acid and Lactose in milk
6. Wine preparation and estimation of alcohol (Alcoholmetry)
7. Assessment of AM colonization
8. MPN test-for coliform presence in water.
9. IMViC test
10. Revision
11. Prefinal exam
12. Final exam

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Code	Paper title	L	T	P
CC-05	ANATOMY AND EMBRYOLOGY	3	0	4

45 hrs

UNIT I

4 hrs

THEORIES OF ORGANIZATION OF APICAL MERISTEMS AND DIVERSITY IN STRUCTURE OF WOOD: Shoot, root and reproductive meristems; Patterns of secondary wall; tyloses; Classification of wood - reaction wood, heart wood and sap wood; growth rings and dendrochronology .

UNIT II

4 hrs

VASCULAR TISSUES: Xylem – Concepts of Proto and Metaxylem, Xylem differentiation, Vascular differentiation in Shoot Apex and Leaf Primordia
Phloem – Ultrastructure and Differentiation of Phloem Elements, Characteristics of Phloem Components.
A brief account of Histochemical staining technique.

UNIT III

10 hrs

SECRETORY CELLS AND TISSUES, NODAL ANATOMY, LEAF ANATOMY AND APPLICATION OF ANATOMY: Secretory cells and tissues (external and internal); structure, classification, types and economic importance.
Nodal anatomy – unilacunar, trilacunar and multilacunar. Origin of bud traces.
Ontogeny and histogenesis of bifacial leaf – Hibiscus, unifacial leaf – grass; Stomata – development and types.
Application of anatomy in detecting food adulteration and contamination, forensic science, as building material (application of wood and wood products) and in paper and fiber industry.

UNIT IV

6 hrs

ECOLOGICAL ANATOMY: Hydrophytes – *Hydrilla* – Stem; Mesophytes – *Tridax* – leaf; Xerophytes - *Aloe* leaf, *Pinus* needle; Epiphytes- *Vanda* and *Dischidia*; Halophytes *Sonneratia* – stem, leaf and pneumatophore, *Suaeda monoica* – leaf; Parasites – *Striga* and Saprophytes – *Monotropa*.

UNIT V

8 hrs

MICROSPORANGIUM AND OVULE: Structure of anther; Microsporogenesis-physiology and ultra structure; Pollen – Structure, Classification and cytochemistry, pollen mitosis, male germ unit (MGU) concept, pollen viability, storage and germination, pollen allergens, mellitopalynology.

Ovule - a general account of ontogeny and structure, Megasporogenesis and Megagametogenesis (Monosporic, disporic and tetrasporic) – Structure of embryo sac and a general account of embryo sac haustoria.

UNIT VI

3 hrs

SEXUAL INCOMPATIBILITY: Self incompatibility, Genetic basis of self-incompatibility, Physiology and biochemistry of incompatibility, Biological significance, Methods to overcome incompatibility.

UNIT VII

4 hrs

FERTILIZATION, APOMIXIS AND POLYEMBRYONY: Fertilization - Introduction, Structure of stigma and style, pollen germination (*in-vivo*), pollen tube entry into stigma, pollen tube growth, entry of pollen tube into female gametophyte, pollen – pistil interaction, double fertilization and its significance, a brief note on heterofertilization. Apomixis, Polyembryony and their practical importance.

UNIT VIII

6 hrs

ENDOSPERM AND EMBRYO: Structure, composition and development of endosperm and embryo; embryogenesis in *Ceratophalus falcatus* (dicot) and *Halophila ovata* (monocot), embryo – endosperm relationship; Suspensor structure and function.

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**PRACTICAL PAPER - CC – 05
ANATOMY AND EMBRYOLOGY**

1. Staining techniques - Histochemical studies – staining technique
 2. Xylem, phloem, maceration (*Aristolochia, Saraca, Tinospora, Cupresses*) and Thickenings in vessels and tracheids; Nodal anatomy - Unilacunar – *Nerium*,
 3. Nodal anatomy - Trilacunar – *Azadirachta*; Multilacunar – *Coriandrum, Polygonum* and Types of stomata based on distribution of subsidiary cells
 4. Embryology – microsporangium – young and old anther; types of pollen (based on availability)
 5. Mellitopalynology; Pollen germination (*Hibiscus, Vinca*)
 6. Estimation of pollen fertility; Acetolysis of pollen grains
 7. Megasporangium – types of ovules, Endosperm mounting – Cucumber
 8. Cytochemical localization of stigma – surface esterases
 9. Embryo mounting – *Tridax*– stages – globular and heart
 10. Revision and attestation
 11. Pre-final exam
 12. Final exam
- **Submission: 5 marks – Project –Histochemistry/ pollen and stigma study**

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Code	Paper title	L	T	P
CC-06	ECOLOGY AND PHYTOGEOGRAPHY	4	2	0

52 hrs

UNIT I

6 hrs

ECOLOGY AND ECOSYSTEM – Origin, scope, definition, homeostasis; Ecosystem - Definition, Composition, structure, function, kinds of ecosystem (one terrestrial and one aquatic), Trophic levels and energy flow, food chain, food webs, ecological pyramid, biological magnification, bio-geochemical cycle, resilience of ecosystem, ecosystem management. Ecological niche, ecocline, ecotone and edge effect. Limiting Factors: Concept of limiting factors-Liebig's law of the minimum, Shelford's law of Tolerance

UNIT II

8 hrs

PRODUCTIVITY IN ECOSYSTEM – Introduction, Types - primary productivity, secondary productivity, turn over, grass land, shrub land and forest ecosystem; Nonconventional sources of energy – wind, tidal, geothermal, biomass based energy.

