DAVANGERE UNIVERSITY

Shivagangothri, Davanagere – 577007

MASTER OF SCIENCE (MSC)

SEMESTER SCHEME - CBCS

DEPARTMENT OF STUDIES IN BOTANY

WITH EFFECT FROM 2016-17 AND ONWARDS

Program Layout/Metrix
M.Sc. Botany (CBCS) Course Structure (2016-17 onwards)

Semester	Subject/ Paper Code	Title of the Paper	Instruction Hrs./week	Marks			Credits	Examatination duration (Hrs.)
				Examination	Internal Assessment	Total Marks		
SEMESTER-I	**THEORY PAPERS**							
	BOT 1.1	Microbiology	4	75	25	100	4	3
	BOT 1.2	Algae and Bryophytes	4	75	25	100	4	3
	BOT 1.3	Pteridophytes and Gymnosperms	4	75	25	100	4	3
	BOT 1.4	Plant Systematics and Economic Botany	4	75	25	100	4	3
	PRACTICAL PAPERS							
	BOT 1.5	Microbiology	4	50	--	50	2	3
	BOT 1.6	Algae and Bryophytes	4	50	--	50	2	3
	BOT 1.7	Pteridophytes and Gymnosperms	4	50	--	50	2	3
	BOT 1.8	Plant Systematics and Economic Botany	4	50	--	50	2	3
	Mandatory Credits: English Language Communication Skill		2	---	---	---	2	---
SEMESTER-II	**THEORY PAPERS**							
	BOT 2.1	Cytology and Genetics	4	75	25	100	4	3
	BOT 2.2	Developmental Biology and Anatomy	4	75	25	100	4	3
	BOT 2.3	Plant Physiology	4	75	25	100	4	3
	BOT 2.4	Plant Biochemistry	4	75	25	100	4	3
	PRACTICAL PAPERS							
	BOT 2.5	Cytology and Genetics	4	50	--	50	2	3
	BOT 2.6	Developmental Biology and Anatomy	4	50	--	50	2	3
	BOT 2.7	Plant Physiology	4	50	--	50	2	3
	BOT 2.8	Plant Biochemistry	4	50	--	50	2	3
	Mandatory Credits: Computer Skill		2	---	---	---	2	---
SEMESTER-III	**THEORY PAPERS**							
	BOT 3.1	Molecular Biology	4	75	25	100	4	3
	BOT 3.2	Biophysics, Bioinformatics and Biostatistics	4	75	25	100	4	3
	BOT 3.3	Ecology and Environment	4	75	25	100	4	3
	BOT 3.4A	Plant Breeding and Evolution (A) (Specialization)	4	75	25	100	4	3
	BOT 3.4B	Seed Technology (B) (Specialization)						
	PRACTICAL PAPERS							
	BOT 3.5	Molecular Biology	4	50	--	50	2	3
	BOT 3.6	Biophysics, Bioinformatics and Biostatistics	4	50	--	50	2	3
	BOT 3.7	Ecology and Environment	4	50	--	50	2	3
	BOT 3.8 A	Plant Breeding and Evolution	4	50	--	50	2	

	BOT 3.8B	Seed Technology						
	BOT 3.9	Plants and Human Welfare Interdisciplinary elective for other science students	**2**	**40**	**10**	**50**	**2**	**2**
SEMESTER-IV	**THEORY PAPERS & PROJECT WORK/DISSERTATION**							
	BOT 4.1	Medicinal and Aromatic Plants	**4**	**75**	**25**	**100**	**4**	**3**
	BOT 4.2	Plant Biotechnology	**4**	**75**	**25**	**100**	**4**	**3**
	BOT 4.3	Plant Pathology	**4**	**75**	**25**	**100**	**4**	**3**
	BOT 4.4	Project Work/Dissertation	**6**	**75**	**25**	**100**	**6**	**3**
	PRACTICAL PAPERS & STUDY TOUR/FIELD VISIT							
	BOT 4.5	Medicinal and Aromatic Plants	**4**	**50**	**--**	**50**	**2**	**3**
	BOT 4.6	Plant Biotechnology	**4**	**50**	**--**	**50**	**2**	**3**
	BOT 4.7	Plant Pathology	**4**	**50**	**--**	**50**	**2**	**3**
	Study Tour/Field Visit		**---**	**---**	**---**	**---**	**---**	**---**
	Total Credits for the Course		**132**	**---**	**---**	**2400**	**102**	**---**

Employability/ entrepreneurship/ skill development

Course Code	Name of the Course	Year of introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
BOT 1.1	Microbiology	2016	Employability and Entrepreneurship in teaching profession and skill based Pathological diagnosis.
BOT 1.2	Algae and Bryophytes	2016	Entrepreneurship/ Skill development in Teaching profession as well as in Mass production for Food and Fodder industries, Biofuel production companies, Pharmaceutical industries and Teaching Profession.
BOT 1.3	Pteridophytes and Gymnosperms	2016	Employability as a taxonomist, paleobotanist, teacher, in forensic science department.
BOT 1.4	Plant Systematics and Economic Botany	2016	Employability in pharmaceuticals and biotechnology, Entrepreneurship, skill based and in Teaching profession. Employability in Central Research Institutes.
BOT 2.1	Cytology and Genetics	2016	Employability, Entrepreneurship and skill based Skill based orientation in teaching profession and clinical laboratory technician to identify the genetically based diseases in medical and diagnosis.
BOT 2.2	Developmental Biology and Anatomy	2016	Entrepreneurship and employability based paper where students get jobs in seed companies, teaching, and research institutes.
BOT 2.3	Plant Physiology	2016	Entrepreneurship/ Skill development in Teaching profession. Employability in Pharmaceutical industry, Biotechnology Laboratories, R And D Centers, Agro-biotech Industries.
BOT 2.4	Plant Biochemistry	2016	Employability, Entrepreneurship in teaching profession and skill based in Research and development, industries.

BOT 3.1	Molecular Biology	2016	Employability, Entrepreneurship in teaching profession and skill based in research and development in institutes, industries, medical, agriculture and pharmaceutical areas.
BOT 3.2	Biophysics, Bioinformatics and Biostatistics	2016	Employability in teaching, as a bioinformatics analyst, research scientist, R and D institutes, instrumentation centers.
BOT 3.3	Ecology and Environment	2016	Employability, Entrepreneurship in teaching profession and pollution control board and skill based as research assistant, environmental biologist and agricultural department.
BOT 3.4A	Plant Breeding and Evolution	2016	Employability in teaching, research institutes like ICAR, IARIs, as a plant geneticist, plant breeder, agro industries etc.
BOT 3.4B	Seed Technology	2016	Employment in R and D Centres, Seed Industries, teaching. Skill Development and entrepreneurship for in germ plasm industries, seed production and marketing.
BOT 4.1	Medicinal and Aromatic Plants	2016	Employability in pharmaceuticals, Entrepreneurship, skill based and in Teaching profession. They would develop business acumen, analytical skills, financial literacy necessary to appreciate the dynamic nature of commerce and industry. Employability in pharmaceuticals, Entrepreneurship, skill based and in Teaching profession. They would develop business acumen, analytical skills, financial literacy necessary to appreciate the dynamic nature of commerce and industry.
BOT 4.2	Plant Biotechnology	2016	Employability, Entrepreneurship in teaching profession and skill based in Research and development, industries, plant tissue culture technician, green house or field technician.

BOT 4.3	Plant Pathology	2016	Entrepreneurship based program where a student can setup his own seed company, Employability in teaching, research institues like ICAR, IARIs, as a plant geneticist, plant breeder, plant pathologists, agro industries etc. Plant pathologists can work in Agricultural consulting companies, Agrichemical companies, Seed and plant production companies, Tissue culture laboratories. Diagnostic laboratories, International agricultural research centers, Botanical gardens and arboreta.
BOT 4.4	Project Work/Dissertation	2016	Skill based, employability, entrepreneurship based program where students get an expertise on conducting in vitro, invivo and insilico experiments.

Department of Studies in Botany

Vision: To impart quality education and research in plant sciences for societal and environmental benefits

Mission: To train, understand and discover plant sciences and technology to teaching, quality education need of students and stakeholders.

PSO1: Apply basic knowledge of plant sciences to competent level.

PSO2: Analyze the plant sciences using advanced techniques and computational tools to address major challenges in pharma, agriculture and food industry.

PSO3: Develop plant science based eco-friendly solutions to solve environmental problems.

Programme outcomes for M. Sc. Botany

1. Academic Excellence: Academic excellence through effective delivery of course contents. Enhancing the horizon of knowledge to enable the learners to carry out qualitative research and pursue academic or professional careers
2. Professional Excellence: Developing effective communication skills and ability to work in teams by strengthening group dynamics
3. Global Outreach and Holistic Development: Nurturing ability to engage in lifelong learning, demonstrating sympathetic social concern, contributing to the development of nation, awareness gained on various issues.
4. Goal-Oriented and Life-Long Education: Setting short term, medium, and long term goals and achieving them in a global competitive perspective.
5. Social Consciousness: Understanding the role and applicability of knowledge acquired in the context of society, environment and sustainable development sticking on to the ethics and values.
6. Technical Knowledge: To find, utilize and create content using information technologies and the internet.
7. Entrepreneurial Development: They would develop business acumen, analytical skills, financial literacy necessary to appreciate the dynamic nature of commerce and industry.

8. Research and practical knowledge: Using research knowledge and aptitude acquired in the course of study for solving problems and face modern day challenges.
9. Competency skills: Developing problem analysis skills and knowledge and applying the same in real life situation.
10. Project Work and Viva: To help them develop the ability to participate in academic discussions.

Programme Specific Outcomes for M. Sc. Botany

1. To lay a strong foundation to the study of Botany and to develop the basic skills to study Botany in detail.
2. To impart an insight into the diversity of the living world and the need to conserve it.
3. To make the students realize the applications of different fields of Botany commercially, ecologically and industrially.
4. To enable the students to appreciate the contributions of the scientific community and to develop a deep sense of research aptitude in them.
5. To enhance the skills of students in various techniques used in Botany for the collection, preservation, propagation, breeding etc.
6. To ensure that the students are equipped with expertise to make use of the opportunities and to tackle the challenges in the field of Botany.

