M.Sc. Botany Syllabus

Veer Bahadur Singh Purvanchal University, Jaunpur

U.P-222001

For University and Affiliated Colleges

Syllabus of M.Sc. Botany;CBCS(As Per Guidelines of U.P Government in Accordance with National Education Policy-2020 with Effect from the session 2022-2023)

Members of the Board of Studies

S.No.	Name	Designation	College/University
1	Prof. Ashok Singh	Convener	Department Of Botany T.D.P.G. College Jaunpur
2	Dr.Rajkumar Yadav	Assistant professor **(P.G.Member)**	Department Of Botany T.D.P.G. College Jaunpur
3	Dr.Bal Mukund Seth	Assistant professor **(P.G.Member)**	Department Of Botany T.D.P.G. College Jaunpur
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5	Dr.Neeraj Kumar Dubey	Assistant professor (U.G.Member)	Rashtriya P.G.College, Jamuhai , Jaunpur
6	Dr.Sunil Kumar Mourya	Assistant professor (U.G.Member)	Kuteer P.G.College Chakke, Jaunpur
7	Dr.Vaikunth Nath Pandey	Assistant professor (U.G.Member)	Rajkiya Mahila P.G.College, Ghazipur
8	Prof. R.N. Kharwar	External Subject Expert	Department Of Botany, B.H.U.,Varanasi
9	Dr.Malvika Shrivastav	External Subject Expert	Department Of Botany D.D.U.Gorakhpur

Semester wise Title of the Papers in M.Sc. Botany

SEMESTER - I

Subject Code	Subject / Paper	Theory /Practical	Teaching hours /Sem.	Credits	Evaluation		Duration of External Examination
					Internal	External	
B040701T	Microbiology	Theory (Paper-I)	60	4	25	75	3
B040702T	Mycology	Theory (Paper-II)	60	4	25	75	3
B040703T	Phycology	Theory (Paper-III)	60	4	25	75	3
B040704T	Bryophytes And Pteridophytes	Theory (Paper-IV)	60	4	25	75	3
B040705P	Practical Lab	Practical (Paper- V)	60	4	25	75	8
	Minor elective (Other than own faculty)	(Paper-Vl)		4/5/6			
B040706R	Industrial training/Research project/Survey	Project Report/Dissertation (Paper-Vll)	60	4		50	

Semester wise Title of the Papers in M.Sc. Botany

SEMESTER - II

Subject Code	Subject / Paper	Theory /Practical	Teaching hours/sem.	Credits	Evaluation		Duration of External Examination
					Internal	External	
B040801T	Gymnosperms and Embryology	Theory (Paper-I)	60	4	25	75	3
B040802T	Ecological principles	Theory (Paper-II)	60	4	25	75	3
B040803T	Taxonomy of Angiosperm and Medicinal Botany	Theory (Paper-III)	60	4	25	75	3
B040804TA Or B040804TB	Cell Biology, Genetics and Biostatistics Or Elementary Biotechnology	Theory (Paper-IV)	60	4	25	75	3
B040805P	Practical Lab	Practical (Paper-V)	60	4	25	75	8
B040806R	Industrial training/Research project/Survey	Project Report/Dissertation (Paper-VI)	60	4		50	

Semester wise Title of the Papers in M.Sc. Botany

SEMESTER – III

Subject Code	Subject / Paper	Theory / Practical	Teaching hours/sem.	Credits	Evaluation		Duration of External Examination
					Internal	External	
B040901T	Biochemistry	Theory (Paper-I)	60	4	25	75	3
B040902T	Plant Physiology	Theory (Paper-II)	60	4	25	75	3
B040903T	Specialization Biodiversity of angiosperm	Theory (Paper-III)	60	4	25	75	3
B040904TA Or B040904TB	Specialization A-Cultivation and Phytochemistry of Medicinal Plant Or B-Genetic Engineering	Theory (Paper-IV)	60	4	25	75	3
B040905P	Practical Lab	Practical (Paper-V)	60	4	25	75	8
B040906R	Industrial training/Research project/Survey	Project Report/Dissertation (Paper-VI)	60	4		50	

Semester wise Title of the Papers in M.Sc. Botany

SEMESTER - IV

Subject Code	Subject / Paper	Theory / Practical	Teaching hours/sem.	Credits	Evaluation		Duration of External Examination
					Internal	External	
B041001T	Plant Anatomy and Palynology	Theory (Paper-I)	60	4	25	75	3
B041002T	Environmental Pollution And Protection	Theory (Paper-II)	60	4	25	75	3
B041003TA Or B041003TB	Specialization A-Taxonomy Of Angiosperm And Ethnobotany Or /B-Plant Pathology	Theory (Paper-III)	60	4	25	75	3
B041004TA Or B041004TB	Specialization A-Pharmacognosy (special) /B-Plant Breeding	Theory (Paper-IV)	60	4	25	75	3
B041005P	Practical Lab	Practical (Paper-V)	60	4	25	75	8
B041006R	Industrial training/Research project/Survey	Project Report/Dissertation (Paper-VI)	60	4		50	

Subject Prerequisites: To study this subject a student must have had the subject(s) Botany atUG Level.

Course Structure: The courses will be based on Choice Based Credit System (CBCS) structure developed by the University. There will be four compulsory or elective core coursesof Botany in each semester. Apart from these, one minor elective course of other faculty is tobe chosen by a student in the first year of M.Sc. (Botany). In each semester, there will be oneresearch project of 04 credits.

Programme (M. Sc.) Objectives:

This programme has been designed to train and enable students to understand the relationship between science and society as well as logical, scientific and ethical issues related to science. In addition to this, the students will be able to think critically for the formulation of hypotheses and experimental designingbased on the scientific method, which will make the students readily employable in various streams of teaching, research, civil services and in industries.

Programme Specific Outcomes (PSOs): After completing M.Sc. (with Botany), the following will be the PSOs

PSO-1: It is expected that after successfully completing M.Sc. Botany, students will develop deeper theoretical & Practical knowledge of different branches of Botany like Phytotecnique, Plant taxonomy, Anatomy, Mycology, Microbiology, Physiology, Biochemistry, Cell biology, Genetics, Molecular biology, Medicinal Botany, Pharmacognosy, Environmental issues etc, making them capable of understanding the societal, environmental issues, demands and their solutions.

PSO-2: This program has a strong theoretical basis that will help students in evolutionary relationship of lower and higher plants by using the key characters which is expected from a student of Botany to support the other branches of knowledge related to plants.

PSO-3: Many of the courses in the programme have been carefully designed that will help the students for qualifying competitive exams like IAS, IFS, CSIR NET, SET, TGT, PGT and to write research proposals for grants.

PSO-4: Continuous internal assessment provides ample opportunity to the students for improvement after every evaluation. Seminar and field visits system grooms the personality of the students and enables them to present oneself with confidence, develop a reasonably

well compiled content and discuss. Assignments enable the students to compile the solutions of the given problems with optimal discussion.

PSO-5: In each semester of the programme, each student is given research project of their own choice to allow students to understand various steps of solving a research problem. Thus, this programme will help to develop research aptitude at PG level with identification of gaps in knowledge and relevance oftheir solutions for the society.

PSO 6. The student completing the course will be capable of executing research projects.

The types of paper, number of papers, credit for each semester and research project semester wise, as per guidelines of UP state govt. letter no. 401/sattar-3-2022, dated February 09, 2022, as a part of NEP-2020 implementation in U.P. universities, have been prepared as above.

The maximum and minimum marks for each Theory paper, Practical papers (internal & external) and projects have been finalized according to the letter number-1032/sattar-3-2022-8(35)/2020, dated 9 February, 2022. The basic structure of the programme related to types of paper, number of papers, credit etc have been finalized according to the letter of government dated July 13, 2021.

Core Compulsory Courses: These are main (major) courses of the subject which every student has to study who has taken admission in PG (First and Second Year).

Core optional (specialization) Courses: These are full major courses of the subject/programme. There courses will selected by the studentsin 1/2/3/4 (or 7/8/9/10 in case of integrated PG) Semesters. The Botany department of university/colleges will run these courses in their department/colleges according to their resources/ specialization of teacher and students may opt them according to their choice.

Minor Electives: Some of the above courses, or any other such course developed by BoS, can be taken as Minor electives by the students of other Faculty, for multi-disciplinarily.