UNIT III

5 hrs

ECOLOGICAL SUCCESSION - types, general trends, causes and processes of succession – hydrosere and xerosere.

UNIT IV

6 hrs

ECOLOGICAL FACTORS: Abiotic – Climatic (Global climatic pattern - global warming, atmospheric ozone, acid and nitrogen deposition), Topographic, edaphic; heavy metals and radionuclide in soil, erosion and conservation; Biotic - Competition, Mermecophily, Amensalism, Symbiosis, Parasitism and Epiphytism.

UNIT V

9 hrs

POLLUTION - Kinds (Air, water and soil pollution) and sources of pollution; Plant indicators of pollution – bioindicators, biomonitoring, bioremediation, biofuelling, biofilm and bio corrosion, current environmental problems-e-waste and its management, bioterrorism, case studies – Kaiga, Kolar mining, Narmada river valley project and Silent valley project and current environmental problems - Rehabilitation of lakes in and around Bangalore. Coping with climatic variations, El-Nino effect & green house effect.

UNIT VI

5 hrs

REMOTE SENSING AND GIS - scope, methodology and importance. Application of Remote sensing and GIS in Ecological science

UNIT VII**8 hrs**

PHYTOGEOGRAPHY AND PLANT DISTRIBUTION: Phytogeography - Introduction, definition, aims, principles and methods to study plant geography.

Plant Distribution – Vestor's classification based on shapes of area; types and patterns of distribution - continuous distribution, discontinuous distribution – types and theoretical explanation; endemic distribution; Plant migration and barriers on plant migration; vicarious and relict species – types and examples; centers of origin; insular flora, Mangrove vegetation.

UNIT VIII**5 hrs**

THEORIES OF PRESENT AND PAST – Continental drift hypothesis; Age and Area hypothesis and Land – Bridge hypothesis.

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Code	Paper title	L	T	P
CC-07	PLANT PHYSIOLOGY	3	0	4

45 hrs

UNIT I

5 hrs

CARBOHYDRATES: Atomic structure, chemical bonds, ionic bond, covalent bond, coordination bond, hydrogen bond, hydrogen ion concentration (pH), buffers. Structure, function and Properties of mono, oligo and polysaccharides. Structure of maltose, sucrose, starch and pectin - glycoside linkage, deoxy sugars, glycoproteins, aminosugars, isomerism and mutarotation.

UNIT II

5 hrs

PROTEINS AND ENZYMES: Structure of polypeptides - protein structure - the Ramachandran plot, α helix, β sheet conformational map, tertiary and quaternary. Enzymes – Nomenclature, classification, structure (apoenzyme, cofactors, metallic activators and coenzymes) and properties (enzyme specificity), mode of action, factors affecting enzyme activity (regulation), enzyme kinetics and enzyme purification (electrophoresis- SDS PAGE).

UNIT III

10 hrs

WATER RELATIONS: Diffusion, osmosis, osmotic potential, water potential and chemical potential. Mechanism of absorption of water.

Mechanism of ascent of sap: Vital Theories, Root Pressure theory; Physical force theories – capillary theory, imbibitional theory, Atmospheric Pressure theory, transpiration pull theory; Factors affecting ascent of sap.

Loss of water: Transpiration, types, structure of stomata, distribution of stomata, mechanism of stomatal transpiration, theories of stomatal movement (photosynthetic theory, glyoxylate theory, classical theory, Steward's theory and modern theory), significance of transpiration, adaptations to reduce transpiration, factors affecting transpiration, anti-transpirants; guttation.

UNIT IV

4 hrs

MINERAL NUTRITION: Up-take of minerals- ion traffic into the root, nutrient's role and deficiency symptoms (mention any six major and four minor), active and passive absorption, Donnan's potential, chelating agents, factors affecting mineral salt uptake and ion antagonism.

UNIT V**5 hrs**

PHLOEM TRANSPORT: Transport of organic solutes (using radioactive tracer autoradiography), vein loading and unloading, Transport mechanisms (Transcellular or streaming hypothesis, contractile protein hypothesis, mass flow, electro osmosis) source sink concept.

UNIT VI**6 hrs**

PHOTOSYNTHESIS: Introduction, ultra structure of Chloroplast, Red drop effect, Emerson's enhancement, Electron flow through cyclic and non-cyclic photophosphorylation, C₃ cycle, evidences, factors affecting photosynthesis, C₄ cycles, difference between C₃ and C₄ cycles, CAM pathway and its adaptive advantages.

UNIT VII**5 hrs**

RESPIRATION: Introduction, ultra structure of Mitochondrion, Types – aerobic and anaerobic, RQ, Glycolytic and Kreb's cycle, ATP synthesis through oxidative electron transfer chain (Cytochrome system), chemi-osmotic regeneration of ATP, Pentose Phosphate Pathway. Photorespiration.

UNIT VIII**5 hrs**

PLANT GROWTH REGULATORS AND MOVEMENTS: Plant Growth Regulators – Discovery, structure, biosynthesis, bioassays, roles and mechanism of action of auxins, gibberellins, cytokinins, ethylene and abscisic acid.