Course Outcome for M. Sc. Botany:

Semester I

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 1.1	Microbiology	04	04

After the successful completion of this course students are expected to be able to:

1. The students would be able to understand the theoretical and practical knowledge in the field microscopy and staining techniques.

2. Expertise in understanding basic microbial structure and function, various isolation techniques of bacteria and fungi.
3. Able to analyze the concept of antigen and antibody reaction and disease diagonosis.
4. Students would pursue higher education in the fields of applied life sciences
5. Able to create bio products like microbial inoculums, biologically active compounds.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 1.2	Algae and Bryophytes	04	04

After the successful completion of this course students are expected to be able to:

1. Learn about the taxonomic ranks and conventions to the hierarchical classification of lower plants.
2. Understand the diversity, systematic, morphology, structure, life cycle and the economic importance of Algae.
3. Know the taxonomic position, occurrence, thallus structure, reproduction and economic importance of the Bryophytes.
4. They will know the economic value and ecological significance of this lower group of plant community.
5. Understanding of plant evolution and their transition to land habitat and become aware of applications of different plants in various industries.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 1.3	Pteridophytes, gymnosperms and palaeobotany	04	04

After the successful completion of this course students are expected to be able to:

1. Study and impart the knowledge about the occurrence, distribution, structure, morphological diversity of Pteridophytes and gymnosperms. Understand the economic importance of the same.
2. Gain knowledge on the phylogeny and evolutionary concepts of pteridophytes and gymnosperms.
3. Know about role and importance of fossil pteridophytes and gymnosperms.
4. Gain insight on paleopalynology.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 1.4	Plant systematics and economic botany	04	04

After the successful completion of this course students are expected to be able to:

1. Understanding of plant morphology terminologies and identifying morphological peculiarities.
2. Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches.
3. Provide lab based training in writing short species descriptions and illustration
4. Recognize members of the major angiosperm families by identifying their diagnostic features and economic importance.
5. Evaluate the medicinal importance of selected angiosperms.
6. Evaluate the biodiversity and give importance to conserve the endangered species.

Semester II

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 2.1	Cytology and Genetics	04	04

1. Familiarize with ultrastructure of cell, cell organelles, chromosomal organization and types of chromosomes, aberrations in chromosome structure and number.

2. Understands the cell cycle and distinguish mitosis and meiosis and their significance in evolution of life.
3. Develops skills to prepare acetocarmine squash preparation of Onion root tips and Rhoeo flower buds identify different stages of mitosis and meiosis.
4. Understands the old and modern concepts of Mendelian genetics including different types of gene interactions, multiple alleles, quantitative characters, concept of linkage & amp; crossing over, mechanisms of sex determination and extra nuclear inheritance.
5. Develops skills to work out problems in monohybrid, dihybrid, incomplete dominance, gene interactions, linkage, two point, three point crosses and construction of a genetic map
6. Familiarize with the different concepts and theories of evolution of organisms.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 2.2	Developmental Biology and Anatomy	04	04

After the successful completion of this course students are expected to be able to:

1. Apprehend the habit, vegetative and reproductive characteristics of the angiosperm plant.
2. Realize the scope & importance of anatomy and embryology.
3. Distinguish various tissue systems. Understand the normal and anomalous secondary growth in plants and their causes.
4. Perform the various techniques in anatomy. Cognize the phenomenon of microsporogenesis and megasporogenesis. Gain knowledge on fertilization, endosperm and embryogeny.
5. Independently perform practical experiment based on written manuals. Statistically analyze, summarize and interpret experimental data and present this in a written report.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 2.3	Plant Physiology	04	04

After the successful completion of this course students are expected to be able to:

1. Impart an insight into the various plant water relations. Take students to higher levels of learning about the mineral nutrition in plants.
2. Understand the mechanism of various metabolic processes in plant (plant hormones, secondary metabolites, respiration, Photosynthesis, abiotic stress and pathways.)
3. Acquire basic knowledge about growth and development in plants.
4. Equip students with skills and techniques related to plant physiology so that they can design their own experiments
5. Knowledge dissemination regarding various technique of to understand the physiological aspects.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 2.4	Plant Biochemistry	04	04

After successful completion of this course students are expected to be able to:

1. Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms.
2. Unique property of water as a universal solvent and its importance in biological system.
3. Understand the chemistry and classification of carbohydrates, proteins, amino acids, lipids, nucleotides, vitamins and enzymes and its significance.
4. Gain skill on working principles of centrifugation, Chromatography and spectroscopy.
5. Learn the technique of Electrophoresis & amp; radioactivity.

Semester III

Course type	Code	Title	Teaching Hours/ Week	Credits

Core	BOT 3.1	Molecular Biology	04	04

After successful completion of this course students are expected to be able to:

1. Aware about experiments to confirm DNA as genetic material, chemical composition of DNA and different forms of DNA and its structure and replication
2. Understands structure of RNA, types of RNA, protein synthesis, prokaryotic and eukaryotic gene expression, concept of gene and transposable elements
3. Differentiate gene interaction, gene regulation in prokaryotes and eukaryotes, explain the mechanism of transcription, translation and protein targeting – signal hypothesis
4. Explain the chromosomal protein, C – value paradox and advances in the study of hereditary material.
5. Understand the importance of DNA modifying enzymes, vectors, gene cloning and link the advances in genetic engineering of gene manipulation tools. Evaluate the significance of transgenic crops.

Course type	**Code**	**Title**	**Teaching Hours/ Week**	**Credits**
Core	BOT 3.2	Biophysics, Bioinformatics and Biostatistics	04	04

After successful completion of this course students are expected to be able to:

1. Recall the basic concepts of atomic structure and chemical bonding among molecules
2. Explore molecular modelling of proteins, nucleic acids and lipids.
3. Understand the principle of IR, NMR, Raman, ORD, XRD, GC-MS. LC-MS, FTIR and CD techniques.
4. Know the theory behind fundamental bioinformatics tools and databases. Learn the concept of statistical basis of biological assay.

5. Understand the fundamental concepts of biostatistics like measure of central tendency, standard deviation, error, chi-square test, ANOVA and T-test.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 3.3	Ecology and Environment	04	04

After successful completion of this course students are expected to be able to:

1. Apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems. Use interdisciplinary approaches such as ecology, economics, ethics and policy to devise solutions to environmental problems.
2. Be proficient in ecological field methods such as wildlife survey, biodiversity assessment, mathematical modeling and monitoring of ecological systems.
3. Core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
4. Core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 3.4 A	Plant breeding and evolution	04	04

After successful completion of this course students are expected to be able to:

1. Explain the laws of Mendel in classical genetics and deviations from Mendelian ratios.

2. Paraphrase the conventional methods of plant breeding, Summarise the types of polyploidy
3. Understands the methods of plant breeding including introduction, hybridization, acclimatization, polyploidy induction and achievements with reference to crops in India
4. Develops skills to emasculate and hybridize a bisexual flower.
5. Develop the employability skills by understanding Mendel's ratios and deviation, linkage and crossing over and the conventional methods of plant breeding.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 3.4 B	Seed Technology	04	04

After successful completion of this course students are expected to be able to:

1. Students will gain knowledge on the fundamentals of seed technology. To acquire knowledge on theoretical concepts principals of seed production.
2. Students will get to know about basics of Seed processing, seed drying and upgrading, various seed testing organization.
3. Pursuing knowledge related to seed certification at national and international level.
4. This will also help students to enhance their employability for jobs in different sectors.

Semester IV

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 4.1	Medicinal and Aromatic Plants	04	04

1. To evaluate natural herbal products from an economic perspective. To develop effective ideas related to collecting, producing, processing and marketing herbal natural sources.

2. To use medicinal and aromatic herbs sustainably. To procure and make chemical analysis of medicinal and aromatic herbs.

3. To form interdisciplinary relations with medical and aromatic herbs. To set up business related to medicinal and aromatic herbs.

4. To conduct interdisciplinary study and research.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 4.2	Plant Biotechnology	04	04

1. The students able to understand the theoretical knowledge in the field of Plant Biotechnology Tissue Culture and Microbial Biotechnology.
2. Pursuing research related to Plant cell and tissue culture at national and international level. Expertise in planning, execution and analysis of experiments.
3. To contribute in industries related to tissue culture as scientists.
4. Design and delivering of useful modern biotechnology products to the Society.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 4.3	Plant Pathology	04	04

1. Understand the world of microbes, fungi and lichens. Appreciate the adaptive strategies of the microbes, fungi and lichens.
2. Understand the economic and pathological importance of bacteria and fungi. Understand the ecological significance of lichens
3. Identify common plant diseases and device control measures.
4. Formulating hypotheses; developing experimental designs to test these hypotheses; establishing and maintaining experiments.

Course type	Code	Title	Teaching Hours/ Week	Credits
Core	BOT 4.4	Project Work/ Dissertation	04	04

During this process students gain the knowledge on,

1. Selecting the topic and literature survey to address the socio-economic challenges related to plant sciences.
2. To equip the students with skills related to laboratory as well as field based studies.
3. Handling instruments, usage of ICT tools for analysis and discuss their experimental results.
4. Best problem-solving skills in students would encourage them to carry out innovative research projects thereby making the jpg2pdf.pdf m to use knowledge creation in depth.