Marks Distribution and Teaching hours

The marks distribution for each core and elective will be as

Maximum marks: 100 (Internal assessment 25 marks + External Assessment 75 marks). Teaching hours for each of the course will be 60 hours. Duration of Theory examination of each paper shall be 3 hours and practicl examination of each paper shall be 8 hours. The distribution of Internal Marks will be as follows

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment(Charts/Flora/RuralService/TechnologyDissemination/field visits with report)	8
Total	25

For Practical the distribution of marks will be as follow

Internal Assessment	Marks
Practical Class Interaction	5
Viva voce	4
Two practical based exercises	7 (4+3)
Charts/model/ Collection	8
Total	25

For External practical examination the distribution of marks will be as follow

External Assessment	Marks
Viva Voce on Practical's	10
Report of Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models with Reports	10
Table work / Experiments	45

Practical Record File	10
Total	75

Research Project:

B.Sc. IV year will be equivalent to M.Sc. 1st year. At the end of the 2nd(even) semester (B.Sc. VIII semester or MSc IInd semester) & 4th/10th semester (M.Sc.), the candidate will submit a research project, which will be evaluated by an external examiner & internal supervisor along with a presentation and viva-voce examination.

In Fourth year (B.Sc.) or MSc first year and Fifth year (MSc final) the topic of the research project will be chosen from among the core compulsory courses/core elective courses of that year.

In each semester, each student will work 4 hour/ week/ semester for 4 credit. In this way a project work will be of 8 credits (i.e. 16 credits for two years).

Research project may be interdisciplinary/ multidisciplinary. It may be an industrial training/ internship/ survey work. **Research project will be done under the guidance of the faculty member (s) preferably having PhD degree**. For this a co-supervisor may be chosen from a university, college, industry, research institute etc.

The research project will be of 100 marks. If any student publishes a research paper from his/her research project in a UGC care listed/ Scopus indexed or Thomsom rueter, then he/shewill get 25 extra marks (although maximum marks will not exceed more 100). The marks obtained in research project will be coded in grades and they will be counted in the calculation of CGPA.

Credits: MSc Programme will be run semester wise and choice based credit system. MSc Ist year or B.Sc 4th year will be of 52 credits whereas MSc 2nd year will be of 48 credits.Each semester will be of 20 credits of courses (4 theory+1 practical, each will be of 4 credits) and thus the credits of two years (4 semesters) will be 80 credits.

A project work will be of 8 credits (i.e. 16 credits for two years). In other words it will be of 4credits/semester i.e. a total of 16 credits.

A minor elective will be of 4 credits.

Thus M.Sc Programme will be of 100 credits (52+48).

Semester I St

Subject-M.Sc Botany I St Semester

Course Code – B040701T **Course Title- Microbiology**

PAPER-I: Microbiology

Unit-I

Lichens- A general account of lichens and its symbionts, thallus structure, physiology, reproduction, classification and chemistry of lichens, isolation of symbionts, synthesis of food and economic importance.

Contribution Of Indian Botanist among different stream in Life Sciences- Professor M.O.P. Iyengar,Professor K.C.Mehta, Professor Shiv Ram Kashyap, Professor Birbal Sahni and Professor Hargovind Khorana

Unit-II

Viruses- Nature of plant viruses and symptoms caused by them, microscopic, histological and cytological,Transmission of plant viruses, their relationship with vectors

Unit-III

Physiology of virus infected plants; serology and its applications.

Phages: Structures, mode of infection and multiplication in their hosts.

Unit-IV

Bacteria-Classification, a general account of their mode of nutrition, cytology, reproduction, general importance of bacteria.

Economic importance and industrial uses of bacteria

Reference Books-

Change. S.T. and P.G. Miles - Edible mushrooms and their cultivation

Mosses, B.V.A. – Mycorrhizae

Powel, C and D. J. Bagyaraj - V.A. Mycorhizae

Berry, R. - Industrial mycology (Vol. I)

Dubey, S.C. - Biotechnology.

Jeffrey C. Pommerville - Alcamo's Fundamentals of Microbiology

Arora D.R. and B. Arora - Text book of Microbiology.

Subject-M.Sc Botany I St Semester

Course Code – B040702T **Course Title- Mycology**

PAPER-II :Mycology

Unit-I

Status of fungi, principles of important systems of classification of fungi upto the rank of classes, Detailedstudy of the classification of Alexopoulos and Mims 1970.

Unit-II

A study of the Myxomycetes, Plasmodiophoromycetes, Phycomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes with reference to:

Classification upto the rank of order. Range of structure and organisation of vegetative and reproductive bodies. Ultra structure of fungal cells. Method of reproduction. Variations in life-cycle.

Unit-III

Modes of nutrition of fungi and their physical and chemical requirement for growth and reproduction.

Heterokaryosis, Parasexuality, Heterothallism, Variation in fungi, Hormonal control of sexual reproduction.

Unit-IV

Economic importance of fungi:

a. Microbial fermentation and production of small and macro molecules.

b.Harmful activities, Deterioration of materials by fungi, Fungi as agents of Plant and Human diseases.

Reference Books-

John Webster and Roland W.S. Weber - Introduction to Fungi

Alexopoulos C.J., C.W. Mims and M. Blackwell – Introductory Mycology

Mehrotra R.S. and K.R. Aneja – An Introduction to Mycology

Smith, J.E. - The Filamentous Fungi

Berry, R. - Industrial mycology (Vol. I)

Subject-M.Sc Botany I St Semester

Course Code – B040703T **Course Title- Phycology**

PAPER- III : Phycology

UNIT - I

General characters and comparative study of important systems of classification of algae – Fritsch system of classification.

Criteria used in the primary classification of algae: a) Pigments b) Reserve food materials c) Flagella d) Cell wall e) Range of the organization.

Algae of diverse habitats – a) Terrestrial b) Freshwater algae and c) Marine algae d)Gross Cell Structure

Reproduction of algae – a) Vegetative b) Asexual – Different types of spores. Sexual

– Zygotic, Sporic and Gametic with suitable examples.

UNIT – II

General characters, morphology, life history and classification of the followinggroups of algae:

Cyanophyceae – *Chrococcus,Gloeotrichia,Nostoc,Cylendrospermum,Stigonema,Cephaleuros.*

Chlorophyceae - *Eudorina, Hydrodictyon, Pithophora, Ulva, Stigeoclonium, Draparnaldiopsis, ,Fritschiella, Closterium and Bryopsis*

Charophyceae - *Nitella*

UNIT-III

General characters and morphology, life history of the following groups of algae.

Bacillariophyceae – *Cymbella, Gomphonema,Pinnularia,Coscinodiscus.*

Xanthophyceae – *Botrydium,Vaucheria*

Dinophyceae-*Peridinium,Ceratium*

Phaeophyceae - *Laminaria , Padina,Ectocarpus,Dictyota,Laminaria,Fucus*

Rhodophyceae – *Porphyra Nemalion,Polysiophonia ,Gelidium.*

UNIT-IV

Algal blooms and Toxic algae, Algal biofertilizers, Algae as Food and Feed. Role of algae in industry (Alginic acid, Agar, Carrageenan)

Fossil Algae (A brief account only).

Reference Books-

Fritsch, F.E. The structure and reproduction of algae volume I and II

Robin South,G and Alan Whittick: Introduction to Phycology

Morris,I: An Introduction to Algae

Bold, H.C. and Wynne, M.D.: Introduction to the Algae structure and reproduction

H.D.Kumar: Introductory Phycology.

Subject-M.Sc Botany I St Semester

Course Code – B040704T **Course Title- Bryophytes and Pteridophytes**

PAPER- IV: Bryophytes and Pteridophytes

UNIT - I

Classification systems of Bryophytes Distribution, structure and reproduction of the following groups: Marchantiales; Marchantiaceae-*Marchantia, Targionia*, Jugarmanniales- *Porella,*Anthocerotales- Anthoceros, *Notothyllas* ,Sphagnales – *Sphagnum*,Polytrichales- *Polytrichum , jungermaniles*

UNIT - II

Structure and evolution of gametophyte in Bryophytes,Structure and evolution of sporophytes in Bryophytes.Economic importance of Bryophyte,Fossil & Fossilization, types of plant fossils,Fossil Bryophytes.