Plant Movements: Autonomic or spontaneous movements, locomotion movement, growth and curvature movement, movements of variation, paratonic or induced movements, tactic movements, tropic movements, nastic movements, haptonomic movements, seismonastic movements.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER II - BATCH 2020-2021**

**PRACTICAL PAPER - CC – 07
PLANT PHYSIOLOGY**

1. Solutions and Measurement of RQ using Respirometer (Lipid and Starch)
 2. Estimation of carbohydrates
 3. Quantitative estimation of proteins by Biuret method
 4. Estimation of total free amino acids
 5. Estimate enzyme activity at different temperature
 6. Estimate enzyme activity at different pH
 7. Measurement of water potential of potato tuber by gravimetric method
 8. Stomatal index of monocot and dicot plants
 9. Separation of photosynthetic pigments using separating funnel and measurement of absorbance of the pigments.
 10. Revision and attestation
 11. Pre-final exam
 12. Final exam
- **Submission: 5 marks – Hormone Bioassay Project Report**

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER II - BATCH 2020-2021**

Code	Paper title	L	T	P
CC-08	HERBAL WEALTH – I	3	0	4

45 hrs

UNIT I

7 hrs

CONSERVATION: Biodiversity and concepts of conservation: in-situ and ex-situ, Medicinal Plants Conservation Area (MPCA), Medicinal Plants Development Area (MPDA); Categories of assessment (seven categories), Red Data book, National and International Conservation organizations and their initiatives. CBD, FAO mandate, Project Tiger.

UNIT II

6 hrs

CULTIVATION: Medicinal plant cultivation in India, Agro climatic zones of Karnataka and India; Adaptive planning and management for sustainable harvesting – *Garcinia*, *Decalepis*, *Cinnamomum*, *Vateria*, *Limonia* and *Dioscorea*; sustainability factor - trade.

UNIT III

3 hrs

INTELLECTUAL PROPERTY RIGHTS (IPR) – Choice of IPR, Patents, Trade secrets, Trade mark, Copyrights, GATT (General Agreement on Tariff and Trade) and its relevance to international trade, TRIPS (Trade Related Intellectual Property Rights) and PGR (Plant Genetic Resource).

UNIT IV

4 hrs

FOOD FLAVORS AND NATURAL COLOURS – Study of some important plants used as sources and importance of food flavour's; Natural colours – introduction; classification; sources, examples – *Juglans regia* (walnut), *Rubia tantrum* and *Rubia peregrine* (madder), *Lithospermum erythrorhizon* (Japanese shikone), *Lawsonia inermis* (henna), *Alkanna tinctoria* (alkanna), *Crocus sativus* (saffron), *Tagetes erecta* (marigold), *Capsicum annum* (capsicum), *Indigofera tinctoria* and *Indigofera suffruticosa* (indigo), *Curcuma longa* (turmeric), *Haematoxylon campechianum* (logwood) and *Monascus purpurea* (monascus, mould)

UNIT V

11 hrs

PRODUCTION TECHNOLOGY: Study of highly used medicinal plants - their cultivation, extraction of active principle, and quality control. List of plants: *Bacopa monnieri*, *Centella asiatica*, *Tinospora cordifolia*, *Garcinia indica*, *Eclipta alba*, *Gymnema sylvestris*, *Cymbopogon citratus*, *Vetiveria zizanioides*, *Piper longum*, *Phyllanthus amarus*,

Cassia angustifolia (Tirunelveli senna), *Morinda citrifolia* (Noni), *Andrographis paniculata*

UNIT VI

4 hrs

PLANT SWEETENERS (NATURAL SWEETENERS) – Sweeteners - Introduction, sources of sweeteners, groups of sweeteners – nutritive and non-nutritive; examples - *Stevia rebaudiana*, *Glycyrrhiza glabra*, *Citrus aurantium var amara*, *Thaumatococcus danielli*, *Dioscoreophyllum cumminii*; *sucralose*

UNIT VII

5 hrs

RAW DRUG REPOSITORY – Collection, Preservation and Storage; Substitutes and Adulterants.

UNIT VIII

5 hrs

WRITING RESEARCH REPORT: Components of the research report - Title, Authors, Address, Abstract, Key words, Introduction, Objectives, Materials and Methods, Results and Discussion, References, Acknowledgements. Literature Survey - Source of literature, collection and compiling.

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**M. Sc. - BOTANY
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**PRACTICAL PAPER - CC – 08
HERBAL WEALTH – I**

1. Study of highly used medicinal plant - *Bacopa monnieri*, *Centella asiatica*, *Tinospora cordifolia*, *Garcinia indica*, *Eclipta alba*, *Gymnema sylvestris*, *Cymbopogon citratus*, *Vetiveria zizanioides*, *Coleus forskohlii*, *Piper longum*, *Phyllanthus amarus*, *Cassia angustifolia* (Tiruvellisenna), *Morinda citrifolia*(Noni), *Andrographis paniculata*, *Stevia reboudiana*
 2. *Plant sweeteners*; Raw drug identification - Adulteration – fruits, bark, seeds, roots, flowers, resins (guggulu);
 3. Herbal preparation - Infusion (Tea) - hot and cold; tulasi taila, guduchi taila
 4. Trikatu, Triphala, Ashtachurna and Sitopaladi churna; Vasava lehya
 5. Ashwagandha Shatavarikalpam
 6. Swarasa – kumari, vasa and ginger
 7. Bringamlaki brahmi taila; Sikthataila
 8. Varna lepa; Adraka kanda; amlamru
 9. Rasayana – ghrita kumara rasayana; Kashaya for common fever
 10. Revision and attestation
 11. Pre-final exam
 12. Final exam
- **Submission: 5 marks – Two propagated medicinal plants – agronomic details to be maintained**

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER II - BATCH 2020-2021**

Code	Paper title	L	T	P
AC-03	Research Methodology	2	0	0

26 hrs

UNIT I

4 hrs

INTRODUCTION TO RESEARCH: Meaning, definition, objectives and characteristics of research. Types of research- basic research (fundamental research), applied research, action research, descriptive research, analytical research, evaluation research, historical research, exploratory research, industrial research, development research.