Davangere University
Shivagangotri, Davangere-577 002, Karnataka

M. Sc in Botany

(From the Academic Year 2016 onwards)

Semester scheme with Choice-Bases Credit System (CBCS)

Course Structure

M. Sc Botany I semester

Sl. No	Course	Code	Title	Teaching Hrs./week	Credits	Marks		
						Examination	Internal assessment	Total
1	Core	Theory BOT 1.1	Microbiology	4	4	75	25	100
2	Core	Theory BOT 1.2	Algae and Bryophytes	4	4	75	25	100
3	Core	Theory BOT 1.3	Pteridophytes and Gymnosperms	4	4	75	25	100
4	Core	Theory BOT 1.4	Plant Systematics and Economic Botany	4	4	75	25	100
5	Core	Practical BOT 1.5	Microbiology	4	2	50	-	50
6	Core	Practical BOT 1.6	Algae and Bryophytes	4	2	50	-	50
7	Core	Practical BOT 1.7	Pteridophytes and Gymnosperms	4	2	50	-	50
8	Core	Practical BOT 1.8	Plant Systematics and Economic Botany	4	2	50	-	50
			Total	32	24		Total	600

30/1/16
CHAIRMAN
BOS in Botany
Department of Botany
Davangere University
Shivagangothri, Davangere-577 002

I SEMESTER M. Sc BOTANY

CORE BOT -1.1: MICROBIOLOGY

50 hours

1	Introduction to Microbiology, Spontaneous generation theory, Biogenesis theory, Branches of Microbiology and Scope of microbiology. Microbiological methods: Microscopy, Staining techniques, microbial isolation techniques, sterilization and media preparation, microbial growth assessment, microbial growth curve, culture preservation methods.	12h
2	a. Viruses: Characteristics of viruses based on host, genetic material, capsid morphology, size and shapes, viral envelop etc. Overview of viral classification; viral replication; detailed study of plant viruses. b. Viroids: General description, study of significance in plant diseases with suitable examples. c. Prions; concepts and Significance	08 h
3	Bacteria: General characteristics, Classification of bacteria, morphological types, colony characteristics, biofilms, ultra structure and chemical organization, fine structure of flagella, fimbriae; Spirochaetes, Rickettsiae, Chlamydiae, Mollicutes, Cyanobacteria, Archaeobacteria, Actinomycetes; Methods of reproduction	12 h
4	Fungi: General characteristics, Classification of fungi to the level of classes, Structural details of unicellular and multicellular fungi, somatic structures, cell wall composition and thallus organization; Homothallism and Heterothallism.; Methods of reproduction in fungi.	10 h
5	Lichens: General characteristics, Types and structural organization, Classification of lichens to the level of orders, Methods of reproduction; economic importance and ecological significance.	08 h

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I SEMESTER M. Sc BOTANY

CORE BOT -1.2: ALGAE AND BRYOPHYTES

50 hours

1	**Algae**: Introduction; basic characteristics of algae. structure of algal cell; Distribution of algal communities - freshwater, marine and terrestrial: nutrition; algae from unusual environments, Economic importance and cultivation of algae, Biofuel production by algae.	05 h
2	Algal Classification to the level of family; a comparative survey of important systems; Pigmentation in algae; structure of different chlorophylls, xanthophylls, carotenoids and other accessory pigments.	10 h
3	Algal thallus organization and reproduction: thallus, ultra structure of cell, Reproduction and life cycle patterns, relationships and evolutionary trends in Cyanophyceae; Chlorophyceae; Charophyceae. Euglenophyceae; Xanthophyceae; Bacillariophyceae; Phaeophyceae; Rhodophyceae.	10 h
4	**Bryophytes**: Introduction, basic characteristics. structure and organization of thallus; growth and differentiation of bryophytes; ecology and distribution of bryophytes.	10 h
5	Classification of Bryophytes in different classes to the levels of families, Structures, Reproduction and Life cycle of Marchantiales, Jungermanniales, Anthocerotales and Polytrichales – Comparative study of gametophytes and Sporophytes of major classes. Spore dispersal mechanisms - Economic importance with special reference to Chemical constituents, Bryophytes as indicator of Pollution, Succession of bryophytes. Evolutionary trends in Sporophytes and gametophytes of bryophytes	15 h
6	Origin and evolution of gametophytes and sporophytes of Marchantiopsida, Anthocerotopsida, and Bryopsida, Economic importance and fossilization.	05 h

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I SEMESTER M. Sc BOTANY

CORE BOT -1.3: PTERIDOPHYTES AND GYMNOSPERMS

50 hours

1	General characteristics, origin, evolution and classification.	02 h
2	Psilopsida-Comparative account of Psilophytales and Psilotales. Lycopsida - Range in vegetative and reproductive structures with reference to Lepidodendrales, Lycopodiales and Isoetales. Sphenopsida-Range in vegetative and reproductive structures with ref. to Sphenophyllales and Calamitales Pteropsida - Range in vegetative and reproductive structures.	12h
3	Phylogenetic trends in Pteridophytes- Evolution of Stele, Sorus–Origin of sporangium-Heterospory and seed habit–Alternation of generation–Affinities of various classes of pteridophytes.	06 h
4	Introduction, General characters, morphology, anatomy and reproduction. Classification of gymnosperms (Sporne, K.R. 1956) - Comparative study of vegetative, anatomical and reproductive characteristics of major families Araucariaceae, Podocarpaceae, Cupressaceae, Gnetaceae– Economic importance of gymnosperms – Living fossils - Affinities with Angiosperms and pteridophytes	14 h
5	a) Types studies of *Cycas, Zamia, Aracaria, Thuja, Taxus, Gnetum, Ephedra, Ginkgo.*	06 h
	b) Geological time scale – fossilization and types of Fossil, carbon dating –Role of fossil in oil exploration- Fossil Bryophytes – Fossil Pteridophytes– *Rhynia, Sphenophyllum, Lepidocarpon, Cladoxylon, Pentoxylon, Botryopteris* Fossil Gynmosperms– *Lyginopteris – Lagenostoma – Cordaites*	10 h

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I SEMESTER M. Sc BOTANY

CORE BOT -1.4: PLANT SYSTEMATICS AND ECONOMIC BOTANY

50 hours

1	Origin of Angiosperms with reference to ancestral stock, time and place of origin; Concept of primitive angiosperm flower.	04 h
2	Principles, Scope and Importance of taxonomy- principles and priorities of ICBN; Herbarium- Importance, collection, preparation, and preservation; Floras, Monographs, Nature and importance of botanical gardens, BSI and its role: vernacular and botanical names, floral diagrams and floral formulas.	06 h
3	Developmental phases of taxonomy- Pioneer phase, consolidation phase, Biosystematics phase, Serotaxonomy.	02 h
4	General survey of the history of the classifications- a. Artificial- Linneaus b. Natural- Bentham and Hooker c. Phylogenetic systems- d. Transitional phylogenetic – Engler and Prantl e. Intentional phylogenetic – Charles Bessey and John Hutchinson f. Contemporary Phylogenetic – Taktajan, Cronquist g. APG system of classification	08 h
5	Taxonomic ranks and modern trends: Aims and objectives of numerical taxonomy, Computer applications in taxonomy.	03 h
6	Taxonomic evidences- Morphological, Anatomical, Embryological, Cytological, Phytochemical, Numerical and Molecular.	03 h
7	Salient features, Economic importance and systematic relationships of the following: Rananculaceae, Magnoliaceae, Capparidaceae, Caryophyllaceae, Malvaceae, Tiliaceae, Sterculiaceae, Menispermaceae, Asclepediaceae, Sapindaceae, Pedaliaceae, Loranthaceae, Fabaceae, Caesalpinaceae, Mimosaceae, Cucurbitatceae, Polygonaceae, Zygophyllaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Rhamnaceae, Apocyanaceae, Bignoniaceae, Solanaceae, Verbenaceae, Scrophulariaceae, Rubiaceae and Asteraceae, Chenopodiaceae, Aizoaceae, Nyctagianceae, Piperaceae, Lauraceae, Santalaceae and Moraceae, Pontederiaceae, Hydrocharitaceae, Amaryllidaceae, Commelinaceae, Arecaceae, Liliaceae, Orchidaceae and Poaceae, Nymhaceae, Podostomaceae.	16 h
8	Cultivation and economic uses of – Cereals and millets, Pulses, Spices and condiments, Timber, Rubber, Beverage, oil yielding, medicinal, Plants as renewable sources of energy and conservation of economically important plant species.	08 h

I SEMESTER M. Sc BOTANY

CORE PRACTICAL 1.5: MICROBIOLOGY

1. Safety measures in Microbiology laboratory.
2. Study of Microscopes
3. Sterilization methods
4. Preparation of culture media
5. Isolation of microorganisms from natural sources
6. Pure culture techniques and aseptic transfer
7. Culturing of microorganisms on solid and liquid media
8. Study of cultural characteristics of bacteria
9. Bacterial motility- Hanging drop technique
10. Preparation of Stains and indicators
11. Simple staining/ Negative staining
12. Gram's staining
13. Measurement of microbial cell / spore number using haemocytometer
14. Measurement of microorganisms by micrometry
15. Slide culture for fungi
16. Study of microbial culture preservation methods
17. Microbial growth assessment – viable count and turbidity
18. Study of Fungi- ***Aspergillus, Penicillium, Saccharomyces, Xylaria, Polyporus, Peziza, Agaricus, Puccinia, Ustilago, Alternaria, Drechslera, Saprolegnia, Rhizopus, Trichoderma, Fusarium***
19. Study of Lichens

I SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT 1.6: ALGAE AND BRYOPHYTES

1. Study of vegetative structures, Anatomy and reproductive structures of the following taxa:
2. BGA-*Microcystis, Spirulina, Scytonema and Oscillatoria*
3. Green algae- *Chlamydomonas, Volvox, Paediastrum, Scenedesmus, Hydrodictyon, Ulothrix*
4. Desmids- *Sacoderm* and *Placoderm;* Xanthophyceae-*Botrydium*
5. Diatoms- *Pinnate* and *Centric-Synedra, Pinnularia, Navicula* and *Cyclotella*
6. Phaeophyceae- *Dictyota* and *Ectocarpus*
7. Rhodophyceae- *Polysiphonia* and *Gracillaria*
8. Charophyceae- *Chara* and *Nitella*
9. Economic products of algae- Agar-Agar, Spirulina tablets, β-carotenes
10. *Cyathodium, Targionia, Marchantia*
11. *Plagiochasma*, Porella
12. *Anthoceros, Notothylus*
13. *Sphagnum, Polytrichum and Bryum*

I SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT 1.7: PTERIDOPHYTES AND GYMNOSPERMS

Habit, anatomy and reproductive structures of the following;

1. *Psilotum* and *Lycopodium*
2. *Selaginella* and *Isoetes*
3. *Ophioglossum* and *Botrychium*
4. *Angiopteris* and *Pteris*
5. *Hymenophyllum* and *Marselia*
6. *Salvinia* and *Azolla*
7. *Cycas* and *Zamia*
8. *Pinus* and *Thuja*
9. *Gnetuma* and *Ginko*
10. Study of fossil forms (Moulds, Charts, Photographs)

I SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT 1.4: PLANT SYSTEMATICS AND ECONOMIC BOTANY

1. Preparation of cleared whole mount of floral parts
2. With the help of dissection and hand section examine- Androecium and gynoecium - Style, stigma, ovaries and placentations.
3. Orientation of students towards construction of key, use of floras, in identification up to species level.
4. Training towards specimen collection, Herbarium preparation, and preservation techniques.
5. Study of diagnostic features of the families studied in theory with special reference to their economic use. Based on Bentham and Hooker's systems of classification.
6. The students are supposed to study at least 2 members of each family in the laboratory, make suitable sketches describe them in technical terms and floral diagrams.
7. Study of the economic important plants; give their local names, Botanical names, family and parts used and their importance mentioned in the theory.
8. Botanical study tour – Compulsory (for a minimum of 7 days)

M.Sc. Botany II semester

Sl. No.	Course	Code	Title	Teaching Hrs./week	Credits	Marks		
						Examination	Internal assessment	Total
1	Core	Theory Bot. 2.1	Cytology and Genetics	4	4	75	25	100
2	Core	Theory Bot. 2.2	Developmental Biology and Anatomy	4	4	75	25	100
3	Core	Theory Bot. 2.3	Plant Physiology	4	4	75	25	100
4	Core	Theory Bot. 2.4	Plant Biochemistry	4	4	75	25	100
5	Core	Pract. Bot. 2.5	Cytology and Genetics	4	2	50	-	50
6	Core	Pract. Bot. 2.6	Developmental Biology and Anatomy	4	2	50	-	50
7	Core	Pract. Bot. 2.7	Plant Physiology	4	2	50	-	50
8	Core	Pract. Bot. 2.8	Plant Biochemistry	4	2	50	-	50
			Total	32	24		**Total**	**600**

II SEMESTER M. Sc BOTANY
CORE BOT 2.1: CYTOLOGY AND GENETICS

50 hours

Cytology		25 hour
1	Introduction and History	02 h
2	Instrumentation in cytology- Microscopy- concepts and applications of Light, Phase contrast, Fluorescent, Electron microscopy: Autoradiography. Cell fractionation and centrifugation	06 h
3	Organization of prokaryotic and eukaryotic cell; Detailed account of cell organelles- EPR, Golgi complex, Plasma membrane-structure, function and comparison of different models, Ribosomes, Mitochondria, chloroplast, Lysosomes and Nucleus.	09 h
4	Structure of eukaryotic chromosomes- chromosome models, nucleosome concept, Polytene. Lamp brush chromosomes and supernumerary. Karyotype, Idiogram and evolution,	04 h
5	Numerical and structural Variations: Cell division and significance of mitosis and meiosis; cell signaling in plants.	04 h

Genetics		25 hour
1	Introduction and History, Transmission Genetics: An over view of Mendelian Genetics; Extensions of Mendelian's principles, Gene interaction Multiple alleles, Quantitative inheritance, Multiple gene interaction, Linkage and crossing over, Tetrad analysis and mitotic recombination; construction of linkage maps. Evolution of gene concept; Alleles, Pseudo alleles, one mutant one metabolic block, one gene one enzyme concept, one gene one polypeptide concept, complementation test, cistron, muton, recon, rII locus in T4 phage. Chromosome mapping, extra chromosomal inheritance, Population and Evolutionary Genetics: Genetic variation - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium, The synthetic theory of evolution, Evidence for adaptive evolution, Molecular evolution	13 h
2	**Recombination and mutation:** Conjugation, transformation and transduction, genetic changes due to recombination, plasmids. Molecular basis of gene mutation, repair and recombination: Mutation: DNA repair: Recombination: **Genetic and molecular basis of sex determination:** Molecular basis of sex determination and dosage compensation in *Drosophila*, **Epigenetic inheritance-** Introduction, dosage compensation, types, molecular basis of dosage compensation in *Drosophila*, man and *Coenorhabditis*, properties of inactive x chromosome, genome imprinting in xci, stability, applications of xci, genome imprinting, consequences and mechanism, life cycle of imprint, imprinting and diseases and regulation	12 h

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II SEMESTER M. Sc BOTANY
CORE BOT–2.2: DEVELOPMENTAL BIOLOGY AND ANATOMY

Developmental Biology		50 hours / 30 hou
1	Introduction, history and scope; Contributions of P. Maheshwari; BM Johri; BGL Swamy to the development of embryology in India	02 h
2	Anther– Types and structure of anther; Microsporogenesis – structure and function of wall layers, role of tapetum in pollen development: Types of tapetum; Male gametophyte development, Pollen structure and cytochemistry, concept of male germ unit (MGU) and its significance, Pollen wall proteins and allergens, Pollen viability.	05 h
3	Ovules–structure, types and development; Megasporogenesis – triads, dyads, tetrads, coenomegaspore; Embryo sac- Types and development, Ultra structure of the components. Nutrition of the embryo sac, Theories of morphological nature of the embryo sac	05 h
4	Pollination–Histochemistry of style and stigma. Significance of pollen pistil interaction, artificial pollination, detailed account of fertilization, Incompatibility-intraspecific incompatibility (Heteromorphic and Homomorphic), GSI and SSI system, Unilateral incompatibility, Methods to overcome incompatibility; *In-vitro* manipulation of sperm and egg, Genetic control of Pollen and Pistil interaction, Pollen allelopathy	04 h
5	Structure, types and development of dicot and monocot embryos, nutrition of embryo	02 h
6	Endosperm-types, development and structure; Cytology and physiology of endosperm	02 h
7	Polyembryony, Apomixis-Genetics of apomixis and Practical importance, parthenocarpy and Palynology– a general account and its applications. Experimental Embryology- experimental induction of poly embryony scope and applications, embryology in relation to plant taxonomy	04 h
8	Seed biology, seed structure, development of seed coat, morphology and its functions, labyrinth seeds and its physiological and biochemical aspects, classification of seeds, development of seeds in cultured ovaries, seed dispersal mechanisms, importance of seeds.	06 h

Plant Anatomy		20 hou
1	Introduction, History and scope: Structural diversity of stem, leaves and root; Cell wall and its development - chemistry of cell wall.	06 h
2	Meristems - Classification, theories with regard to apical Meristems, Development of vascular cambium in roots and stem, Role of cambium in wound healing and grafting, Cambium in Monocotyledons.	04 h
3	Tissue system – Fundamental, dermal, Vascular, stelar, nodal and secretary tissue	02 h
4	Primary structure of root, stem and leaf: Root stem transition, - Development and differentiation- The structure of specialized cells. Vascular differentiation, (Procambium, residual Meristems, inter and intra fascicular cambium) Acropetal and basipetal differentiation in leaves, stem and root. Differentiation of Phloem, Tracheary elements and its control,	06 h
5	Anomalous secondary growth–concepts, modification of the common vascular cambium,	02 h

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II SEMESTER M. Sc BOTANY
CORE 2.3: PLANT PHYSIOLOGY

Plant Physiology		50 hours
		50 hours
1	Water and plant cells; properties of water, Hydrogen bonding, polarity, Cohesion and adhesion. The concept of water potential, Components of water potential. Water movement in cell and tissues. Transpiration –structure of stomata, stomatal movement and mechanism; Absorption of water and Ascent of sap, Guttation.	07 h
2	Solute transport: Passive and active transport across membranes, membrane transport proteins; mechanism and theories of transportation in phloem	03 h
3	Secondary metabolites: a brief survey of secondary metabolites, Physiological role. Significance; ecological and phylogenetic importance	03 h
4	Fundamentals of enzymology: Nomenclature. Nature and properties, active sites, co enzymes, Kinetics of enzyme; allosteric enzymes, ribozymes, and Abzymes; extraction and purification of enzymes	04 h
5	Energy Flow: Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP, types and mechanism of phosphorylation	04 h
6	Phytohormones- discovery, biosynthesis, metabolism, transport and physiological effects of auxins ,gibberellins, cytokinins, ethylene and ABA; A brief account of Horticultural and commercial application of growth hormones; Seed dormancy and germination	04 h
7	Phytochrome: Photochemical and biochemical properties of phytochrome; Localization; Phytochrome induced whole plant responses; structure and function; cellular and molecular modes of action ; Photoperiodism	04 h
8	Photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting copmplexes , photo-oxidation of water, mechanisms of electron and proton transport, carbon assimilation-The calvin cycle, photorespiration and its significance, C_4 cycle, CAM path way- physiological and ecological considerations.	07 h
9	Respiration: Overview of plant respiration; Glycolysis; Two phases, regulation, fate of pyruvate under aerobic and anaerobic condition; TCA cycle, Electron transport and ATP synthesis; overall balance sheet; Alternate path ways; Pentose phosphate pathway; RQ of general substrates.	07 h
10	Nitrogen metabolism: Nitrate and ammonia assimilation; molecular mechanism of nitrogen fixation; Nif genes; Hup genes and leghemoglobin.	03 h
11	Stress physiology: Types of stress- water. temperature, salt; Stress caused by pests, pathogens and pollutants; Metal toxicity. HR and SAR mechanisms	04 h

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II SEMESTER M. Sc BOTANY
CORE 2.4: PLANT BIOCHEMISTRY