UNIT - III

Classification systems of Pteridophytes, Stelar evolution in Pteridophytes. Distribution, structure and reproduction of the following groups: Psilotales- *Psilotum*,Filicales – *Ophioglassum, Adiantum, Salvinia, Azolla* Lycopodiales- *Lycopodium, Selaginellales-Selagenella,Isoetales- Isoetes*,Equisetales-*Equisetum*.

UNIT- IV

Telome theory & its application,Heterospory & seed habit,Geological time scale,Process of fossalization, and techniques employed in types of fossils,Origin and evolution of early vascular plants,General characters of Lepidodendrales, Calamitales and Sphenophyllales.

Reference Books-

Smith, G.M. Cryptogamic Botany. Vol.II

Parihar, N.S.: Bryophyta

Parihar, N.S.1976: Biology and Morphology of Pteridophytes

Sporne, K.R. Pteridophyta

Rashid: Introduction to Pteridophyta

Cavers, F. Inter-relations of Bryophytes.

Subject-M.Sc Botany I St Semester

Course Code – B040705TP **Course Title- Practical lab**

PAPER- V: Practical lab

Unit-I -Microbiology

Introduction to basic Mycrobiological Techniques and Lab. Safety; Methods of sterilization, media preparation and culturing.

Staining of Gram + ve and Gram - ve Bacteria

Unit - II -mycology

Identification of fungal cultures, slides and specimens of *Synchytrium, Allomyces, Glomus, Emericella, Neurospora, Morchella, Fusarium, Colletotrichum, Melampsora, Phallus, Ustilago, Peronospora, and Stemonitis.*

Study of Symptomology of the following fungal diseases by taking sections and slide preparation: Downy mildews, Tikka disease, *Melampsora* rust, Wheat rust and White rust.

Identification of fungal cultures, slides and specimens of *Rhizopus/Mucor, Aspergillus, Penicillium, Yeast, Fusarium, Alternaria, Cercospora, Pythium,* , VAM fungi, *Trichoderma.* Study of Mycorrhizal colonization in roots of *Parthenium* and Study of Mushroom specimens.

Unit - III-Phycology

Identification of the genera mentioned in Cyanophyceae and Chlorophyceae. Collecton and identification of algae occurring in and around university college/campus . .

Identification of the genera mentioned in Cynophyceae,Chlorophyceae, Bacillariophyceae, Xanthophyceae, Phaeophyceae and Rhodophyceae.

Identification of bloom forming algae. Identification of Algal biofertilizers. Identification of toxic algae.

Unit - IV-Bryophytes And Pteridophytes

Bryophytes: Morphologiocal and structural study using whole mount

Plagiochasma

Targionia

Notothylas

Sphagnum

Pteridophyta, Morphology and anatomy of vegetative and reproductive organs using cleared whole mount sections. Macerations and permanent preparation of *Psilotum, Isoetes, Ophioglossum, Adiantum, Salvinia, Azolla*.

Industrial Training/Research Project/Survey(Value Added)

Course Code: B040706R (Research Project)

PAPER- VII : Industrial Training/Research Project/Survey(Value Added) Duration: 60 Hrs.

Course Objectives: The objective of this course is to provide students with hands-on trainingin specialized areas of plant sciences

Course Outcomes: After completion of this course the students will acquire the following:

1. Training in experimental design and execution
2. Knowledge on techniques and tools of research
3. Designing of research proposal.
4. Writing of research and review paper

Contents

The topic of the research project will be chosen from among the core compulsorycourses/core elected courses of that year.

Semester IInd

Subject-M.Sc Botany IInd Semester

Course Code – B040801T **Course Title- Gymnosperms and Embryology**

Paper-I - Gymnosperms and Embryology

UNIT – I

Distribution of Gymnosperms - Past and present. Classification of Gymnosperms – Proposed by Sporne and Pant.

Economic importance of Gymnoperms ,Wood anatomy of Conifers.

UNIT – II

A general account of Gymnosperms with reference to their vegetative morphology and anatomy and male and female cones of the following taxa). a)Cycadales (*Cycas, Zamia*) b). Ginkgoales (*Ginkgo*)c). Coniferales (*Araucaria, Podocarpus, Cupressus* and *Cedrus*) d)Taxales (*Taxus)* e).Gnetales (*Ephedra, Welwitschia*)

General Account of Pteridospermales, Pentoxylales and Cordaitales.

UNIT – III

Microsporangium: Anther, sporogenous tissue, formation of pollen wall, vegetative and generative nucleus.

Megasporangium: Ovule, types of ovules, Nucellus, Megasporogenesis, embryosac types, a special account of mature embryosac.

UNIT-IV

Fertilization: Double fertilization, self-incompatibility, barriers of fertilization. Endosperm: Development and types of endosperms. Embryogeny of dicots. A general account of Apomixix and Parthenocarpy. Embryology in relation to Taxonomy.

Reference Books-

Chamberlain, C.J. Gymnosperms: Structure and evolution

Sporne K. R: The Morphology of Gymnosperms.

Vashistha, P.C. 1978: Gymnosperms.

Foster & Gifford. Comparative Morphology of Vascular Plants

Delevoryas, T.1963. Morphology and evolution of Fossil Plants

Arnold C.W. introduction to Paleobotany

Shukla & Mishra: Essentials of Paleobotany

Steward, W.N. 1988: Paleobotany & Evolution of plants

Sergeiv, Moyen: Fundamentlis of Paleobotany – 1098

Taylor, T.N. 1981. Introduction to Fossils

Subject-M.Sc Botany IInd Semester

Course Code – B040802T **Course Title- Ecological Principles**

Paper- II - Ecological Principles

Unit -I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.Habitat and Niche**:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.Species Interactions**:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit- II

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Unit- III

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit-VI

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reference Books-

E.P. Odum 1996 Fundamentals of ecology

E.J Koromondy .1996 Concept of Ecology

P.D Sharma. 1996 Ecology and environment

S.P. Misra .S.N. 2010 Pandey Essentail Enviromental studies

N.S Subrahmanyam and Sambamurty 2000 Ecology

Subject-M.Sc Botany IInd Semester

Course Code – B040803T Course Title -Taxonomy of Angiosperms and Medicinal Botany

Paper- III - Taxonomy of Angiosperms and Medicinal Botany

UNIT -I

1. Systems of classification: Phenetic and Phylogenetic systems. Critical account of the system of classifications of a) Hutchinson b) Cronquist and c) Takhtajan.
2. Taxonomic evidence and techniques used therein a) Morphology b) Micromorphology c) Epidermology d) Cytology e) Phytochemistry f) Nucleic acid hybridization.

UNIT -II

3. Nomenclature: a) Concept of ICBN b) Salient features of Botanical Nomenclature c) Ranks and Nomenclature of taxa d) Typification e) Rules of Priority f) Effective and valid publication g) Author citations.
4. Biosystematics: a) Concept b) Categories c) Species concept

UNIT -III

5. A comparative study of the following pairs of families and their treatment in recent systems:

a) Magnoliaceae & Winteraceae
b) Malvaceae & Sterculiaceae
c) Rutaceae & Meliaceae
d) Apocynaceae & Asclepiadaceae
e) Verbenaceae &Lamiaceae
f) Amaranthaceae & Chenopodiaceae
g) Cyperaceae & Poaceae

6. Origin of angiosperms, with reference to recent findings.

UNIT -IV

7. Medicinal Botany:

a) Role of plants in medicine, its origin and development
b) Morphology, active principles and medicinal value of the following:

i. Andrographis paniculata
ii. Asparagus racemosus
iii. Clitoria ternatea
iv. Phyllanthus emblica
v. Gymnema sylvestre

8. Flora of U.P.: Salient features of vegetational aspects.

Reference Books-

1. Lawrence: Taxonomy of Vascular Plants
2. Sivarajan, V.V. (Ed. Robson). Introduction to the Principles of Plant Taxonomy
3. Heywood, V.H. Plant Taxonomy
4. Naik, V.N. Taxonomy of Angiosperms (1988)
5. Stace, C.R. Plant Taxonomy and biosystematics (2nd Ed.)
6. Hutchinson, J. The families of flowering plants (3rd Ed.), 1973
7. Takhtajan, K. Outline of classification of flowering plants. Botanical Rev. 46:225-359), 1980
8. Flowering plants. Origin and Dispersal (Trans. By Jeffry), 1969

Subject-M.Sc Botany IInd Semester

Course Code – B040804T A **Course Title - Cell Biology, Genetics and Biostatistics**

Paper- IV - Cell Biology, Genetics and Biostatistics

UNIT -I

1. Membrane structure and function
2. (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis,ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes).
3. Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).
4. Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).
5. Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).