UNIT II

6 hrs

RESEARCH PROCESS: Research design, important experimental designs, sample design. Census and sample method; theoretical basis for sampling, methods of sampling, size of sample, merits and limitations of sampling, sampling and non sampling errors, reliability of sampling.

Data and methods of data collection; types of data- primary and secondary data. Primary data collection methods- direct personal investigation, direct oral investigation schedules and questionnaires, interviews and type of interviews. Pre-testing and pilot study.

UNIT III

4 hrs

MEASUREMENT AND SCALING TECHNIQUE: Measurement in research; measurement scales- nominal scale, ordinal scale, interval scale, and ratio scale. Sources of error in measurement.

Scaling- meaning, classification basis, important scaling techniques- rating scale, ranking scale, arbitrary scale, summated scale.

UNIT IV

2 hrs

Patenting: Patenting - definition of patent. Patenting and fundamental research. Product and process patents. Patenting multicellular organisms. Patent infringement. Trademarks.

UNIT V

6 hrs

Scientific writing: Research resources: reviews, abstracts, books, journal and magazine articles- Exploration and communication; Resources: online and print; Review of latest literature (peer reviewed). Logical format for writing thesis and papers. Essential features of abstract, introduction, review of literature, materials and methods, and discussion. Effective illustration- tables and figures. Reference styles. Understanding Plagiarism: definition, unintentional plagiarism and consequences; Collaborative work; Copyright infringement.

UNIT VI**4 hrs**

DATA ANALYSIS USING EXCEL AND R-TOOL: Analysis of quantitative data and presentation with tables, graphs etc., Use of Excel for Formulae Function, Charts and Graphs, Table formula, t-test, Anova and Correlation. Basics of working with R.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER II - BATCH 2020-2021**

**PRACTICAL PAPER - AC – 04
ANALYTICAL PHYTOCHEMISTRY AND CYTOLOGY**

1. Assay of acid phosphatase
2. Fluorescence analysis of some drugs
3. Estimation of Piperine
4. Extraction of hesperidin.
5. Estimation of Gossypol
6. Estimation of calcium citrate and Extraction of starch
7. Squash preparation of onion root tips and Smear preparation of onion flower buds
8. Isolation of DNA by SDS method
9. Isolation of chloroplast and Karyotype study
10. Revision and attestation
11. Pre-final
12. Final exam

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-01	TAXONOMY OF ANGIOSPERMS	3	0	4

45 hrs

UNIT I

7 hrs

INTRODUCTION AND GENERAL ACCOUNT TO TAXONOMY - Definition, scope and objectives of taxonomy; Taxonomic hierarchy; A critical study of principles, outline and phylogeny of Angiospermic classification of Linnaeus (Artificial system of classification), Bentham and Hooker (Natural system of Classification), Engler and Prantl (Phylogenetic classification); Hutchinsons classification; a brief account on Angiosperm Phylogeny Group I, II and III (APG System).

UNIT II

5 hrs

PLANT NOMENCLATURE – Major rules; problems of common/vernacular names; binomial nomenclature, importance, principles and aims of ICN (ICBN); codes, principles and priorities; Typification; *Nomina conservanda*; Citation; Rejection of names; Valid and effective publication; Principles of priority and limitation of priority; Rules and Recommendations; International Code of Nomenclature for Cultivated Plants (ICNCP).

UNIT III

3 hrs

TAXONOMIC LITERATURE - Floras, Monographs and Revisions; Bibliography, Botanical Survey of India; general account of keys; Method of preparation, maintenance and significance of herbarium; Botanical gardens - Kew , Calcutta and Bangalore.

UNIT IV

6 hrs

FAMILIES I - Salient features, morphological peculiarities, systematic position, affinities and economic importance of the following families – Dicots - Polypetalae – Myrtaceae, Meliaceae, Sapindaceae, Combretaceae and Umbelliferae

UNIT V

7 hrs

FAMILIES II – Dicots - Gamopetalae – Solanaceae, Acanthaceae, Rubiaceae, Scrophulariaceae and Asteraceae.

UNIT VI

6 hrs

FAMILIES III- Dicots - Monochlamydeae – Nyctaginaceae, Loranthaceae, Amaranthaceae, Euphorbiaceae and Urticaceae

UNIT VII

6 hrs

FAMILIES IV- Monocots – Cannaceae, Poaceae, Orchidaceae, Musaceae and Arecaceae

UNIT VIII

5 hrs

MODERN TAXONOMY – Cytotaxonomy, Numerical taxonomy, Chemotaxonomy and Computer application in taxonomy; **Taxonomic Evidences** - Study of morphological, anatomical, embryological, palynological, serological characters and molecular approach (DNA finger printing) and ecology in relation to taxonomy.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