Plant Biochemistry		50 hours
1	Concepts in Biochemistry: An overview of macromolecules, properties of water as suitable solvent in biological system. Acids, Bases, pH, buffers, effects of pH on biological process, buffer solutions for biological investigations.	04
2	Chemistry of amino acids, peptides; Definition, classification, structure, general properties. chemical tests for amino acids. Chemistry of Proteins-Definition, structure, purification, characterization and function analysis, protein families, Edman degradation	06
3	Chemistry of carbohydrates: Definition, classification, structure and general properties, importance and properties of sucrose, lactose, maltose, starch, cellulose, dextrins, hemicellulose, pectins, lignins, agar and bacterial cell wall polysaccharides	06
4	Chemistry of Lipids and Fats: Definition, classification, structure and importance of lipids and fats	03
5	Chemistry of nucleotides: Purines, Pyrimidines, structure and properties of nucleosides and nucleotides	03
6	Vitamins: Definition, classification, structure and importance	02
7	Porphyrins: Definition, classification, structure and importance of chlorophyll, cytochrome and hemoglobin	02
8	Enzymes: Classification, nomenclature, general properties, enzyme kinetics, coenzymes, activators, inhibitors, isoenzymes, multi-enzyme complex, allosteric enzymes, mechanism of enzyme action	06
Biochemical Techniques		18
9	Centrifugation techniques: Basic principles of sedimentation Methods and applications of density-gradient centrifugation, preparative centrifugation, ultracentrifugation.	
10	Chromatographic techniques: General principles and techniques. Methods and applications of paper chromatography, thin-layer chromatography, exclusion chromatography, affinity chromatography, ion-exchange chromatography, HPLC, Gas-liquid chromatography	
11	Electrophoretic techniques: General principles and applications of electrophoresis and iso-electric focusing	
12	Spectroscopic techniques- General principles and laws of radiation, colorimetry-UV-visible spectrophotometry	
13	Radioisotopic techniques- General principles, nature of radio activity, detection and measurement of radioactivity, applications of radioisotopes in biological investigation	

II SEMESTER M. Sc BOTANY PRACTICALS

CORE BOT 2.5: CYTOLOGY AND GENETICS

1. Methods of fixing and staining (Acetocarmine, Aceto-orcein and feulgen)
2. Study of mitosis (*Allium/Maize*)
3. Study of meiosis (*Tradescantia/Chlorophytum/Allium*)
4. Determination of chromosome number at mitotic metaphase and diakinesis/metaphase I of meiosis.
5. Study of Mitotic Index in Root meristematic tissue of *Allium cepa*
6. Ploidy in *Triticum*
7. Karyotype analysis in *Allium*
8. Polytene chromosome in Chironomos larvae/Fruit flies.
9. Problems from Mendelian linkage, Quantitative genetics and population genetics
10. Observation of mutant flies of *Drosophila*
11. Linkage problems- 3 point test cross
12. Models and Photographs related to genetics and plant breeding

II SEMESTER M. Sc BOTANY PRACTICALS

CORE BOT–2.6: DEVELOPMENTAL BIOLOGY AND ANATOMY

1. Study of trichomes, stomatal types, Tracheary cells
2. Root anatomy &Stem anatomy
3. Leaf anatomy &Flower bud anatomy
4. Secondary growth and abnormal secondary growth
5. Double staining techniques
6. Embryo (Crotalaria) (slides – Dicot and monocot- grass) and endosperm mounting (Cucumis / Grewelia) (slides- types of endosperms)
7. Microsporangium wall, Microsporogenesis; Megasporangium and female gametophyte
8. Pollen germination by hanging drop and sitting drop methods: *Balsam*, *Delonix*, *Hibiscus* and *Peltaphorum*
9. Study of totipotency in cell types: stomata, epidermal cells, stem and leaf explants on a tissue culture media
10. Polarity in stem cuttings: *Pothos* spp.
11. Study of regeneration in succulents *Kalanchoe*, *Byrophyllum*
12. Study of leaf galls of plants: *Pongamia pinnata* & *Achyranthes aspera*: Morphological observations and histology.

II SEMESTER M. Sc BOTANY PRACTICALS
CORE BOT–2.7: PLANT PHYSIOLOGY

1. Determination of water potential of tissue by Plasmolytic/ gravimetric method.
2. Determination of stomatal index, the area of stomatal aperture in different plants.
3. Quantitative estimation of chl. a, chl. b; and total chlorophyll in plant tissues.
4. Determination of absorption spectra of chlorophyll pigment.
5. Determination of diurnal fluctuation of acid content in CAM plants (TAN).
6. Quantitative estimation of carbohydrates by Benedict's and DNS methods.
7. Determination of RQ of different substrates by Dougla's respirometer.
8. Determination of proteins in seeds by Lowry's method.
9. Determination of role of kinetin in postponing senescence.
10. Estimation of the lipase/amylase activity in seeds.
11. Estimation of phenols in germinating seedlings.

II SEMESTER M. Sc BOTANY PRACTICALS

SUPPORTIVE: BOT-2.8: PLANT BIOCHEMISTRY

1. Preparation of molar and normal solutions
2. Determination of the concentration of Hel by volumetric analysis
3. Determination of the concentration of NaOH by volumetric analysis
4. Ionization of water and concept of pH and pOH
5. Titration curve of strong acid and strong base
6. Titration curve of weak acid and strong base
7. Buffers
8. Qualitative analysis of carbohydrates
9. Qualitative analysis of amino acids
10. Qualitative analysis of proteins
11. Quantitative estimation of carbohydrate by DNS method
12. Quantitative estimation of proteins by Biuret method
13. Estimation of free fatty acids
14. Chromatography
    a. Circular paper chromatography
    b. Ascending paper chromatography
    c. Thin-layer chromatography
15. Polyacrylamide gel electrophoresis for proteins.
16. Components of colorimeter/Spectrophotometer
17. Components of pH meter

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M.Sc. Botany III semester

Sl. No	Course	Code	Title	Teaching Hrs. /week	Credits	Marks		
						Examination	Internal Assessment	Total
1	Core	Theory BOT 3.1	Molecular Biology	4	4	75	25	100
2	Core	Theory BOT 3.2	Biophysics, Bioinformatics and Biostatistics	4	4	75	25	100
3	Core	Theory BOT 3.3	Ecology and Environment	4	4	75	25	100
4	Specialization	Theory BOT 3.4 (A)	Plant Breeding and Evolution	4	4	75	25	100
		Theory BOT 3.4 (B)	Seed Technology					
5	Core	Practical BOT 3.5	Molecular Biology	4	2	50	-	50
6	Core	Practical BOT 3.6	Biophysics, Bioinformatics and Biostatistics	4	2	50	-	50
7	Core	Practical BOT 3.7	Ecology and Environment	4	2	50	-	50
8	Specialization	Practical BOT 3.8 (A)	Plant Breeding and Evolution	4	2	50	-	50
		Practical BOT 3.8 (B)	Seed Technology					
9	Interdisciplinary Elective (for other science students)	Theory BOT 3.9	Plants and Human welfare	2	2	40	10*	50
				Total	26		Total	650

Note: In interdisciplinary elective, the components of internal assessment are Assignment 05 marks and Test 05 marks.

I/II/III/IV Semester M. Sc Degree Examination, June/Dec

Botany

(New Scheme)

Bot- ;

Time:3 Hours

Max. Marks: 80

SECTION-A

Answer any **Ten** of the following questions; **(10x2=20)**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

SECTION-B

Write short notes on any **Six** of the following; **(4x6=30)**

8
9
10
11.
12.
13.
14.
15.

SECTION-C

Answer **any Three** of the following questions: **(3x10=30)**

16.
17.
18.
19.
20..

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Additional mandatory credit courses

9	**Skill development courses**		Functional and Communicative English	2	2	
			Computer Basics and Applications	2	2	
10	**Socially relevant Credit Audit Courses**		Basic Laws and Legal Awareness	2	2	
			Socially relevant issues	2	2	
			Administration and e-governance	2	2	
			Personality development	2	2	

III SEMESTER M. Sc. BOTANY

CORE THEORY BOT 3.1: MOLECULAR BIOLOGY

50 hours

1	Introduction and scope ;Nature of genetic material: Nucleic acid as genetic material; the primary and secondary structure of DNA and RNA; Organization of the Genetic material in prokaryotes and eukaryotes; mitochondrial and chloroplast DNA organization; Replication of DNA: Patterns of replication-experiments of Messelson's and Stahl, Cairns, Tailor, enzymes and proteins of DNA, replicating machinery, mechanism of replication-initiation, elongation and termination in prokaryotes and eukaryotes, fidelity of replication, proof reading mechanism, RNA directed DNA synthesis (reverse transcription).	08 h
2	Expression of Genome: Transcription - RNA polymerase-types, structure and function, mechanism of transcription-initiation, elongation and termination in prokaryotes and eukaryotes. Post transcriptional modifications-RNA processing, capping, polyadenylation, splicing, alternate splicing, exon, shuffling, structural organization of m-RNA, t-RNA and r-RNA, m-RNA transport; Translation: t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, the genetic code, deciphering of genetic code, degeneracy and Wobble hypothesis, enzymes, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins;	08 h
3	Gene regulation in prokaryotes: Concept -Lac operon-positive and negative control, tryp – operon ; Gene regulation in eukaryotes	04 h
4	Transposable elements: Prokaryotic transposons - retrotransposons-retroviruses and retro transposons, copia and Ty elements, mechanism of transpositions, uses of transposons-as genetic markers, mutagens, transposon tagging for gene isolation and vectors for transformation; : eukaryotic Transposons - AC-DS elements in maize, cpm /en elements in snapdragon.	05 h
5	Principles and methods of Nucleic acid sequencing; Sanger di-deoxy sequencing, Next Generation Sequencing, Pyrosequencing, multi locus sequencing, whole genome sequencing; Blotting Techniques; Southern, Western and Northern blots, Gene Cloning, Molecular markers in Genetic Diversity analysis; RFLP, RAPD, PCR, Real-time PCR, ISSR, SSR markers, Fluorescence-in situ hybridization, DNA finger printing and Micro Array technology,	-10h-
5	Recombinant DNA technology and their applications-Enzymes, vectors, construction and screening of gene and c-DNA libraries, expression of cloned genes in bacteria and plants, transgenic plants, vector dependent and independent methods	-10 h
6	Applications of GMO's in forestry, Agriculture, horticulture, Pharmaceuticals, Bioremediation; gene piracy, bioethics and biosafety in rDNA technology and IPR	5h