UNIT –II

Mutations: Gene mutations (substitutions and frame-shift mutations), Chromosomal aberrations (structural), Transposon-induced mutations; Site-directed mutagenesis.

Brief study of DNA damage and repair mechanisms

Inherited human diseases: Haemophilia and Sickle cell Anaemia. Gene therapy

Brief account of Proto-oncogenes, oncogenes and tumor suppressor genes.

Mendelian inheritance. Gene interaction (12:3:1; 9:3:4; 9:7 ratios).

Linkage and chromosome mapping in eukaryotes

UNIT –III

Extra nuclear inheritance: Cytoplasmic male sterility

Hardy-Weinberg Law. Gene pool, Gene frequency and genotype frequency

Brief account of plant tissue culture, micro propagation and transgenic plants. Overview of recombinant DNA technology. Gene cloning, genomic / cDNA libraries, restriction mapping, blotting methods, polymerase chain reaction and DNA fingerprinting. Brief overview of plant breeding methods: Conventional, mutation breeding, QTLs and MAS.

UNIT –IV

Basic concepts of gene sequencing, genomics, proteomics and Bioinformatics.

Mean, Variance, Standard deviation and Standard error.Chi-square and Student's "t" test. Probability distribution (Binomial, Poisson and Normal). Introduction to computers. Use of Word and PowerPoint in the preparation and

presentation of documents. Use of Internet and World Wide Web in research.

Reference Books-

A. K. Sharma and A. Sharma. 1990. Chromosome techniques. Butterworths. 1990 Ed.

G. M. Cooper. 1997. The Cell and Molecular approach. ASM Press. Ed.

Strickberger. Genetics. 3rd Ed. 1990. Ed.

Snustad and Simmons. 1997. Principles of Genetics. Ed.

Benjamin Lewis. 1999. Genes VII.

Daniel Hartl. 1994. Basic Genetics. Ed.

Griffiths, Miller,Suzuki, Lewontin & Gelbert1999 An introduction to Genetic analysis

A.V.S.S. Sambamurthy. 1999. Genetics.

P.K. Gupta. 1990. Genetics.

K. K. De. 1992. Plant tissue culture.

Narayanaswamy. 1994. Plant cell & tissue culture.

Prathibha Devi. Principles & Methods in Plant Molecular Biology, Genetics&Biochemistry, Agrobios.

Stansfield. 1996. Theory & Problems in Genetics. Schaum's Series. McGraw & Hill.

Khan, I. A. and A. Khanum. 1994Fundamentals of Biostatistics

B. N. Mishra and K. K. Mishra. Naya Prakash. 1983. Introductory practicalBiostatistics

Cynthia Gibas. O'Reilly & Assoc.2000. Developing Bioinformatics Computer skills.

Balasubramainan. Ed. Concepts in Biotechnology.Universities Press.1996.

OR

Subject-M.Sc Botany II[nd] Semester

Course Code – B040804T B **Course Title – Elementary Biotechnology**

Paper- IV - Elementary Biotechnology

Unit-I

1.Definition, Basic concepts, Principles and scope of Biotechnology

2.Recombinant DNA technology, basic concept in genetic engineering, tool and techniques of recombinant DNA technology.

3.Enzymology of genetic engineering. Restriction enzymes, DNA ligase, Polymerase etc.

4.Cloning vehicles: Plasmids, Cosmids, Lambda phage, Charon phage, shuttle vectors, 2µ DNA plasmids, yeast plasmids, M13 vector. Fermentation and enzyme technology

Unit-II

1.Biotechnology - Scope, potentialities and constrains.

2.Enzymes in genetic engineering - exonucleases, endonucleases, restriction endonucleases, S I nucleases, DNA ligases, reverse transcriptase and alkaline phosphatase.

3.Gene cloning vectors - Plasmids, Phages, Cosmids, Transposons,

Primary vectors and plasmids - expression vectors.

Unit-III

1-Selection of genes, Gene libraries, Genomic and cDNA library - Gene transfer methods, Genetic organization of Ti plasmids, Ti plasmid mediated transfer - Agrobacterium tumifaciens, DNA mediated transfer.

2-Calcium phosphate, PEG, DEAE, via liposomes - Microinjection -Macroinjection, microprojectile, and electroporation, - Selection of clones,marker and reporter genes in screening methods.

3-Hybridizations - colony,Southern, Northern, Western Blotting.

Unit-IV

1.DNA fingerprinting, gene therapy and genetic counselling.

2.Use of transposons in genetic analysis: Transposon tagging and its use in identification and isolation of genes.

3.Elementary Knowledge of next generation sequencing.

4.Biosafety regulation: Physical and Biological containment.

Reference Books-

1.Tropp, B. E. (2012). Molecular Biology. Fourth Edition, Jones and Bartlett India Pvt. Ltd, New Delhi.

2.Howe, C., (2007). Gene Cloning and Manipulation. 2nd Edition.

3.Watson, D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R. (2008). Molecular Biology of Gene. 6th Edition, Cold Spring HarborLaboratory Press Cold Spring Harbor, New York, U.S.A.

4.Clark, D., Pazdernik, N., McGehee, M. (2018). Molecular biology. 3rd Edition.

5.Freifelder, D. (1990). Molecular Biology. 2ndEdition,Narosa Publishing HouseNew Delhi.

6.Nicholl, D. S. T. (2008). An Introduction to Genetic Engineering. 3rd Edition.

7.Plant Molecular Biology - Genetic Analysis of Plant Development and Metabolism. Springer-Verlag, New York, London.

8.Grierson, D. and Covey, S. (1984). Plant Molecular Biology, Practical Approach. IRL Press, Oxford, Washington DC.

9.Henry, R. J. (2005). Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.

10.Shaw, C. H. and Brown. T.A. (1988, 2020). Gene Cloning and DNA Analysis: An Introduction. 8th Edition.

11.Primrose, S. B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. 7th Edition.

12.Tewari, K. K. and Singhal, G. S. (1997). Plant Molecular Biology and Biotechnology. Narosa Publishing House, New Delhi.

Subject-M.Sc Botany IInd Semester

Course Code – B040805P **Course Title - Practical Lab**

PAPER- V: Practical Lab

UNIT- I

1-Gymnosperms: Comparative study of the vegetative, reproductive parts and Anatomy of the following*: Zamia, Araucaria, Cedrus, Thuja, Ginkgo* and *Taxus.*

2-Embryology: Study of embryology by specimens and slides.T.S. of anther.Study of ovules by hand section.Globular embryo Mature embryo .Polyembryony.Pollen viability.

Paper- II .Ecological Principles

Determination of quantitative characters by random quadrat method -Abundance, Density, Frequency,and Dominance:Similarity and Dissimilarity Index

Estimation of Carbonates, Bicarbonates, Chlorides and Dissolved Oxygen

Morphology and Anatomy of Hydrophytes and Xerophytes and their Adaptations

Maintenance of Practical records

Unit III . Taxonomy of Angiosperms and Medicinal Botany

1. Study of the locally available plants and recording of the intraspecific variation.
2. Description and identification at family, genus and species levels using Floras.
3. Identification of key characters in a group of species of a genus and construction of keys.
4. Construction of indented keys for the given material
5. Simple Nomenclatural problems
6. Identification of families studied based on flowers or essential parts of the flowers
7. Knowledge of Herbarium techniques
8. Record and Herbarium

Unit - IVA.Cell Biology, Genetics and Biostatistics

Cytological Squash preparation of onion root tips to study mitosis.

Problems in Genetics:Mendelian inheritance and gene interaction.Chromosome mapping in eukaryotes.Population Genetics.Problems in Restriction mapping of plasmids.Problems in Biostatistics:Graphic representation of data: Histogram.Mean Variance, Standard Deviation and Standard Error.Chi-square and Student's "t" test.Problems on Probability. Demonstration of plant tissue culture methods.Maintenance of Practical Record.