**PRACTICAL PAPER - EC – 01
TAXONOMY OF ANGIOSPERMS**

1. Preparation of dichotomous keys
2. Construct the phylogenetic tree based on gene sequences of the given species from NCBI database
3. Use of Flora; Study of Two plants / class (Two families per practical)
4. Study of Two plants / class (One family per practical)
5. Study of Two plants / class (Two families per practical)
6. Study of Two plants / class (One family per practical)
7. Study of Two plants / class (Two families per practical)
8. Study of Two plants / class (One family per practical)
9. Study of Two plants / class (One family per practical)
10. Revision and attestation
11. Pre-final exam
12. Final exam

- Polypetalae – Myrtaceae, Meliaceae, Sapindaceae, Combretaceae and Umbelliferae
- Gamopetalae – Solanaceae, Acanthaceae, Rubiaceae, Scrophulariaceae and Asteraceae.
- Monochlamydeae – Nyctaginaceae, Loranthaceae, Amaranthaceae, Euphorbiaceae and Urticaceae
- Monocots – Cannaceae, Poaceae, Orchidaceae, Musaceae and Arecaceae (Palmae)

(3 - 9 identification of plants using flora and drawing diagrams)

Submissions – 05 plants herbarium + 5 digital herbarium

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-02	CYTOGENETICS, PLANT BREEDING AND EVOLUTION	4	2	0

TOTAL: 52 hrs

UNIT I

5 hrs

CELL CYCLE: Eukaryotic cell cycle- role of cyclins and protein kinases (CdKs – cyclin dependent kinases) and their interaction at various stages of cell cycle, Kinase inhibitors and their role in regulation – check points for DNA damage, Chromosome compaction and Programmed cell death.

UNIT II

7 hrs

CELL DIVISION: Microtubule behavior during metaphase plate formation. Control of anaphase – (anaphase promoting complex - APC) and spindle check point factor. Forces for chromosome movement at anaphase and telophase. Synaptonemal complex and chiasmata formation. Genetic recombination; non disjunction of chromosomes and its significance

UNIT III

7 hrs

CHROMOSOME: Euchromatin and heterochromatin. Nucleosome model. Chromatin and its chemical nature. Kinetochore complex and telomere. Numerical aberrations: euploidy, aneuploidy. Structural aberrations – deletions, duplications, inversions and translocations.

Role of polyploidy in plant breeding and evolution.

UNIT IV

6 hrs

DNA: DNA chemistry and structure; Polymorphism in DNA structure; DNA replication- Enzymes, Mechanism of DNA replication in Prokaryotes and Eukaryotes

DNA repair mechanism- Photoreactivation, Excision repair, Recombination repair and Mismatch repair.

UNIT V

8 hrs

GENES AND LINKAGE: Gene – present concept, split genes, fine structure of rII locus, genetic code – cell free system; use of synthetic RNAs, poly U experiment and cracking of first genetic code

Linkage - Theories of linkage, linkage groups – complete and incomplete linkage, causes of linkage, linkage in maize, recombination and chromosome mapping, male sterility in plant breeding, biochemical genetics – *Neurospora*. Transposable genetic elements.

UNIT VI

7 hrs

MUTATIONS: Introduction, Molecular basis of mutations; Spontaneous and Induced mutations; Physical and Chemical induced Mutations; Types of mutations-Point mutations and Frame shift mutations. Reverse mutation and para mutation.

PROTEIN SYNTHESIS: Biosynthesis of proteins in prokaryotes – Aminoacyl tRNA activity, Translation – initiation, elongation and termination, post translation modifications. Biosynthesis of proteins in Eukaryotes.

UNIT VII

6 hrs

PLANT BREEDING-INTRODUCTION AND HETEROSIS: Selection and Hybridization methods in self, cross pollinated and vegetative propagated crop plants. (Pure line selection, pedigree selection, mass selection, back crossing and modern methods). Pattern of evolution of crop plants (domestication, germplasm, acclimatization and introduction). Distant Hybridization - Introduction, barriers, techniques for the production of distant hybrids, sterility in distant hybrids, Importance of distant hybridization in crop improvement.

UNIT VIII

6 hrs

POPULATION GENETICS AND EVOLUTION: Population genetics - Genetic variation in plants; Random mating and implication of Hardy Weinberg law. Calculation of allele and gene frequencies; genetic equilibrium.

Evolutionary Genetics: Migration, Natural selection, gene pool and gene flow, Speciation, Isolation, Meiotic drive, Random Genetic Drift and Genetic Load. Molecular evolution – a brief account.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-03	PHARMACOGNOSY	3	0	4

45 hrs

UNIT I

4 hrs

CLASSIFICATION OF HERBAL DRUGS: Classification of plant drugs, plant parts, chemical constituents, morphological, pharmacological, secondary metabolites on curative properties and uses – *Piper longum*, *Ficus bengalensis*, *Pandanus fascicularis*, *Emblica officinalis*, *Cyperus rotundus*, *Gmelina arborea*, *Oroxylum indica* (bark and stem).

UNIT II

6 hrs

EXTRACTION OF HERBAL DRUGS: Extraction of phytopharmaceuticals – selection of plant material, collection, identification, drying and grinding, cutting, processing and powdering of herbs; choice of solvent; Extraction methods – Soxhlet extraction, steam distillation, vaporization, infusion, decoction, maceration and percolation; Guidelines for harvesting medicinal plants (GMP- Good Manufacturing Practices).

UNIT III

5 hrs

PREPARATION OF MEDICINES: Preparation of herbal medicines for primary health care and their healing properties. Herbal preparations: powder, fresh juice, poultice, oils, ghee and syrups.