REFERENCES

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2. Herkwitz, I. W. 1977, Principles of Genetics, 2nd Ed. MacMillan Publ. Co., New York.
3. Lewin B. 2004. Genes 8th Ed. John Wiley and sons. New York.
4. Prescott, D. M. 1988 Cells: Principles of Molecular structure and function. Johes and Bortlet pub.
5. Syenga. I. 1972, General cytogenetics, North Hapland Pub. Co.
6. Strickberg, M. W.1985. Genetics, 3rd Ed. MacMillan Pub. Co., New York.
7. Waston, J.D. et al. 1965. Molecular, Biology of the gene. 4th Ed. The Benjamin/Cunnings
8. H.S. Bhamrah, 1990. Molecular cell Biology, Anmol Publications, New Delhi.
9. G. Shanmugam, 1988, Cell Biology Lab Manual, Macmillan, India Ltd., Madras.
10. James Jorwell, Honey Lodish, 1986. Molecular cell biology, Scientific American Books.
11. P.S. Verma and V.K. Agarwal, 1999. Cell Biology and Genetics S. Chand and company Ltd., New Delhi.
12. George, M. Malacinski, 1986, Macmillan publishing co., New York. Molecular Genetics of Mammalian cells.
13. A.K.Tobin. 1992. Plant organelles compartmentation of Metabolism in Photosynthetic tissue, Cambridge University, Press..
14. H.S. Bhamaah, 1990, Molecular cell Biology, Anmol Publication New Delhi.
15. Roerl Miesfeld, 1999, Applied Molecular Genetics, Wiley's Liss Publication.
16. S.C. Rastogi, 1995. Concepts in Molecular Biology.
17. Reeta Arora, 1988. Cell Biology. Anmol Publications, New Delhi
18. G. Shanmugam, 1998. Cell Biology Lab Manual, Macmillan India Ltd., Madras.
19. Sharad Srivastava, 1997, Molecular Genetics, Anmol Publications, New Delhi
20. Geoffrey & W.H. Potler. 1995. Analysis of Biological Molecular, Chapman & Hall Pub.
21. James Darwell, Honey Lodish, 1986, Molecular Cell Biology, Scientific American Books,
22. Vinceeta Singhal & C.K. Arora, 1995, Techniques in Molecular Biology, Anmol Publishers, New Delhi.
23. Thorpe, N.O. 1989. Cell Biology, John Willey and sons New York.
24. Cullis, C. A .2001, Plant genomics and proteomics, Willey- VCH.
25. Hughes, M. A. 1996. Plant molecular genetics, Addison Wesley Longman. Ltd. UK.
26. Grierson, D and Covey, S. N, 1998. Plant molecular biology. Blacklee Academic and professional, London.

CORE THEORY BOT 3.2: BIOPHYSICS, BIOINFORMATICS AND BIOSTATISTICS

50 hours

Biophysics		
1	Introduction, Chemical buildings blocks; structure of atoms, bonds within molecules – ionic, covalent, hydrogen, electrostatic, disulphide and peptide bonds, vander Waals forces, bond length, bond energies, bond angles; isomerism-structural, geometrical, optical isomerism; secondary bonding; weak interactions.	05 h
2	Molecular modeling of Proteins structure, principles of ionization; predicting properties from amino acid composition; unusual amino acids, stabilizing forces, conformational properties of polypeptides, Ramchandran plot, domains and motifs; structure-function relationship; study of three dimensional structures of proteins – cytochromes, lysozyme, trypsin, immunoglobulins	08 h
3	Molecular modeling of nucleic acid structure, Conformational parameters of nucleic acids and their constituents, nucleic acid geometrics, base pairing, base stacking, Chargaff's rule, DNA polymorphism, DNA super coiling; hyperchromicity; modified nucleotides, tertiary structure of nucleic acids.	06 h
4	Membranes: Lipid structure and their organization, phase titration in lipids, polysaccharides, molecular shapes and conformation; membrane fluidity, membrane proteins	04 h
5	Methods in biophysical analysis: Spectorscopy –IR, fluroscence, Raman spectroscopy; Circular Dichroism (CD), Optical Rotatory Dispersion (ORD), NMR, X-ray diffraction.	07 h
Bioinformatics		
6	Introduction, genomics and the genome projects, data base types–nucleotide databases-NCBI, DDBJ, EMBO; protein data bases, Biodiversity databases, OMIM; Oligo anaylsis, BLAST, computer tools for sequence analysis: finding and retrieving sequences, similarity searching, sequence allignments–pairwise and multiple sequence allignments and comparision; Molecular phylogenetics – molecular clock hypothesis, concept of phylogenetic tree, types of trees, Methods of Phylogenetic tree construction (UPGMA, Maximum Liklihood, Maximum Parsimony, Minimal evolution, Neighbor Joining), Phylogenetic tree evaluation methods, elementary idea of clustering and cladistic methods	10 h
Biostatistics		
7	Introduction to Biostatistics; Mean, median, mode, measure of dispersion, range, standard deviation, mean deviation, standard errors, confidence limits, simple significance tests based on the normal distribution; use of t-tests, regression analysis, ANOVA, multiple regression, Principal Component Analysis (PCA), Detrendended correspondence analysis (DCA), Canonical Correspondence Analysis (CCA), LSD, Chi-square test, statistical basis of biological assays – response-dose metameter, direct and indirect assays, probit, logit, LD_{50}, ED_{50}, PD_{50}, slope ratio assay; use of calculators and computer programs for statistical analysis.	10 h

III SEMESTER M. Sc. BOTANY

CORE THEORY BOT 3.3: ECOLOGY AND ENVIRONMENT

50 hours

Ecology		
1	Introduction and scope of ecology: Review of fundamental concepts related to energy, food chains, food webs, and trophic levels; life forms and growth forms; concepts of primary production; methods of productivity; global trends in primary productivity; and ecological niche	06 h
2	Ecological factors- climatic, edaphic, topographic and biotic factors; soil erosion and its control measures.	03 h
3	Succession- Types, climax and stability concepts; changes during succession; characters of pioneer and climax species.	03 h
4	Population ecology; Structure of population, density, natality, mortality, biotic potential, carrying capacity, aggression and dispersal, ecotene and edge effect.	04 h
5	Communities: Classification and structure; interactions between species; negative interactions; competition, Predation, parasitism	04 h
Environmental Biology		
6	Environmental pollution; Air, water, and soil; effects on plants with emphasis on biological methods; sustainable development; cumulative effect on global environment – green house effects, ozone depletion, Use of fertilizer, pesticides and other chemicals in agriculture and hygiene and their disposal. Chemical usage and disposal from industry and pollution. Impact of chemicals on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals, environmental issues, policies and regulations, EL Niño and La Niña effects	06 h
7	Conservation Strategies-in situ and ex situ; biosphere reserves, National parks, Wild life sanctuaries, Botanical gardens, gene bank. Afforestation, Social forestry, Environmental impact assessment, International biological programme, Man and biosphere programme; environmental acts; wild life preservation act (1972); Indian forest act, (1980) and United nations environment programme, Remote sensing and its applications	08 h
8	Problems of conservation; Causes of threat to environment- human interference, deforestation, habitat destruction, overexploitation of resources. Applications of ecology in forestry, agriculture, range management, land use planning. Environmental awareness; Role of government and NGOs.	04 h
Phytogeography		
9	Aims and principles of Phytogeography; Physical features of the world, climatic zones, tectonic and continental movement; Patterns of plant distribution; circumpolar, circumboreal, circumaustral, pan tropical; methods of dispersal, migrants and isolation; endemism.	06 h
10	Floristic provinces of the world: a brief account of the phytocoria of the Indian subcontinent. Origin and distribution of cultivated plants- coffee, cardamom, sugarcane, cashew, ragi, maize, wheat, rice, cotton and tea	06 h

REFERENCES

1. Wilson, K and Coulding K.H. 1986. A Biologists Guide to principles and Techniques of Biochemistry, EIBS edn.
2. Zubay. G. 1983. Biochemistry, 3rd edition, Addison-Wesley..
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15. Chang, R. 1977. Physical Chemistry with application to Biological Systems (2 Ed.)
16. Branden and Tooze, 1991, Introduction to protein structure, Garland publishing company.
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19. Lacroix Z and Critchlow, Z. 2003, Bioinformatics, Morgan Kaufmann Publishers.
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III SEMESTER M. Sc. BOTANY

CORE THEORY BOT 3.4 (A): PLANT BREEDING AND EVOLUTION

50 hours

Plant breeding		
1	Introduction to plant breeding-history, objectives, achievements in the pre-Mendelian era, post-Mendelian plant breeding, potential and opportunities.	5h
2	Introduction, domestication and acclimatization. Patterns of evolution in crop plants, Centres of origin, gene pool concept - primary, secondary and tertiary gene pool, and gene introgression. Plant genetic resources: Importance of plant genetic resources and diversity in plant breeding, collection, evaluation and conservation of germplasm.	10h
3	Modes of reproduction in plants - asexual & sexual reproduction, self and-cross-pollination mechanisms, male-sterility and self incompatibility	5h
4	Genetic basis of plant breeding: Genetic consequences of self and cross fertilization, genetics of self incompatibility. Mating systems - genetic & phenotypic assortative and disassortative matings and their genetic consequences; Qualitative & quantitative traits and their genetic behavior in segregating populations; Components of variation, single gene and multiple gene concepts, epistasis and gene interactions; Heritability and genetic advance; Selection - responses to selection, selection differential, intensity and realized advance; Heterosis - concept and theories, inbreeding depression.	10h
5	Methods of breeding- self-pollinated, cross-pollinated and asexually propagated crops; Land races, pure line selection and mass selection; Pedigree selection, bulk method and its modification; Marker Assisted Selection, Hybrid breeding, populations and population improvement, intra and inter population improvement; Clonal selection.	8h
6	Mutation breeding, use of polyploidy and distant hybridization in plant breeding.	2h
Evolution		
2	Nature of Evolution; Theories of origin of life; Evolutionary Thoughts before Darwin, Darwin's Evolutionary Theory, Evolutionary Theories after Darwin, Geological time scale, Modern Synthesis. Evidences for the theory of organic evolution: Paleontology, Biogeography, Taxonomy, Comparative Anatomy and Embryology, Physiology and Biochemistry, Plant and Animal Breeding. Genetic drift, Variations: Gene mutation- Mendelian concept; Chromosomal mutations. Speciation and origin of higher categories: Natural Selection-Selective forces, Types of natural selection, selection models, Selection and non-adaptive characters. Isolation-mechanisms and speciation, Polyploidy: Autotetraploidy, Allotetraploidy and Polyploidy, Molecular basis of evolution and Neo-Darwinian evolution, co-evolution	10h

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1. Allard, R. W. 1960. Principles of Plant Breeding. John Wiley & Sons, New York.
2. Hays, H. K., Immer, F.R. and Smith, D.C. 1955. Methods of Plant Breeding, McGraw Hill Book Company, Inc., New York.