OR

Unit – IVB. Elementary Biotechnology

1. Preparation of tissue culture media
2. Surface sterilization of explants
3. Organ culture
4. Callus propagation, organogenesis, transfer of plants to soil
5. Encapsulation of somatic embryos and synseed production
6. Protoplast isolation and culture
7. Cytological examination of regenerated plants
8. Agrobacterium culture, selection of transformants

Industrial Training/Research Project/Survey(Value Added)

Course Code: B040806R (Research Project)

PAPER- VI : Industrial Training/Research Project/Survey(Value Added) Duration: 60 Hrs.

Course Objectives: The objective of this course is to provide students with hands-on trainingin specialized areas of plant sciences

Course Outcomes: After completion of this course the students will acquire the following:

5. Training in experimental design and execution
6. Knowledge on techniques and tools of research
7. Designing of research proposal.
8. Writing of research and review paper

Contents

The topic of the research project will be chosen from among the core compulsorycourses/core elected courses of that year.

Semester III rd

Subject-M.Sc Botany III rdSemester

Course Code – B040901T **Course Title - : Plant Biochemistry**

Paper- I - Plant Biochemistry

UNIT -I

Structure of atoms, molecules and chemical bonds.

Composition, structure and function of biomolecules (carbohydrates, lipids,proteins, nucleic acids and vitamins).

Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding,hydrophobic interaction,etc.).

Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

UNIT –II

Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, grouptransfer, biological energy transducers.

Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

UNIT-III

Conformation of proteins (Ramachandran plot, secondary structure, domains,motifand folds).

Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-R

UNIT-IV

Stability of proteins and nucleic acids.

Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

Reference Books-

Plant Physiology, biochemistry and molecular biology. David, T: Dennis and Davis Turnip. Longman. Scientific and technical U.K. 1990.

Plant Biochemistry Voet, D and Voet J.G. International

Outlines of biochemistry. 5th edition Con E.E. and Stump P.K. 1995. Willey

Principles of biochemistry, Lehnenger, A.L. 1982 CBS Publication

Biochemistry, Strayer W.H. 1976. Foreman Company.

Introduction to Plant Physiology. Willium G. Hopkins and Norman P. A. Huner

Plant Physiology. Lincoln Taiz and Eduardo Zeiger. International Edition

Plant Biochemistry. P.M. Dey and J.B. Harborne

Plant Biochemistry. Hans-Walter Heldt

Physicochemical and Environmental Plant Physiology. Park S. Nobel

Subject-M.Sc Botany III rd Semester

Course Code – B040902T **Course Title - : Plant Physiology**

Paper- II - Plant Physiology

UNIT –I

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways.

Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

UNIT –II

Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis.

Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

UNIT-III

Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

UNIT-IV

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Reference Books-

Mineral nutrition of crop plants. H. Marshener academic Press 1986.

Plant Physiology by F.B. Salisbury and C.W. Ross. Wordsworth biology series.

Growth and differentiation in plants by Warering and Phillips, Pergamon press.

Plants Cell structure and metabolism. J.L. Hall, Flower and Roberts, ELBS, Longman.

Advanced Plant Physiology by M.B. Wilkinson, ELBS, Longman

Introduction to Plant Physiology by G.R. Noggle and G.J. Fritz, Printice Hall Press

Cell Biology by C.B. Powar, Himalaya Publishing

Plant Physiology by R.N. Devlin and F.H. Witham, CBS 1986

Introduction to plant physiology W.G. Hopkins and Norman P.A. Huner, Plant Physiology. Lincoln Taiz and Eduardo Zeiger

Subject-M.Sc Botany III rd Semester

Course Code – B040903T **Course Title - : Biodiversity of Angiosperms**

Paper- III - Biodiversity of Angiosperms

UNIT –I

Concept of Biodiversity, its origin and development .a) Definition b) Past history c) Ranks recognized in Biodiversity studies, taxonomy and others d)Keystone taxa.,Aims and objectives of Biodiversity ,Characterization of Biodiversity

a) Levels of Biodiversity b) Measurement of Genetic diversity, species diversity and communitydiversity.

UNIT –II

Magnitude and Distribution of Biodiversity,Current magnitude of Global Biodiversity,Botanical regions and Hotspots ,Distribution of Biodiversity,Endemism and Biodiversity,Degeneration Maintenance and Loss of Biodiversity,Diversification of species,Ecological extinctions,Proximate causes

UNIT –III

Inventorying, Monitoring and Assessment of resource base for Biodiversity

Inventorying: Definition, purpose, orientation, completeness and intensity. Indicator selection for Biodiversity inventory.

Monitoring of Biodiversity at different biological levels: Genetics, Population level and Species level; Species turnover in Ecosystems-Landscape levels.

Monitoring:

Definition, purpose, orientation, completeness and intensity

Monitoring in marine environment and freshwater ecosystems. Long-term monitoring of ecosystems

Inventorying and monitoring for conservation: RAMSAR convention, sites, Red data (booksand lists).

Biotechnology and Biodiversity,Assessment and use of molecular DNA data on Biodiversity

Application of Biotechnology for the utilization of Biodiversity

UNIT –IV

Economic value and utilization of Biodiversity with reference to the following taking five examples for each: a) Food b) Fodder c) Fibre d) Oils e) Drugs f) Timber g) Rubber h) Spices I)Essential oils j) Gums and Resins k) Insecticides and Pesticides l) Ornamentation

A brief account of origin of cultivated plants,Biodiversity convention a) Initiative from UN b) Rio Conference c) Recent efforts,Conservation of Biodiversity

In-situ conservation,Ex-situ conservation.

Reference Books-

Global Biodiversity assessment Heywood, V.H. and Watson, RT Ed. 1995.

Biodiversity measurement and estimtioin.Ed. Hawksworth. Chapman & Hall, 1995.

Biodiveirsity and ecosystem function.Ed.B7 Schulze, ED and Mooney, HA SpringerVerlag. NY. 1996.

Functional roles of Biodidversity: A Global Perspective. Mooney, HA, Cushman, JH,Miduo, E, Sale, OE and Schulze, ED. 1995.

Biodiversity prospecting: Using Genetic resources for suitable development. Reid et al.WRI, USA, 1993.

Conserving Biodiversity for suitable development, Ramakrishnan, AK.Das and Saxena INSA, N.Delhi. 1995.

Biodiversity and Forest Genetic Resources. D.N. Tewari. International Book Distrib.Dehradun

Biodiversity and its conservation in India S.S. Negri. 1996.

Biodiversity in Managed landscapes. Theory and practice. R.C. Szatro and D.W. Johnston.Oxford University Press. 1996.

General Ecology. HD. Kumar. Vikass Publ. House Pvt. Ltd. 1995.

Global Biodiversity. Trivedi.

Biodiversity. Agarwal – K.C.

Kumar, U – Biodiversity

Navadanya – The Biodiversity convention to its impact on III World.

Subject-M.Sc Botany III rd Semester

Course Code – B040904TA Course Title - :Cultivation and Phytochemistry of Medicinal Plants

Paper- IVA - Cultivation and Phytochemistry of Medicinal Plants

UNIT -I

Importance of active principles and uses of medicinal plants in different traditional systemsof medicine and Allopathy

Origin, Historical background. Active principles uses and cultivation practices of the following medicinal plants

Andrographis paniculata b) *Asparagus racemosus* c*) Bacopa monnieri* d) *Coleus forskohlii* e) *Rauwolfia serpentine* f)*Withania somnifera*

Origin, Historical background, Active principles uses and cultivation practices (including organic farming) of the following aromatic plants: a) Lemon grass (*Cymbopogon flexuosus*)

Citronella c) Palmarosa d) *Eucalyptus citriodora*

UNIT -II

Distillation of aromatic plants: a) Description of distillation units .b) Principles of distillation .c) Methods of distillation .d) Maintenance and precautions for distillation units. e) Yields and recoveries of different aromatic plants

Preparation of Crude drugs in different systems of medicine

Value addition grading and processing of plant drugs

UNIT-III

Major groups of Phytochemicals sources, Pharmaceutical and medicinal importance of

a)Alkaloids b) Terpinoids c) Coumarins d) Steroids e) Flavonoids

Techniques involved in the isolation in the biomolecules of medicinal importance-solvent extraction, chemical separation, steam distillation, soxhlet extraction

Chromatography: HPLC, TLC, UV

UNIT –IV

1. Biosynthetic pathways important phytochemicals

a) Shikimic acid b) Mevalonic acid pathway

2. Biosynthetic pathways of commercially important phytochemicals

a) Forskolin b) Taxol c) Vincristin, d)Vinblastin

Threatened and endangered Medicinal Plants

Financial aspects of medicinal plants: a) Loans b) Subsidies, IPR – Patents

Reference Books-

Cultivation of medicinal and aromatic crops by Farooqui and Sreeramulu.Univ. Press

Textbook of Pharmacognosy by Young Ken – Heber W and Young Ken

Pharmacognosy of indigenous drugs by K. Raghunathan and Roma Mitra

Pharmacognosy- Kokate et al

Pharmacognosy- Mohammed Ali

Pharmacognosy- Wallis

Pharmacognosy- Trease & Evans-1996

Pharmacognosy- Shaw and Quadri

Pharmacognosy- Tyler, Brady and Robbins

OR

Subject-M.Sc Botany III rd Semester

Course Code – B040904TB **Course Title - : Genetic Engineering**

Paper- IVB - Genetic Engineering

Unit I

Genetic Engineering (General), Restriction mapping, Restriction of Chimeric DNA- staggered cleavage, addition of oligopolymer tailing & linkers, blunt end ligation.Gene sequencing (principle & different techniques), c-DNA & genomic libraries.