UNIT IV

6 hrs

ACTIVE PRINCIPLES: Active principles of medicinal plants namely *Ocimum sanctum*, *Withania somnifera*, *Aloe vera*, *Asparagus racemosus*, *Adathoda vasica*, *Terminalia arjuna*, *Terminalia bellerica* and *Tinospora cordifolia* (classification, active principle, extraction, preparation and safety and efficacy)

Phytochemistry – Preliminary screening of secondary metabolites - Alkaloids, flavanoids, tannins and saponins

UNIT V

5 hrs

AROMATIC PLANTS: Aromatherapy – Introduction, types, extraction methods; therapeutic value of *Rosmarinus officinalis* (Rosmarinus), *Pelargonium* sp. (scented)

Geranium), *Acorus calamus* (Acorus), *Lavendula officinalis* (Lavender), *Polianthus tuberosa* (Tube rose), *Jasminum sp.* (Jasmine), *Eucalyptus globulus* (Eucalyptus).

UNIT VI

3 hrs

SAFETY AND EFFICACY OF PLANT DRUGS: General rule and standardization of using plant material as medicine. Pharmaco vigilance; GMP guidelines for raw drugs.

UNIT VII

8 hrs

EVALUATION OF NATURAL PRODUCTS AND SIGNIFICANCE OF PHARMACOPOEIAL STANDARDS: **Pharmacological evaluation** – organoleptic evaluation; microscopic evaluation – leaf constants, stomata, trichomes or plant hairs, calcium oxalate crystals, quantitative microscopy – *Lycopodium* spore method; chemical evaluation; physical evaluation – moisture content, viscosity, melting point, solubility, optical rotation, refractive index, ash values and extractives, volatile content, foreign organic matter; Biological evaluation; infrared spectroscopy (FTIR), microbiological assay - bacterial testing, mould and yeast testing; significance of pharmacopoeial standards; Evaluation of drugs using standard chromatographic techniques - TLC, HPTLC, HPLC and GC-MS.

UNIT VIII

8 hrs

MICROSCOPIC AND POWDER CHARACTERS OF CRUDE DRUGS – *Senna*, *vasaka*, cinnamon bark, fennel, *Ephedra* stem, cloves and liquorice.

Protocol for preparation of pharmaceuticals – Capsule, ear drops, cream and lotion.

Plant fibres and surgical dressing – cotton, flax, jute and *Cannabis*.

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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

**PRACTICAL PAPER - EC – 03
PHARMACOGNOSY**

1. Identification of organized and unorganized plant drugs.
2. Separation of anthocyanin from flower petals using TLC
3. Quantitative estimation of an alkaloid – Solanine.
4. Extraction and estimation of lycopene.
5. Determination of pH of fresh and dry material of the following plants (*Ocimum*, *Adhatoda* leaves, *Terminalia arjuna* fruit,)
6. Quantification of phenolics.
7. Estimation of curcumin in given sample.
8. Evaluation of natural products – estimation of the ash value and determination of water soluble and acid soluble ash (Muffle furnace); Determination of moisture content of sample using moisture balance method; Determination of microscopic characters
9. Estimation of Rutin
10. Revision and attestation
11. Pre-final exam

Submission: Two Herbal product/ workshop

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-04	APPLIED PHYCOLOGY	3	0	4

45 hrs

UNIT I

5 hrs

ALGAL DISTRIBUTION: Distribution and ecology of fresh water, marine, terrestrial algae and unusual habitats

UNIT II

5 hrs

ALGAE AS BIO-FERTILIZER AND GREEN MANURE: Symbiotic and non symbiotic algae in soil fertility and crop production, role of *Anabaena* and *Nostoc* in nitrogen fixation (aerobic and anaerobic); Algae in agriculture (Reclamation of usar soil and algalization)

UNIT III

5 hrs

ALGAE AS NUTRIENT SUPPLEMENT AND IN PHARMACY: Nutrient supplements of *Spirulina*, *Chlorella*, *Scenedesmus* and *Porphyridium*; Importance of *Botryococcus braunii* and *Dunaliella*; Value added products from microalgae and processes; Algae in pharmacy – iodine, carrageenan, agar, amino acids, vitamins, enzymes, antibiotics, vermifuge and sterols.

UNIT IV

5 hrs

ALGAE AND HEAVY METALS TOXICITY: Metabolism of heavy metals by algae, mechanism of metal toxicity, metal tolerance and biomass production; immobilization of algae

UNIT V

10 hrs

ALGAE AND ITS ROLE IN ASSESSMENT OF WATER QUALITY: Algae as indicators of water quality in fresh and marine environment (including algal blooms); Effect of algae in water supplies - taste, odour, filter and screen clogging, slime formation, coloration, corrosion, coagulation, toxicity and parasitic algae; Algal bioassay test - bottle test (Brief explanation of principles, planning, media, inoculums, procedure data analysis)

and interpretation of results) and PAM fluometry; Methods to control algae in water supplies, recreational waters and aquarium.

UNIT VI

6 hrs

CULTIVATION OF ALGAE: Mass cultivation of algae with examples *Spirulina*, *Chlorella*, *Dunaliella*; Fermentation and its products from algae (methane and ethanol), Cultivation of agarophytes- methodology, requirements, harvest and processing of *Porphyra*, *Euचेuma*, *Gelidium*, *Gracilaria* and *Laminaria*.

UNIT VII

4 hrs

ALGAL BIOTECHNOLOGY AND TISSUE CULTURE OF SEaweEDS: General information about challenges in algal biotechnology; callus induction, protoplast culture and somatic hybridization; commercial application of seaweed biotechnology.