3. Fehr, W. R. 1987. Principles of Cultivar Development (2 Volumes). MacMillan Publishing Co., New York.
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11. Mark Ridley. 2003. Evolution (3rd edition), Blackwell.
12. Roderic D. M. Edward C. Holmes. 1998. Molecular Evolution: A Phylogenetic Approach Page, Blackwell.
13. Scott R, Freeman and Jon C. Herron. 2003. Evolutionary Analysis, Prentice Hall

III SEMESTER M. Sc. BOTANY

CORE THEORY BOT 3.4 (B): SEED TECHNOLOGY

50 hours

1	Seed technology; Introduction, Definition, History, Importance of seed technology in India and abroad, and its importance in Agriculture, seed development in cultivated plants;Seed Industry in India and abroad, Development of seed programmes, basic strategies of Seed production.	04 h
2	General Principles of seed production, Nucleus and Breeder's seed production, seed production in self and cross-pollinated crops, Hybrid seed production, Seed Production of Cereals, Pulses, Sugar crops, Fruits and Vegetables	06 h
3	Seed Processing; Seed drying, cleaning and upgrading, Seed treatment, packaging and handling, Seed storage-types of storage structure, seed factors affecting storage life, effect of RH on seed storage, Seed marketing; Demand forecasts, Marketing structure and organization, Seed pricing.	15 h
4	Seed Testing; Organizations involved in seed testing; International Seed Testing Association (ISTA), Association of Official Seed Analysts (AOAC), Central Seed Testing Laboratory, State Seed Testing Laboratory, Seed testing laboratory-layout and staff; Seed sampling, Analysis of seed Purity, Germination, Viability, Seed Vigor tests, Seed health testing methods, Seed moisture.	15 h
5	Seed Certification and Seed legislation; objectives, concepts, procedures, Seed certification standards, Field and seed inspection.	10 h

References

1. Agrawal, R. L. 2006. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Basra, A. 2006. Handbook of Seed Science and Technology. CRC Press.
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4. Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi.
5. Michael, B. and Bewely, D. 2000. Seed Technology and its Biological basis. Blackwell Publishing.
6. Neergaard, P. Seed Pathology. Palgave-McMillan, Denmark.
7. Reddy, 2008. Principles of crop production. Kalyani Publishers, New Delhi
8. Singh, 2009. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
9. Umarani et. al. 2006. Experimental Seed Science and Technology. Agrobios, Jodhpur.

III SEMESTER M. Sc. BOTANY PRACTICALS

CORE 3.5; MOLECULAR BIOLOGY

13. Isolation and separation of plasmid DNA
14. Isolation of plant DNA by CTAB method
15. Estimation of DNA by Diphenyl method
16. Estimation of RNA by Orcinol method
17. Agarose gel electrophoresis for separation of DNA
18. Preparation of competent cells and transformation of *E. coli* (chemical/electroporation method)
19. PCR, Real-Time PCR
20. Charts/Models and Photographs

III SEMESTER M. Sc. BOTANY PRACTICALS

CORE 3.6; BIOPHYSICS, BIOINFORMATICS AND BIOSTATISTICS

1. Determination of Tm of different DNA.
2. Determination of absorption spectra of different compounds.
3. Spectroscopic estimations.
4. Dose response curves – determination of LD_{50}, ED_{50}, MIC etc.
5. Prediction of amino acid sequence of proteins.
6. Prediction of nucleotide sequence.
7. Study of protein databases.
8. Study of nucleic acid data bases.
9. Designing of oligo nucleotides.
10. BLAST Analyis
11. Sequence comparisons and alignment.
12. Use of computer model building for peptides and proteins.
13. Use of computer programs for nucleic acid research.
14. Construction of phylogenetic trees.
15. Biostastical problems.

III SEMESTER M. Sc. BOTANY PRACTICALS

CORE BOT 3.7: ECOLOGY AND ENVIRONMENT

1. Study of local vegetation/ lake as models of ecosystems.
2. Study of vegetation by quadrat method and determination of minimum size and number of quadrats.
3. Transect method of studying vegetation.
4. Study of ecological adaptations in plant. ecological anatomy(Hydrophytes, xerophytes, epiphytes, parasites& Halophytes)
5. Methods of water and soil sampling and assessment of PH.
6. Estimation of DO, Co_2, Total hardness, Chlorides, Calcium.
7. Estimation of primary productivity by dark bottle method.
8. Major and minor forest products of Karnataka.
9. Physical features of world, India and Karnataka. – Oceans, Deserts, Islands, Mountains and grasslands.
10. Study of endemic plants of India
11. Ecological instruments
12. Pictures /charts/photographs/maps marking of different vegetation types of India.

III SEMESTER M. Sc. BOTANY

CORE PRACTICAL BOT 3.8 (A): PLANT BREEDING AND EVOLUTION

1. Study of floral biology of crops; typical examples of self and cross pollinating plants
2. Techniques of emasculation and hybridization
3. Pollen viability; germination and TTC tests
4. Vegetative propagation methods- Types of Cuttings, Budding, Grafting and layering.
5. Models and Photographs related to plant breeding.
6. Photographs, pictures, schemes related to evolutionary theories.

III SEMESTER M. Sc. BOTANY

CORE PRACTICAL BOT 3.8 (B): SEED TECHNOLOGY

PRACTICAL SYLLABUS

1. Study of seed sampling methods
2. Determination of Physical Purity of seed samples
3. Determination of moisture content of seeds by using;
   a. Oven method
   b. Infra-red moisture balance
   c. OSAW meter
4. Determination of seed viability by TTC method
5. Determination of Density of seed samples
6. Determination of germination by using different methods;
   a. Top Paper method
   b. Between Paper method
   c. c. Sand method
7. Determination of seed vigor by;
   a. Conductivity test
   b. Hiltner's test
   c. Accelerated ageing method
8. Determination cultivar purity by Grow-out-test
9. Study of seed-borne diseases and their pathogens (Bacteria, Fungi, Viruses)
10. Visit to the Seed Production Industry

III SEMESTER M. Sc BOTANY (FOR OTHER SCIENCE STUDENTS)

INTERDISCIPLINARY ELECTIVE PAPER BOT 3.9: PLANTS AND HUMAN WELFARE

25 hours

Module: I

Biodiversity: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity. Values and uses of Biodiversity. 05 Hrs

Module: II

Study and utility of the useful parts of the following:

1. Cereals and Millets- Rice, Wheat, Maize, Barley, Sorghum, Finger millet, pearl millet.
2. Pulses: Red gram, Green gram, Black gram, Horse gram, Pea, Cow pea, Bengal gram;
3. Oil Yielding plants: Sunflower, Safflower, Groundnut, Linseed, Rape seed.
4. Sugar yielding plants- Sugar cane and Sweet potato;
5. Spices and condiments- Ginger, Turmeric, Cardamom, Cinnamon, Clove, Saffron, All spice, Black pepper, Nutmeg, Red pepper, Coriander, Cumin, Fennel and Vanilla,
6. Fibre- Cotton, Jute, Flax, Hemp, Sun hemp, China grass, Coconut and Kapok;
7. Timber yielding plants- *Tectona, Dalbergia and Rosewood.*
8. Dyes- Indigo, Henna.
9. Rubber- Para rubber and other substitutesGums- Gum Arabic. 10 Hrs.

Module: III

1. Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences. Ethno medicinal Plant Gardens. Important medicinal plants and their uses, Palaeo-ethnobotany, folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India.
2. Applications of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.
3. Importance of forestry their utilization and commercial aspects; Avenue trees, Ornamental plants of India. ; Alcoholic beverages through ages. Fruits and nuts: Fruit crops of Karnataka and their commercial importance. 10 Hrs.
4. Wood and its uses. A brief introduction to horticultural plants and Floriculture.

M.Sc. Botany IV semester

Sl. No	Course	Code	Title	Teaching Hrs./week	Credits	Marks		
						Examination	Internal Assessment	Total
1	Core	Theory BOT 4.1	Medicinal and Aromatic plants	4	4	75	25	100
2	Core	Theory BOT 4.2	Plant Biotechnology	4	4	75	25	100
3	Core	Theory BOT 4.3	Plant Pathology	4	4	75	25	100
4		Dissertation 4.4	To be given by the faculty	4	4	75	Viva -25	100
5	Core	Practical BOT 4.5	Medicinal and Aromatic plants	4	2	50	-	50
6	Core	Practical BOT 4.6	Plant Biotechnology	4	2	50	-	50
7	Core	Practical BOT 4.7	Plant Pathology	4	2	50	-	50
			Total	28	22		Total	550

IV SEMESTER M. Sc BOTANY
CORE THEORY PAPER BOT 4.1: MEDICINAL AND AROMATIC PLANTS

50 hours

1	Introduction and scope of medicinal plants - importance of medicinal plants over synthetic medicines. Scope of pharmacognosy.	2h
2	Classification of medicinal plants and crude drugs - classification based on origin (plant, animal, and minerals) and nature of plants (medicinal, poisonous and aromatic plants). Crude drugs–alphabetical; morphological; and pharmacological; taxonomical; chemical and chemotaxonomic criteria.	8h
3	Plants as a sources of medicine (Aromatic, Spices, Medicinal, Poisonous); Ex- *Santalum album, Cinnmomum camphora, Cymbopogon, Eucalyptus, Jasminum spp., Lavendula officinalis, Rosmarius officinalis, Rosa damascene, Pogostemons pachouli, Acorus calamus, Thymus vulgaris, Alpinia galanga, Mentha piperita, Papaver somnifera, Crocus sativus, Piper spp., Syzigium aromaticum, Cuminum cyminum, Rauwofia serpentiana, Withania somnifera, Centella asiatica, Catharanthus roseus, Atropa belladonna, Argemone Mexicana, Nerium indicum, Taxus brevifolia, Abrus precatorious, Datura stramonium,* etc.	10h
4	Popular systems of world medicine- Indian systems of medicine – Ayurveda, siddha, and Unani (branches); Ayurvedic pharmacopoeia, Materia medica and current research trends, Chinese systems of medicine, European systems of medicine, African systems of medicine and Tibetans systems of medicine.	5h
5	Plants in different therapies – Naturopathy, Chromotherapy, Aromatherapy, Raw juice therapy, Herbal cosmetics, Home remedies, Bach flower remedies and Neutraceuticals (Therapeutic effects of plants used as food).	5h
6	Phytochemistry – introduction and general methods (extraction of plant material, isolation and Purification). Basic metabolic pathways and the origin of secondary metabolites, enzymes and coenzymes involved in the synthesis, chemical nature of secondary metabolites (Alkaloids, Terpenoids, Flavonoids, Glycosides, Steroids, Essential Oils, Coumarins, Tri-terpenes).	5h
7	Analytical Pharmacognosy – drug adulteration and substitution of crude drugs. Detection of adulteration and evaluation. Biological detection of adulterations and evaluation, biological testing of herbal drugs, techniques in microscopy, powered drugs, the microcomputer and analytical aid in drug microscopy, quantitative microscopy, Pharmaco genomics, Chemo informatics and medical informatics.	5h
8	Market potential of crude drugs and their product. Collection, preparation, storage and packing of crude drugs for the market. Trade (Export & import) of crude drugs and phytochemicals. International and domestic consumer marketing. Problems in marketing, Steps to boost marketing of medicinal plants.	5h
9	IPR issues – patents, patenting of biological material, trade secret, copy right, trademark, IPR and plant genetic resource, obligations with patent application, implication of patenting, patenting of medicinal plants – turmeric and neem.	3h
10	Sustainable conservation and developmental strategies for medicinal plants– conservation of medicinal of medicinal plant diversity in India, IUCN, SSC, CBD, CITES, Traffic, WWF for nature, red list of threatened species, red data book.	2h

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IV SEMESTER M. Sc BOTANY

CORE THEORY PAPER BOT 4.2: PLANT BIOTECHNOLOGY

50 hours

1	Plant development-fundamental and general aspects, Polarity and its significance, growth in relation to morphogenesis-Differentiation, Dedifferentiation, Redifferentiation, Totipotency and regeneration-*in-vitro* and *in-vivo*.	5h
2	Plant tissue culture-Definition, history and Importance, Laboratory organization-Methods of sterilization-medium composition and preparation - culture initiation and incubation of culture.	10h
3	Callus induction and establishment, Callus sub-culture and maintenance. Cell suspension culture – characteristics, Organ culture, Somatic embryogenesis - somatic embryo development and synthetic seed production. Somaclonal variation and applications. Experimental androgenesis and gynogenesis.	8h
4	Micro propagation: methods-axillary and adventitious budding - advantages. Plant protoplast isolation, culture and fusion. Call wall regeneration from protoplasts - application of protoplast hybridization. Biotransformation and immobilization of plant cells. Hairy root clones. Production of secondary metabolic compounds using cell and tissue culture. Molecular farming and immuno-protective drugs.	10h
5	Microbial Biotechnology; Microbial growth; fermentation-process-types of fermenters and fermentation, fermentation products; industrial production of antibiotics, vitamins, amino acids; organic acids, enzymes; genetic improvement of fermentation products	7h
6	Biotechnology- Scope, potentialities and constrains, host controlled restrictions, gene cloning vectors - Plasmids, Phages, Cosmids, Transposans, Primary vectors and plasmids - expression vectors. Enzymes in genetic engineering - exonucleases, endonucleases, restriction endonucleases, S 1 nucleases, DNA ligases, reverse transcriptase and alkaline phosphatase.	10h

IV SEMESTER M. Sc BOTANY

CORE THEORY PAPER BOT 4.3: PLANT PATHOLOGY

50hours

1	Concepts; importance of microorganisms in plant health, influence of microorganisms in plant growth, modern concepts of microbial inoculants in agriculture; Interaction of soil microorganisms with plants: Rhizosphere and phyllopiane microorganisms.	04 h
2	Mass culturing and quality control of microbial inoculants-mother culture, shake culture and brief account of large scale production of biofertilizers, types of carrier materials, packing, storage, bench life and transportation of biofertilizers. Methods of application to seed, soil and nursery.	05 h
3	Brief account of salient features, mass production and applications of *Rhizobium*, *Azotobacter*, *Azospirillum*, Cyanobacteria, *Azolla* and *Frankia*	04 h
4	Plant growth promoting rhizobacteria (PGPR) and phosphate solubilizing bacteria - properties, significance and applications. Beneficial fungi in agriculture, *Trichoderma*, Mycorrhizae - importance and applications.	05 h
5	Significance of plant diseases, types of plant diseases, basic procedure of plant disease diagnosis; parasitism and pathogenicity; disease development in plants, disease cycle, infection cycle and plant disease triangle.	03 h
6	Effects of pathogens on plant physiology – photosynthesis, nutrients uptake, respiration, membrane permeability, transcription and translation, plant growth and reproduction.	02 h
7	Genetics of plant disease: Variability in pathogens, stages of variation, types of plant resistance to pathogens; genetics of virulence in pathogens and resistance in plants; pathogenicity genes, resistance genes in plants, signal transduction, molecular mechanisms.	04 h
8	Plant pathogenesis: Process of pathogen attack; chemical weapons – enzymes, toxins, growth regulators in plant disease.	04 h
9	Plant defense mechanisms: preexisting and induced structural and chemical defenses, role of elicitors, receptors and suppressors in disease development; systemic acquired resistance; defense through genetic engineering.	04 h
10	Plant disease epidemiology: Effect of environmental factors on disease development; Dissemination of plant pathogens; Disease forecasting and its significance.	02 h
11	Plant Disease Management: Quarantine regulations, cultural methods, physical methods, chemical control, biological control, cross protection, breeding for disease resistance, transgenic plants for plant disease management, integrated disease management practices.	05 h
12	Brief account of some important plant diseases -rots, damping-offs, downy mildews, white rust, powdery mildews, smuts, rusts, wilts, leaf spots, anthracnose, galls, ergots, bacterial, viral, phytoplasmal, nematodal, protozoal, viroid, non-parasitic diseases and post-harvest diseases.	08 h

IV SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT-4.5; MEDICINAL AND AROMATIC PLANTS

1. Study of Morphology, Medicinal uses of the following plants:
   a. *Clerodendron infortunatum*
   b. *Cassia mimosoides*
   c. *Solanum xanthocarpum*
   d. *Argyria cunieta*
   e. *Lantana cramlata*
   f. *Santalum album*
   g. *Lawsonia inermis*
   h. *Holorrhena antidysentrica*
   i. *Aloe berbedens*
   j. *Centella asiatica*
   k. *Morinda tinctoria*
   l. *Plumbago zeylanica*
   m. *Gymnema sylvestre*
   n. Other plants
2. Preparation of lehya, churna, rasyana, decoctions, Poultice
3. Anatomy of Crude Drugs yielding plants

   i. *Rauwolfia*-Root ii. Ginger-Rhizome iii. *Cinchona*-Bark iv. *Datura*-Leaves

   v. Clove-Flower Bud vi. *Vinca*-Leaves/root
4. Detection of Adulteration

   a. *Sesame* oil in pure ghee; b. Tea powder; c. *Argemone* oil in edible oil
5. Study of commercial formulation of aromatic compounds from plants.
6. Extraction of plant bioactive principles from plants by sox let method.
7. Separation of plant bioactive principles by TLC method.
8. Study of antimicrobial properties of medicinal plant extracts
9. Phytochemical tests for crude plant extracts (Tests for Phenolics, alkaloids, flavonoids, tannins, Steroids, tri-terpenes, carbohydrates, saponins, lignins, coumarins)
10. Visit to Pharmacological industries/Ayurvedic colleges/institutes.

IV SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT-4.6–PLANT BIOTECHNOLOGY

1. Basic tissue culture laboratory organization, principles and techniques.
2. Equipment and Instrumentation.
3. Culture media and sterilization: simple media, synthetic media, complex media, semi defined media, special media, enriched media.(MS and B5)
4. Explants preparation, inoculation techniques/ procedures.
5. Initiation and establishment of primary cultures: preparation and culture of – stem, root, leaf, Meristems, anther, ovary, seeds and embryo.
6. Sub culturing techniques.
7. Cell suspension cultures.
8. Synthetic seed production.
9. Morphology and histology of callus.
10. Production of somatic embryos.
11. Biochemical analysis of secondary metabolites from tissue culture.
12. Southern, Northern, Western blot, Eastern blotting techniques.
13. Preparation of wine from grapes.
14. Biotechnological products- Insulin, SCP, Biopesticides, Biofertilizers, Vitamins, Transgenic organisms (Photographs); figures of vectors used in genetic engineering.
15. Visit to biotechnological, tissue culture labs and industries.

IV SEMESTER M. Sc BOTANY

CORE PRACTICAL BOT-4.7–PLANT PATHOLGY

1. Comparison of rhizosphere microorganisms from different crop plants.
2. Isolation of *Rhizobium, Azospirillum, Azotobacter, Anabaena, Azolla.*
3. Estimation of phosphate by Fiskay-Subbarao method.
4. Estimation of phosphate by Koeming and Johnson's method.
5. Detection and quantification of mycorrhizae by root clearing technique.
6. Seed health testing by dry seed examination.
7. Seed Health testing by seed wash method.
8. Detection of seed-borne fungi by blotter method.
9. Study of plant diseases caused by fungi, bacteria and viruses.
10. Histopathological preparations of diseased specimens.
11. Effect of seed-borne pathogens on seed germination and seedling vigour
12. Fungicide evaluation by spore germination inhibition assay
13. Fungicide evaluation by agar diffusion method
14. Fungicide evaluation by poison food technique
15. Effect of fungicidal seed treatment on seed-borne fungi.
16. Testing of antagonism by dual culture plate technique.
17. Testing of antimicrobial property of antagonists culture filtrate.
18. Post harvest diseases.
19. Observation of diseased specimens, sections and slides.

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