Unit II

DNA analysis: Labelling of DNA & RNA probes, southern & florescencein-situ hybridization, DNA fingerprinting, chromosome walking.

Techniques for gene expression: Northern & western blotting, gelretardation technique, DNA footprinting, primer extension, S1 mapping,

reporter assays.

Unit III

Proteomics as a tool for plant genetics, breeding & diversity studies.Protein extraction/ purification techniques viz electrophoresis & column chromatography.Protein sequencing methods, detection of post translational modifications of proteins, methods of analysis of gene expression at RNA and protein level, large scale expression such as Microarray based techniques. Protein Engineering and metabolic

engineering- definition and explanation, Steps, Achievements and future prospects

Unit IV

RNA interference- Introduction, RNAi as tool for gene expression. RNAias a potential therapy.Use of transposons in genetic analysis: Transposons & T-DNA tagging & its use in identification & isolation of genes.Introduction to genome editing with reference to CRISPR/Cas

system.

Refrence Books-

1. Howe, C. (2007).Gene Cloning and Manipulation (2nd Edition).
2. Clark, D., Pazdernik, N. and McGehee, M. (2018). Molecular biology (3rd Edition).
3. Primrose, S. B. and Twyman, R. (2006). Principles of Gene Manipulation andGenomics (7th Edition).
4. Brown, T. A. (2020). Gene Cloning and DNA Analysis: An Introduction (8th Edition).
5. Thieman, (2020). Introduction to Biotechnology (4th Edition).

Subject-M.Sc Botany III rd Semester

Course Code B040905P **Course Title - : Practical Lab**

PAPER- V : Practical Lab

UnitI- Plant Biochemistry

- Determination of amylase activity
- Estimation of fructose by resorcinol method
- Estimation of protein by Biuret method
- Estimation of reducing sugars in fruits.
- Determination of iodine number.
- Extraction and estimation of alkaloids from tea leaves/coffee seeds

Unit–II- Plant Physiology

- Determination of water potential by Shardolo's methods.
- Determination of total and titrable acidity.
- Separation of chloroplast pigments by solvent method
- Determination of chlorophyll a, chlorophyll b and total chlorophylls in C3 and C4 plants.
- Estimation of reducing sugars in fruits.
- Determination of iodine number.

Unit–III- Biodiversity of Angiosperms

i. Interpretation of Biodiversity and vegetation based on the data provided
ii. Comparison of floristic elements of Biodiversity in published Floras:
iii. Comparison of ten dominant families in different Floras
iv. Genetic diversity (number of Genera)
v. Ten dominant Genera
vi. Comparative study of species diversity of different Genera from published Floras (Jaccard index Coefficient). The student should be provided data on specific Genera represented in therelevant Floras.
vii. Field study – Record and Field Note Book.

Unit–IVA- Cultivation and Phytochemistry of Medicinal Plants

1. Thin layer Chromatography, HPLC
2. Isolation of some natural products: Pipperine, Caffeine, Flavone, Coumarin
3. Spectroscopic estimation of some natural products
4. Organoleptic and Microscopic analysis, identification and adulteration check of thefollowing crude drugs.
5. Leaf drugs Cassia augustifolia
6. Root drugs Rauwolfia serpentina vs. R. tetraphyla
7. Bark drugs Hollahrena pubiscente vs Wrightia tinctoria
8. Flower drugs Saffron-vs Safflower
9. Whole plant drugs Catharanthus roseus
10. Histochemical identification of the following chemical substances: a) Carbohydrates b) Proteins c)Amino acids d)Starch e)Tannins f)Enzymes
11. Estimation of oil content in aromatic crops (Clevenger apparatus) and GSC analysis of oilsamples for identification of major compounds.

OR

Unit–IVB-

1. Isolation and purification of genomic DNA from plant materials.
2. Isolation and purification of RNA from plants.
3. Culture of plasmid and maintenance of culture.
4. Isolation of plasmid DNA.
5. Quantitative estimation of genomic DNA and RNA usingspectrophotometer.
6. Agarose gel electrophoresis of genomic DNA and RNA anddetection using gel documentation system.
7. Digestions of DNA by restriction enzymes and size fractionation offragments.Ligation of digested fragments.
8. Primer designing. cDNA formation using reverse transcriptase.

Industrial Training/Research Project/Survey(Value Added)

Course Code: B040906R (Research Project)

PAPER- VI : Industrial Training/Research Project/Survey(Value Added) Duration: 60 Hrs.

Course Objectives: The objective of this course is to provide students with hands-on trainingin specialized areas of plant sciences

Course Outcomes: After completion of this course the students will acquire the following:

9. Training in experimental design and execution
10. Knowledge on techniques and tools of research
11. Designing of research proposal.
12. Writing of research and review paper

Contents

The topic of the research project will be chosen from among the core compulsorycourses/core elected courses of that year.

Semester IVth

Subject-M.Sc Botany IVthSemester

Course Code B041001T **Course Title - Plant Anatomy and Palynology**

Paper- I - Plant Anatomy and Palynology

UNIT -I

Introduction, importance and relationships of Plant Anatomy

Shoot Development: Recent views on organization of shoot Apical Meristem and types of vegetative shoot apex in Gymnosperms and Angiosperms.

Cytological zonation, Sub-apical differentiation of tissues.

Root Development: Organization of root apex and significance of Quiscent center,Recent experimental studies on differentiation of tissues.

Leaf: Structure with reference to C3 and C4 plants – Kranz and CAM Syndrome.

UNIT -II

Epidermology:

Structural composition of Epidermal cells, stomata and trichomes b). Epidermal cell complex – Structure, orientation and arrangement

c). Stomatal complex–Basic structure with reference to subsidiaries and

ultrastructure of guard cells. Ontogeny of Paracyctic, diacytic, and anisocytic stomata.Classification of trichomes.

Transfer cells: Structure, distribution, ontogeny and function.

UNIT -III

a) Secondary growth with reference to Dicot stem:

Significance of Dicots wood anatomy.

c). Morphology and arrangement of Vessels, Axial Parenchyma Fibres and Ray parenchyma and their value in wood identification.

Salient features of the following woods-*Tectona grandis,Terminalia tomentosa,Shorea robusta,Pongamia pinnata.*

UNIT – IV

Palynology: Introduction and scope of palynological science,Morphology of pollen – Polarity, symmetry, size and shape, apertural pattern, exinestratification and ornamentation of pollen wall.

Aeropalynology – principles, dissemination, distribution of aerospora and meteorological factors. Pollen and spore allergy and clinical treatment. Importance of melittopalynology.

Role of Palynology in Taxonomy

Reference Books-

Fahn, A. Plant Anatomy (4th Ed.), 1990.

Easu, K. Anatomy of Seed Plants.

Easu, K. Plant Anatomy, 2nd Ed. Wiley N.Y. 1965.

Cutter, E.G. Plant Anatomy, Part I and II Edward Arnold; London, 1971 and 1978

Metcalf and Chalk. Anatomy of dicots (2nd Edition) (1983). Clarendon Press, Oxford.

Metcalf (1982-87) Anatomy of Dicots Vol. I to III

P.K.K. Nair. Pollen Morphology of angiosperms.