UNIT VIII

5 hrs

TOXINS AND BIOCHEMICALS FROM ALGAE: Algal toxins – neurotoxins, hepatotoxins, effect of toxins, mode of action, problems and prospects. Biochemicals from algae – pigments, essential fatty acids, polysaccharides, wax, hydrocarbons, plant growth regulators, osmoregulators.

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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

**PRACTICAL PAPER - EC – 04
APPLIED PHYCOLOGY**

1. Analysis of water quality – phosphate estimation.
2. Analysis of water quality – BOD estimation.
3. Collection, isolation and culture of algae (fresh water and industrial waste) and Study of algae
4. Measurement of growth (algal biomass).
5. Chlorophyll estimation in different algae
6. Carotenoid and phycobilin protein estimation in different algae
7. Estimation of total sugar
8. Estimation of total soluble proteins and total lipids
9. Ammonia excretion
10. Revision
11. Pre-final exam and attestation
12. Final exam

Submission – 05 Algal forms

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

**AC – 05 – PLANT TISSUE CULTURE TECHNIQUES AND VEGETATIVE
PROPAGATION**

1. Media preparation
2. Sterilization and inoculation
3. Apical meristem and leaf culture
4. Nodal, anther and embryo culture
5. Preparation of synthetic seeds
6. Isolation of protoplast
7. Morphogenesis slides
8. Auxin estimation
9. Vegetative propagation
10. Revision
11. Pre- final exam
12. Final exam

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER IV - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-05	ADVANCED PLANT PHYSIOLOGY	3	0	4

45 hrs

UNIT I

4 hrs

NITROGEN METABOLISM: Nitrogen fixation (Nif gene complex), host microbe specificity, mechanism of nitrogen fixation, assimilation of nitrates, synthesis of amino acids – reductive and transamination and GS –GOGAT system

UNIT II

4 hrs

LIPID METABOLISM: Structure and function of Lipids and its derivatives; Synthesis of fatty acids. Breakdown of fatty acids (β and γ Oxidatives), Synthesis of Triacyl Glyceride (Kennedy pathway). Glyoxylate pathway and Gluconeogenesis, Synthesis of Phospholipids and Glycolipids.

UNIT III

8 hrs

FLOWERING: the flowering process, Photoperiodism and its significance, Phytochrome, role of Vernalization, endogenous clock and its regulation, biochemical signaling involved in flowering, floral induction and development, Introduction to genetic and molecular basis or mechanism of flowering.

UNIT IV

6 hrs

SEED STRUCTURE AND BIOLOGY: Structure of dicot and monocot seeds, Types of seeds-Apomictic seeds, Polyembryonic seeds, Orthodox and recalcitrant seeds, Heirloom varieties, seed treatments, seed protectants, priming, coating, pelleting.

Principles of seed processing: Seed sampling, classes of seeds – breeder's seed, nuclear seeds, certified seeds, cultivar seeds; seed certification and submission procedure for seed certification.

UNIT V

5 hrs

SEED DORMANCY AND GERMINATION: introduction, types, induction and mechanism to break dormancy (seed and bud), seed germination and seed viability, Germination enhancers, Factors affecting germination.

UNIT VI**7 hrs**

PLANT SECONDARY METABOLITES AND IT'S DEFENCE: Biosynthesis, function and role of the following as defence molecules: flavonoids, terpenoids, alkaloids, steroids, anthocyanin and lignin; role of secondary metabolites in plant-microbe interaction; plant-plant interaction; Importance of secondary metabolites to humans (Pharmaceuticals); brassinosteroids; jasmonic acids; Antinutritional factors (ANF).

UNIT VII**6 hrs**

SIGNAL TRANSDUCTION IN PLANTS: Introduction, Phytochrome signaling pathway-Ion fluxes, gene expression, Phytochrome signaling, Phytochrome associated protein Kinases and Phosphatases. Protein degradation; ABA signal transduction pathways; Brassinosteroid signaling pathway; Brief account on G-proteins, Cyclic nucleotides and calcium- calmodulin cascade.

UNIT VIII**5 hrs**

STRESS PHYSIOLOGY: Drought, soil salinity, light and temperature stresses and their physiological effects on plants; molecular mechanism of drought tolerance in plants; engineering plants for stress tolerance.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER III - BATCH 2019-2020**

**PRACTICAL PAPER - EC – 05
ADVANCED PHYSIOLOGY**

1. Estimation of leghaemoglobin and demonstration of nitrates in green plants
 2. Extraction and estimation of lipids – Folch Method
 3. Estimation of lipase activity
 4. Saponification value of oils and iodine number
 5. Quantitative estimation of anthocyanins and To detect seed viability and germination
 6. Quantitative estimation of flavanoids
 7. Quantitative estimation of alkaloids
 8. Quantitative estimation of tannin
 9. Estimation of free proline
 10. Revision and attestation.
 11. Pre-final examination
 12. Final exam
- **Project**

**MOUNT CARMEL COLLEGE, AUTONOMOUS
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**M. Sc. - BOTANY
SEMESTER IV - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-06	BIOTECHNOLOGY AND MOLECULAR BIOLOGY	4	2	0

52 hrs

UNIT I

8 hrs

MORPHOGENESIS: Morphogenesis at cellular level – differentiation, dedifferentiation, redifferentiation of vascular tissues in-vitro. Role of cytoplasm and nucleus in morphogenesis, *Acetabularia*; Asymmetric division and its significance; Morphogenetic factors – water, temperature, light, chemical factors and growth regulators; Polarity – general account; Plant galls and their importance in morphogenesis

UNIT II

6 hrs

PLANT TISSUE CULTURE: Brief history and applications of PTC, Requirements of PTC and aseptic maintenance. Organogenesis - Single cell culture, suspension culture, pollen culture (haploid cell culture), meristem culture and embryo culture.