P.K.K. Nair: Essentials of Palynology

Moor & Moor: Pollen analysis

R.B. Knox, Pollen allergy

Subject-M.Sc Botany IVthSemester

Course Code B041002T **Course Title - Environmental pollution and protection**

Paper- II - Environmental pollution and protection

UNIT I

1. Kinds of pollution, Air pollution-Sources of air pollution,
2. Major air pollutants, Primary and Secondary Pollutants stationary and mobile sources.
3. Effects of air pollutants on plants, human beings and materials, control of air pollution.
4. Noise pollution- sources, effects and control measures.
5. Acid rain- causes and effects on terrestrial and aquatic systems.

UNIT II

6. Water pollution- Sources, Effects and control of water pollution.
7. BOD, COD, Hardness of water, criteria of water quality.
8. Primary treatment (Industrial wastewater) - Segregation, equalization, neutralization, sedimentation, flotation and oil separation.
9. Secondary treatment (Biological treatment)- Principles of biological treatment
10. Waste stabilization ponds, Aerated lagoons-Activated sludge process, Trickling filters.

UNIT III

11. Soil pollution – Sources, effects and control measures.
12. Bioremediation- In-situ and Ex-situ bioremediation
13. Bioremediation of toxic metals.
14. Concept of Phytoremediation

UNIT IV

15. Classification of solid wastes, types and sources. Disposal methods,
16. Management of Municipal waste
17. Hazardous and Biomedical waste
18. Environmental (protection) Act-1986.

Reference Books-

1. MN Rao, McGrace Hill 1993 – Air pollution
2. C.S.Rao- Environmental Engineering and technology
3. S.P. Misra and Pandey- Essential Environmental Studies
4. Y.Anjaneyulu- Introduction to Environmental Science.
5. P.D.Sharma- Ecology and Environment
6. P.C.Santra- Environmental Science

Subject-M.Sc Botany IVthSemester

Course Code B041003TA Course Title - Taxonomy of Angiosperms and Ethnobotany

Paper- IIIA - Taxonomy of Angiosperms and Ethnobotany

UNIT –I

1. Method to describe a new Taxon with reference to Genus and species
2. Contribution of the following to the growth of Taxonomy a) R.M.T. Dahlgren b) R.F. Thorne c) Kubtizki
3. Plant identification – taxonomic keys

UNIT –II

4. Role of the following institutions in the growth of Taxonomy

a) Botanical Survey of India, India
b) Kew Gardens, London, UK
c) Smithsonian Institutions, Washington, D.C., USA

5. Floral diversity in a) Annonaceae b) Malvaceae c) Apocynaceae d) Asclepiadaceae e) Hydrocharitaceae f) Lemnaceae

UNIT – III

6. Taxonomy of the following significant families

a) Nympheaceae (*Sensu stricto and Sensu lato*)
b) Euphorbiaceae with emphasis on its role in modern economy
c) Podostemaceae
d) Musaceae
e) Arecacae

7. Seed Morphology: external features

a) Embryo, Endosperm, Seed coat anatomy
b) Corner's classification and its role in taxonomy

UNIT –IV

8. Ethnobotany: Concept, scope and objectives
9. Ethnobotany as an inter-disciplinary science. The relevance of Ethnobotany in the present context. Methodology of ethnobotanical studies

a) Field work b) Herbarium c) Ancient literature d) Archaeological findings e) Temples and sacred groves

10. Plants Vs. Tribal Life: a) Food plants and Food cycles b) Intoxicants and Beverages c) Ropes and Bindings materials d) Resins and oils e) Poisons as baits
11. Role of ethno botany in modern medicine with special examples.

Reference Books-

1. Wills, J.C. Dictionary of Flowering plants, 1971
2. Santapau, H and A.N. Henry. Dictionary of Flowering plants in India, CSIR, 1973
3. D.J. Mabberly, Plant Book (2nd Edi.) 1997. Cambridge Univ. Press
4. Hubbard, C.E. Grasses, 1954. Penguin Books, London
5. Henry and Chandrabose. An Aid to International code of Botanical Nomenclature
6. Hutchinson, J. The families of Flowering plants (3rd Edi.) b1973.
7. Lawrence, G.H. Taxonomy of Vascular plants. 1951
8. Sivarajan, V.V. (Ed. Robson) Introduction to Principles of Plant Taxonomy
9. V.N. Naik. Taxonomy of angiosperms
10. Cronquist. A. The Evolution and classification of flowering plants. 1988
11. Takhtajan. A. Outline of classification of flowering plants. Botanical Rev. 1980.
12. Davis P.H. and Heywood, V.H. Principles of Angiosperm Taxonomy

OR

Subject-M.Sc Botany IVthSemester

Course Code B041003TB **Course Title - Plant Pathology**

Paper- IIIB - Plant Pathology

Unit -I

Concept and importance of plant diseases
Symptoms of plant diseases caused by fungi, bacterial and viruses ,Mode of infections and development of pathogen in plants ,Enzymes and toxins in plant diseases

Mechanism of defence in plants: Morphological and biochemical defence mechanism, disease resistance.Variability in plant pathogens: Types of variations, mechanism of variability.

Effect of environment on development of infectious diseases of plants: epidemiology, plant disease forecasting.

Transmission of plant disease

Methods of study of disease of plant, isolation of pathogens and tests of pathogenecity

Principles and method of plant disease control: regulatory methods, cultural and biological methods,physical means, chemical methods (fungicides chemotherapy), resistant varieties.

Unit –II

Plant Diseases
Study of important symptoms, causal organism, disease cycle and control of the following disease of cropplants in U.P. caused by fungi, bacteria, viruses and M.L.O.

a. Rots: Fruit and stem rot of papaya, fruit rot and die-back of chillies, rhizome rot of ginger and red rot of sugarcane.

b. Damping of seedling of crop plants.

c. Downy mildew of bajra, crucifers, pea and cucurbits.

d. Powdery mildew of barley, wheat, pea, apple and cucurbits.

e. Rusts of wheat, *Cicer* (Gram), barley and linseed.

f. Smuts and Bunts: Covered and loose smuts of barley and wheat; smuts of maize, sorghum and sugarcane; loose smut of rice and bunt of rice.

g. Wilt of arahar, cotton, gram and sugarcane.

h. Leaf spots, blights and necrosis; leaf spot of crucifers, rice and turmeric; Tikka disease of ground nut, early and late blight of potato; leaf blight of wheat; blast disease of rice, mango abnormalities.

h. Galls and other abnormalities stem, galls of coriander, ergot of bajra, leaf curl of peach and apple.

UNIT –III

Bacterial Disease
Citrus cankers, blight of cotton, angular leaf spot, black and scattering blight; blight of rice, brown rot of potato, red stripe of sugarcane, tundu diseases of wheat.

UNIT -IV

Virus Disease
Mosaics of apple, cucurbits, sugarcane, papaya, potato (Potato virus A, X,Y) and tobacco vein mosaic of bhindi, Yellow mosaic of legumes.
Leaf curl of chillies, papaya, tobacco and tomato; leaf roll of potato bunchy top of banana, tristeza ofcitrus; tug of rice

Disease cuased by M.L.O.: Little leaf of brinjal, curling of citrus, purple top of potato, sesame phyllody,grassy shoot of sugarcane.

Refrence Books-

1. Plant pathology by G.N.Agrios
2. Plant diseases by R.S.Singh
3. Modern plant pathology by H.C.Dube
4. Plant bacteriology by K.K.mondal
5. Plant virology by K.K. Biswas
6. The Fungi by H.C Dube
7. Diseases of field crops and their management by Chaube and Pumdhir

Subject-M.Sc Botany IVthSemester

Course Code B041004TA **Course Title - Pharmacognosy (special)**

Paper- IVA - Pharmacognosy (special)

UNIT –I

1. Introduction and Scope of Pharmacognosy: Pharmacognosy and modern medicine
2. Crude plant drugs

a) Sources: Geographical, Biological, Cell Culture and Sea

b) Classification: Morphological (Organized and unorganized), Taxonomical, Chemical, Pharmacological and alphabetical

3. Indigenous tradional drugs and their market adulteration of Punarnava, Shankhapuspi (Clitoria), Indian goose-berry, Tulasi, Commiphora, Kalmegh

UNIT -II

4. Types of Plant drug and their Pharmacognostic study

a) Root drugs; *Glycyrrhiza and Ipecac, Raulvolfia, Satavari, Colcus, Withania*

b) Rhizome drugs, Ginger

c) Leaf drugs, *Andrographis, Clitoria, Senna*

d) Bark drugs: *Terminalia arjuna, Holorrhena*

e) Flower drugs: Saffron

f) Seed drugs: *Piper longum*, Mucuna

g) Fruit drugs: Cumin, Amla, Senna pods

h) Whole plant drugs: *Catheranthus roseus*

UNIT -III

5.Evaluation of the drugs; Organoleptic, Microscopic, Physical Chemical and Biological methods of evaluation

6. A brief account of various drug constituents: Carbohydrates, Cardiac glycosides, alkaloids, volatile oils, resins quinines and steroids with particular reference to Accacia gum, amla, Coleus, Satavari, *Rauvolfia*

UNIT -IV

7. Medicinal Principles and powder analysis of *Curcuma*, Cloves, Senna, Fennel and Cinnamon
8. Large scale Industrial preparation of Crude Drugs

a) Types of reactors used and extraction methods

b) Active principles and non-active principle of drugs

c) Import and Export potentials of Crude Drugs

d) Preparation of crude drugs in indigenous system of medicine

e) Quality control test – contamination, Adulteration

Reference Books-

1. Cultivation of Medicinal plants - Purohit & Vyas CBS, 2006
2. Introduction to Medicinal Chemistry (12996). Aler Gingauz. Wiley publications.
3. Medicinal Chemistry (2001). Graham L. Patrick. Oxford University Press

OR

Subject-M.Sc Botany IVthSemester

Course Code B041004TB **Course Title - Plant Breeding**

Paper IVB - Plant Breeding

Unit -I

Principles and concept of plant breeding; techniques of plant breeding, selection, hybridization, acclimatization, heterosis, sterility and incompatibility

Unit –II

chimera and graft hybrids, breeding for disease,insect and drought resistance, crop improvement and methods of breeding of wheat maize, paddy, sugarcane, arhar, potato and cotton with special reference to work done in India

UNIT –III

In-vitro techniques in relation to plant breeding classification, meristem culture, anther and pollen culture, tissue and cell culture, cybrids, protoplast fusion, hybridomas achievements and prospects

UNIT -IV

Biometry and experimental designs : Importance of biometry in plant breeding data representation, classification tabulation, frequency, Null hypothesis, chi-square test (Numericals in relation to the genetics and plant breeding) correlation and regression in relation to plant breeding) Experimental designs

Refrence Books-

1. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard,
2. Breeding Field Crops by JM Poehlman,
3. Plant Breeding: Principles & Practices by JR Sharma,
4. Genetics by Strickberger
5. An introduction to genetic analysis by Suzuki et Al.

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Subject-M.Sc Botany IVthSemester

Course Code B041005P **Course Title - Practical lab**

Paper-VI: Practical lab

Unit- I- Plant Anatomy and Palynology

1. Study of angiosperm leaf epidermis in the following taxa: *Crotalaria, Portulaca* or *Talinium,*

Tridax, Petunia or *Datura, Barleria, Rheodiscolor or Commelina, Brassica, Cyperus* and Grass.

2. Estimation of stomatal frequency and stomatal index in the materials studied.

3. Maceration of wood and identification of various elements in *Michelia, Bombax, Tectona, Terminalia* and *Azadirathta*

4. Study of wood structure with the help of T.S., R.L.S. in the following: *Tectona, Bombax, Michelia, Pongamia* and *Azadiratha*

5. Histochemical tests for identification of the following: a) Callose b) Lignin c) Pectin d) Starch e) Suberin f) Silica bodies in the leaf of grasses and sledges.

6. Study of shoot apex in suitable locally available materials to understand cyto histological zonation *(Coleus, Kalanchoe*)

7. Study of roots in Monocots and Dicots. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives (maize, aerial roots of *banyan, Pistia, Jussiea*)

8. Study of the pollen grains of Hibiscus, *Tribulus, Ocimun* and Grass.

9. Acetolysis

Unit - II- Environmental pollution and protection

Estimation of the following in water:

a) Total hardness
b) Calcium
c) Organic matter
d) BOD

1. Estimation of noise.
2. Qualitative estimation of the following:

a) Solid waste
b) Coal
c) Fly ash
d) Sugarcane bagasse
e) Wood
f) Cow dung

Unit - IIIA- Taxonomy of Angiosperms and Ethno botany

1.Study of the following locally available taxa (living sand herbarium) belonging to:

a) *Cleome b) Cassia c) Sida d) Indigofera e) Euphorbia f) Corchorus g)Tephrosia h) Phyllanthus i)Brachiaria j)Ipomoea*

1. Identification of key characters of species of above genera and construction of keys
2. Study of the seed morphology of the following:

a*) Cleome b) Gossypium c) Calotropis d) Annona e) Cyperus f) Oryza g) Castor/ Croton h) Portulaca i) Tecoma j) Glinus / Mullugo k)Pulses*

3. Identification of selected families based on their Androecium and Gynoeciumgiven in the mixture

a) Malvaceae b) Meliaceae c) Fabaceae d) Umbelliferae e) Cucurbiataceae f) Compositsae g) Euphorbaceae h) Lamiaceae\

4. Students are required to maintain field note book and record of the taxa occurringin the areas visited
5. Students are required to prepare herbarium of plants collected during field trips
6. Record.

OR

Unit - IIIB- Plant Pathology

1- Isolation of bacterial, fungal, and nematode plant pathogens of crop plants.
2- Study of mineral deficiency diseases of Tomato and French bean.
3- Estimation of foliar infection by Stover's method.
4- Study of spore germination.
5- Estimation of total phenols in diseased and healthy plant tissues.
6- Mycoflora analysis by Standard Blotter Method SBM/agar plating method.
7 -9-Study of Tobacco mosaic, Bacterial blight; Downy mildew of Maize; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Root Knot of Mulberry. Bunchy top of banana, Grassy shoot of sugar cane, Little leaf of Brinjal; Potao Spindle Tuber Disease (PSTVd)
10-Study of effect of pathogens on seed germination and vigour index.
11-Study of effect of fungicide on seed-borne pathogens.
12- Study of Fungal bio-control agents.

Unit - IVA- Pharmacognosy (special)

1.Histochemical analysis of the following chemical compounds:
a) Alkaloids b) Steroids c) Quinones d) Resins e) Glucosides
f) Pigments g) Volatile oils
1. Organoleptic evaluation of the following:
a) *Glycyrrhiza* (Root) b) Ginger (Rhizome) c) Eucalyptus (leaf)
d) *Terminalia arjuna* (Bark) f) *Strychnos nuxvomica* (seed)

2. Powder analysis. a*) Curcuma* b) Cloves c) *Senna* d) Fennel
e) Cinnamon: Market drugs: a) Turmeric b) Chillies c) Coriander
d) Wheat and Jowar
3. Qualitative and Quantitative tests for
a) Alkaloids b) Carbohydrates c) Anthroquinones d) Tannins
e) Steroids f) Terpenoids
4. Growing chosen Medicinal plants in an experimental plot and preparation of Crude Drug for commercial market – Project
5. Collection of crude drugs from the market and studying their characteristics Preparation of exhibits

OR

Unit - IVB-Plant Breeding

1.Line diagrams showing the plan of different methods of breeding self pollinated crops- Mass selection, Pureline selection, Pedigree method,

2. Line diagrams showing the plan of different methods of breeding cross pollinated crops- Bulk Selection, Recurrent selection.

3. Methods of hybridization in rice, sorghum, bajra, cotton in standing crop in the field.

4. Assignments with problems for computing measures of central tendency and dispersion- mean, median and mode, standard deviation and standard error.

5. Assignment with problems for computing correlation and regression coefficients.

6. Assignment with problems for implementing t test.

7. Assignment with problems for computing ANOVA.

Industrial Training/Research Project/Survey(Value Added)

Course Code B041006R (Research Project)

Paper- VI: Industrial Training/Research Project/Survey(Value Added) Duration: 60 Hrs.

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Course Objectives: The objective of this course is to provide students with hands-on trainingin specialized areas of plant sciences

Course Outcomes: After completion of this course the students will acquire the following:

13. Training in experimental design and execution
14. Knowledge on techniques and tools of research
15. Designing of research proposal.
16. Writing of research and review paper

Contents

The topic of the research project will be chosen from among the core compulsorycourses/core elected courses of that year.