UNIT III

7 hrs

IN VITRO PROPAGATION: Somatic embryogenesis, synthetic seed production. Somatic hybridization, somaclonal variation and cryopreservation; production of high value secondary metabolites through cell and tissue culture in plants like *Andrographis*, *Bacopa* and *Stevia*; Application of tissue culture in agriculture, industry, forestry and medicine.

UNIT IV

9 hrs

TECHNIQUE OF TRANSFORMATION: Physical methods - microprojectile, electroporation, Organelle transformation; Chemical method - PEG mediated DNA uptake and Biological method - *Agrobacterium* mediated; application of transgenic plants; general account of vaccines from plants – banana; applications and hazards of biotechnology; GM foods – golden rice, Bt brinjal and Bt cotton; Biosafety of GM foods.

UNIT V

6 hrs

INDUSTRIAL BIOTECHNOLOGY: Microbial Biotechnology - production of organic compounds by fermentation, basic principles of fermentation technology, types of fermenters, Production of Acetone and Butanol.

Enzyme biotechnology: Extraction and purification of enzymes, immobilization of enzymes, uses of enzymes (amylase, protease, invertase). Brief account on Biosensors and Biochips.

UNIT VI

7 hrs

DNA: DNA chemistry and structure, polymorphism in DNA structure, DNA replication – enzymes, mechanism of DNA replication in Prokaryotes and Eukaryotes.

UNIT VII

4 hrs

DNA REPAIR MECHANISM: Photoreactivation, excision repair, recombination repair and mismatch repair.

UNIT VIII

5 hrs

BIOINFORMATICS: History, Databases - Types of databases, Database structure, Models, Sequences and Nomenclature, IUPAC symbols, Nomenclature of DNA sequences, Protein sequences, types of sequence used in bioinformatics; Information sources-NCBI, PubMed, Taxonomy browsers, BLAST, FASTA; Use of Bioinformatic tools in analysis.

**MOUNT CARMEL COLLEGE, AUTONOMOUS
CBCS SYLLABUS**

**M. Sc. - BOTANY
SEMESTER IV - BATCH 2019-2020**

Code	Paper title	L	T	P
EC-07	TOOLS AND TECHNIQUES IN PLANT SCIENCE	4	0	0

52 hrs

UNIT I

5 hrs

MICROSCOPY I

Introduction, principles and properties of light and laser light; polarization of light, resolution power - numerical aperture; polarized and lambda filters.

UNIT II

6 hrs

MICROSCOPY II

Principles and working of: Phase contrast microscopy; Fluorescent microscopy; Confocal Raman microscopy, Atomic Force Microscopy and Electron microscopy (TEM & SEM).

UNIT II

8 hrs

MICROTECHNIQUE: Introduction; Principles and preparation of material for light and electron microscopy-- a brief account of fixation and fixatives; stains and staining, double staining, shadow casting; sectioning methods – Microtome – types of microtome; freeze drying, freeze etching, cryosectioning. Preparation of media for microorganism's growth (both bacteria and fungi); isolation techniques – spread plate method, pour plate method and streak plate method; Anti microbial activity-disc and well diffusion method, Bioautography, Flow Cytometry

UNIT III

6 hrs

SEPARATION TECHNIQUE I: Centrifugation – Principles, types, and theory of centrifugation; Chromatography – introduction, principle, types of chromatography – paper chromatography, thin layer chromatography, HPTLC, column chromatography - HPLC, gas chromatography.

UNIT IV

7 hrs

SEPARATION TECHNIQUE II: Electrophoresis – Introduction, principle, buffers, detection and assay, recording and storage, safety and applications, factors affecting electrophoresis; types of electrophoresis – moving boundary electrophoresis, paper electrophoresis, gel electrophoresis - polyacrylamide gel electrophoresis (PAGE), agarose electrophoresis; iso electric focusing electrophoresis, immuno electrophoresis, denaturing

gradient gel electrophoresis, temperature gradient gel electrophoresis, capillary electrophoresis.

UNIT V

09 hrs

SPECTROSCOPIC TECHNIQUES: Introduction, Principle of Spectroscopy - visible and UV; linear and circular dichroism, CD spectra of protein and nucleic acids, ionization, protein mass determination, atomic spectroscopy - Atomic absorption spectroscopy including Plasma emission, flame photometer, IR, Raman spectroscopy, Fourier Transform Infrared Spectroscopy. Analysis of polymer structures - NMR, ESR and X-ray crystallography - Methods of growing crystals, theory of X - ray diffraction, Bragg's law.

UNIT VI

6 hrs

RADIOCHEMICAL TECHNIQUES: Introduction to Radioactivity, Units of radioactivity, Stable and radioactive isotopes, half-life of radioisotopes, Specific activity, Isotopic dilution techniques, theory and construction of GM Counter, Liquid and Scintillation counter, autoradiography and applications of tracer techniques.

UNIT VIII

5 hrs

MOLECULAR TOOLS: Gene isolation and characterization through PCR, Microarrays, DNA based molecular markers - RAPD, AFLP, RFLP, STS; use of molecular markers in plant genetics; Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding