STRUCTURE OF M.Sc. SYLLABUS (SEMESTER COURSE, 2007-2008)

SEMESTER-I		
Bot/General/Theory/(101)	Microbiology (45 + 5) = 50	50
Bot/General/Theory/(102)	Mycology (45 + 5) = 50	50
Bot/General/Theory/(103)	Phycology (45 + 5) = 50	50
Bot/General/Theory/(104 Unit-I &II)	Bryology (Unit-I) (22.5 + 2.5) = 25 Anatomy (Unit –II) (22.5 + 2.5) = 25	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(105)	Microbiology (25) & Mycology (25)	50
Bot/General/Prac./(106)	Phycology (20), Bryology (15) & Anatomy (15)	50
SEMESTER-II		
Bot/General/Theory/(201)	Pteridology	50
Bot/General/Theory/(202)	Paleobotany (Unit-I), Palynology and Reproductive Biology (Unit-II).	50
Bot/General/Theory/(203)	Taxonomy of Angiosperms - & Plant Geography	50
Bot/General/Theory/(204)	Cell Biology and Genetics	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(205)	Pteridology, Paleobotany, Palynology and Reproduction Biology	50
Bot/General/Prac./(206)	Taxonomy of Angiosperms (25), Cell Biology and Genetics (25)	50
SEMESTER-III		
Bot/General/Theory/(301)	Plant Pathology (45 + 5) = 50	50
Bot/General/Theory/(302)	Gymnosperms	50
Bot/Spl./Theory/(303)	Special theory – 1 (45 + 5) = 50	50
Bot/Spl./Theory/(304)	Special theory – 2 (45 + 5) = 50	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(305)	Plant Pathology (25), Gymnosperms (25)	50
Bot/Special/Prac/(306)	Special Practical	50
SEMESTER-IV		
Bot/General/Theory/(401)	Plant Physiology (45 + 5) = 50	50
Bot/General/Theory/(402)	Biochemistry (45 + 5) = 50	50
Bot/General/Theory/(403)	Ecology (25), Molecular Biology & Plant Breeding (25)	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac/(404)	Plant Physiology & Bio Chemistry	50
Bot/General/Prac/(405)	Special Practical – Ecology (25) & Plant Breeding & Biometry (25)	50
Bot/Diss/(406)	Dissertation	50
	Total	1200

Special papers to be offered :-
(1) Cytogenetics & Molecular Biology, (2) Microbiology & Microbial Biotechnique
(3) Mycology & Plant Pathology, (4) Paleobotany & palynology
(5) Phycology , (6) Plant Physiology & Biochemistry
(7) Pteridology, (8) Taxonomy of Angiosperms and Bio-Systematics

Bot/General/Th/101 Microbiology Full Marks – 50
Lecture hrs. : 50L

1. Early history and milestone discoveries in Microbiology. (2L)

2. Position of microorganisms in living world. Brief idea about the basis of bacterial classification. (2L)

3. Ultra structure and function of cell wall and cell membrane of bacteria and archaea Muerin biosynthesis: ultra structure of capsule, pill, and flagella. Mechanism of flagella movement and chemotaxis; Reserve material and other cytoplasamic inclusions; Endospore - structure, formation and regulation of endospore formation and germination. (8L)

4. Bacterial genetic material :- structure and reproduction of bacterial chromosome. Plasmid - structure type and properties, episome. (2L)

5. Bactenal growth in liquid medium, growth curve, growth factor, kinetics of growth, batch and continuous culture; synchronous culture, enrichment culture, diauxic growth. (2L)

6. Microbial growth control:- disinfectant antiseptic and chemotherapeutic agents – a brief account of their types and mode of action (2L)

7. Metabolic diversity in bacteria :- Brief idea about Autotrophy, heterotrophy and Mixotrophy (2L)

8. Genetic recombination in bacteria :- Molecular mechanism of Transformation, Conjugation, Transduction, Gene mapping and Complementation test (6L)

9. Bacterial mutation :- Spontaneous and induced mutation of bacteria, molecular basis of Mutation. Mutagen and their action, types of mutant, selection of mutant, and Ames test. (4L)

10. Metabolic regulation and inhibition in bacteria :- Operon concept : *lac* and *trp* operon : catabolic repression, attenuation, allostenic control, types of feed back inhibition and isozvme. (4L)

11. Microbes in N_2 and Sulphur Cyclc :- Nitrification, Denitrification, Ammonification, Mechanism of biological N_2 fixation and structure and regulation of *nif* Gene. Microbial oxidation and reduction of sulphur. (3L)

12. Virus :- Organization and structure of Capsid Viral genome -types and structure. Replication of virus and viral nuclic acid. Assay of Virus; Virus and Prion (4L)

13. Lytic and Ivsogeruc Cycle :- Lytic cycle of bacteriophage : Regulation of lysogeny, induction of Iysogeny and significance of lysogeny. (3L)

14. Fundamentals of Immunology :- Innate and acquired immunity, T-cell. B-cell, MHC, Cytokines, Antigen - types and characteristics : Structure and functions of immunogloblms, Cell mediated and Humoral Immunity; Ag-Ab reactions and

Immunological techniques. (6L)

Mycology

Bot/Gen/Th/102 Full Marks – 50
Lecture hrs. : 50

1. Position of fungi in modern systematics, modern approaches towards classification of fungi (2L)

2. Ultrastructural features of fungal cell structures-nucleus and its division, cell wall and its biochemical composition, tissue organization, modifications of fungal hyphae. (6L)

3. Life cycle patterns and basic pattern of sexuality, sexual mechanisms and their correlations in different groups of fungi, Parasexual cycle-basic concept. (6L)

4. Fungal symbionts : Mycorhizae-basic concept and their applications. Lichen-Phycobiont and mycobiont, histology, biology and physiology of lichen thallus, economic importance of lichen. (6L)

5. Beneficial uses of fungi, industrial production of alcohol and penicillin. (6L)

6. Edible Mushrooms-cultivation technology, nutritional and medicinal properties of mushrooms. (5L)

7. Fungi as animal parasites, mycoses of vertebrates-types and symptoms, insect fungus association. (4L)

8. Mastigomycotina : A comprehensive knowledge with emphasis on occurrence of sex hormones and sporangia to conidia transition. (4L)

9. Ascomycotina : A comprehensive knowledge with emphasis on types of ascocarps and methods of spore dispersal. (3L)

10. Basidiomycotina : A comprehensive knowledge with emphasis on fruiting structures and methods of spore dispersal. (3L)

11. Deuteromycotina : A general account with emphasis on sporulating structures of the members, classification with special reference to conidial ontogeny. (3L)

Phycology

Bot/Gen/Th/103 Full Marks – 50
Lecture hrs. : 50

1. Modern criteria of algae classification with special emphasis on chloroplast ultrastructure, flagella and pigments.

2. Cyanophyta : General features & ecology; genetic recombination; heterocyst structure and function; affinities.

3. Rhodophyta : General features; specialities in sexual reproduction and

postfertilization changes.

4. Chlorophyta; Charecteristic features of different classes highlighting distinctive features of different orders; evolutionary trends.

5. Ochrophyta :

a) Xanthophyceae : General features, parallelism with green algae & affinities.

b) Bacillariophyceae : Cell structure; auxospore formation in Centrales and Pennales.

c) Phaeophyceae : General features and ecology, life patterns.

6. Economic and applied aspects of algae.

Bryology

Bot/Gen/Th/104 (Unit-I) (25 marks, 25 lecture hours).

1. Introduction : Diversity in forms, habitats and values.

2. Classification of Bryophytes – traditional and modern systems with reference to Hepaticopsida, Anthocertopsida and Bryopsida.

3. Origin and evolution of Bryophytes.

4. Brief idea about :

a) Fossil Bryophytes

b) Photoperiodism

c) Apogamy and apospory

d) Water relations

e) Regeneration techniques

f) Ecology of Bryophytes

g) Monitoring of environmental state with Bryophytes

h) Peristome characteristics and their importance

i) Vegetative modes of reproduction.

5. Characteristics, affinities and systematic position of Sphaerocarpales, Takakiales and Monocleales

Plant Anatomy

Bot/Gen/Th/104 (Unit-II) [25 marks, 25 lecture hours]

1. Organisation of shoot and root apical meristems. Changes in shoot apex during transition to flowering.

2. Differentiation : Polarity, symmetry, pattern formation (outline idea of genetic control of differentiation and organogenesis).

3. Anatomico-physiological basis of tissue classification.

4. Origin, differentiation and phylogeny of xylem and phloem.

5. Origin, histology, tissue differentiation and vascularisation of leaf.

6. Nodal anatomy and its phylogenetic significance.

Bot / General/Prac/105

Microbiology

Full Marks – 25

1. Aseptic method :- Autoclave, hot air oven, incubator, bacterial filter and Laminar air flow.
2. Preparation and sterilization of culture media :- idea about different kinds of bacterial media, preparation of media, slants, stabs and pouring of plates.
3. Methods of isolation or pure culture by streak plate and pour plate method.
4. Morphological characteristics of bacteria and microscopic examination of stained cell preparation – Simple staining, gram staining, staining of bacterial Endospore, Capsule and flagella.
5. Direct examination of root nodule bacteria in microscope and isolation of *Rhizobium* from root nodule.
6. Measurement of bacterial growth by turbidimetry and by direct cell count by Breed method or Haemocytometer method.
7. Isolation and enumeration of microorganisms from natural samples (soil and water) by agar plate technique.
8. Determination of antibiotic sensitivity of some bacteria by disc diffusion method.
9. Demonstration of the following experiments :-
    a) Subculturing.
    b) Replica plating technique for isolation of auxotrophic mutants.
    c) Isolation of pure culture from streak plate method.
    d) Assay of bacteriophage.
10. Demonstration of following instruments :-
    (a) Colorimeter, (b) Spectrophotometer, (c) Autoclave, (d) Hot air oven,
    (e) Incubator, (f) Bacterial filter, (g) Laminar air flow, (h) Haemocytometer.

Mycology

Bot/Gen/Prac/105 Full Marks –25

1. Study of fungal tissue organization.
2. Study of different spore forms in fungi.
3. Study of vegetative and reproductive structures of some important members of the following groups and their identification : (a) Phycomycetes, (b) Ascomycetes, (c) Basidiomycetes, (d) Deuteromycetes.
4. Study of some important rusts showing different spore forms.
5. Smut spore forms.

6. Principles of sterilization, autoclave-demonstration.

7. Preparation of fungal culture media, preparation of slants, stubs and sterilization of media.

8. Demonstration for subculturing of fungal cultures and inoculation technique.

[Students are required to submit field and laboratory records, preserved and dried specimens and permanent slides]

Bot/Gen/Prac/106

Phycology

Full marks : 20

1. Collection and identification of local algae of West Bengal.

2. Study of common phytoplankton.

3. Study of representative marine algae.

Bryophytes: Full Marks:15

1. Methods of collection and preservation of Bryophytes.

2. Identification of unknown bryological specimens up to Genus level using a suitable artificial key.

3. Methods of preparation of permanent slides.

[Students are required to submit field and laboratory records, preserved and dried specimens and permanent slides]

Plant Anatomy

Full marks : 15

1. Study of stomatal index, Palisade ratio, Vein-islet number.

2. Comparative study of nodal vascular : Unilacunar, Trilacunar, Multiacunr.

3. Comparative study of laticifers.

4. Structural analysis of secondary xylem and secondary phloem in section.

5. Study of sieve elements in angiosperms and gymnosperms.

[Submission of laboratory records including permanent slides]

Semester-II

Pteridology

Bot/Gen/Th-/201 Full Marks : 50

Lecture hrs. : 50

1. Introduction about pteridophytes. (1L)

2. Comparative studies on the vegetative and reproductive organographies, evolutionary tendencies and affinities of the members belonging to different groups of Rhyniopsida. Zosterophyllopsida, Trimerophytopsida, Psilopsida, Lycopsida (Drepanophycales, Protolepidodendrales, Lycopodiales, Selaginellales, Lepidodendrales and Isoetales) and Sphenopsida (Hyeniales, Sphenophyllales, Calamitales and Equisetales). (14L)

3. An idea about the outline system of classifications of ferns by Copeland (1947), Christensen (1938) and Pichi Sermolli (1977). (3L)

4. Sporangial development, annulus, tapetum (types and functions) (2L)

5. A comparative study of the members belonging to the following taxonomic groups and also their systematic treatments, evolutionary tendencies and affinities: (a) Cladoxylales (b) Coenopteridales, (c) Marattiales, (d) Ophioglossales, (e) Osmundales, (f) Filicales (Schizaeaceae, Gleicheniaceae, Cyatheaceae, Polypodiaceae), (g) Salviniales, (h) Marsileales. (15L)

6. Stelar concept, types and evolution (2L)

7. Soral evolution in ferns (1L)

8. Spores : Types, germination pattern, gametophyte development. (2L)

9. Mating systems in ferns, control of sexuality in homosporous pteridophytes by Antheridogen activity, Apogamy and Apospory, vivipary in pteridophytes. (15L)

10. Heterospory and evolution of seed habit (1L)

11. Morphogenesis of sporophytes. (4L)

Bot/Gen/Th-/202 **F.M.50, 50 lecture hrs.**

Palaeobotany (Unit-I) (Full marks :20, 20 lectures hrs)

1. Definition of fossil, different types of plant-fossils as per their mode of preservation, concept of form-genus.

2. Principles of correlation and stratigraphy; dating of rocks; outline of Standard Geologic lime Scale.

3. Origin of life; early life forms recovered from Precambrian strata.

4. Major events of plant life through geologic history.

5. Indian Gondwana Sequence. Classification, distribution, megaflora succession through the sequence.

6. Introductory idea of Continental Drift Hypothesis with reference to Sea-door Spreading and Plale Tectonics.

7. Fossil plants in palaeoecological deductions.

Bot/Gen/Th-/202

Palynology and Reproductive Biology (Unit-II):

(Full marks 30, 30 Lecture hours)

1. Microspore tetrads and polarity of spores and pollen grains.

2. Spore-pollen morphology: Symmetry, shape, size, aperture patterns, NPC System for numerical expression of apertural details, exine stratification, surface structures and sculptures of sporoderm; LO-analysis and edge-analysis.

3. Chemical nature of sporopollenin, development of pollen wall, Ubisch body, exineless pollen grains.

4. Hxtraexinous wall material - perine, viscin-threads. pollen-kitt.

5. Evolution of spore-pollen exine with reference to adaptive significance.

6. Application of palynology in taxonornic arid phylogenetic deductions.

7. Aeropalynology with reference to allergy. AeroalIergens, introductory idea of Immune System with special reference to IgE. study of airspora, identification of allergic taxa by *in-vivo* and *in-vitro* tests with spore-pollen extracts, chemical nature of exine-borne allergens, allergic taxa of West Bengal plains.

8. Melissopalynology. Indian species of honey bees, importance of pollen grains as constituent of bee-bread, pollen-collecting mechanism of honey bees, analysis of pollen load and honey sample in understanding bee forage, objectives of melissopalynological studies, important bee planis of West Bengal plains.

9. Palaeopalynofogy. Introductory idea about palaeopalynological remains, significance of palaeopalynology.

10. Forensic palynology : Definition and significance, a few well-known case studies.

11 Pollination Biology : Pollen dispersal units; pollination types, contrivances for cross- and self-pollination; pollen vectors, pollination modes and flora organization, evolutionary trends in pollination modes.

12. Breeding systems, self-incompatibility and compatibility control with reference to pollen-pistil interactions.

Bot/General/Theory/(203)
Angiosperms- Taxonomy & Phytogeography

(Full Marks 50 ; 50 Lecture Hours)

1. Taxonomy - Concept, objective and relevance to conservation

2. Plant Nomenclature – ICBN, Principles, Rules, Recommendations and Appendices, Type concept, Valid publication and rejection of names.

3. Taxonomic hierarchy, delimitation of taxa and attribution of rank. Species concept.

4. Recent Systems of Angiosperm classification including APGII(2003).

5. Taxonomic literature : Types, definition and examples.

6. Taxonomic evidences : Phytochemistry and ultrastructure.

7. Numerical Taxonomy / Phenetics and Cladistics : Principles, Methods. Meats and Dements.

8. Concept of Homology, Morphocline, Homoplasy, Monophyly (Holophyly and Paraphyty), Polyphyly.

9. Biosystematics-methods, categories and relationship with traditional taxonomv.

10. Circumscription and phylogeny : Magnoliales, Amentiferae, Umbelliferae, Tubiflorae, Campanulales, Helobiae, Pandanales, Poaceae and Orchidales.

11. Biodiversity : components, levels, values and conservation.

12. Concept of Phytogeography : Endemism, Hot spots, alien species, invasion and introduction.

13. Plant migration, vicanance and disjunction

14. Major Phytochona of the world and India.

15. Local plant diversity and its socioeconomic importance.

Bot/General/Theory/(204) Full marks : 50
CELL BIOLOGY AND GENETICS

Cell Biology -

1. Basic chemical and Physical concept. Molecular structures, Elementary Biophysical concepts. Macro molecules and its assembly.

2. Plasma membrane- Structure Dynamics channels, pumps and carriers

3. Storage and expression of Genetic information:

(a) Chromosomal organism

(b) Basics of Nucleor structure and dynamics

4. Biogenetics. Traffic and functions of cellular membrane system fa) Protein synthesis and folding

(b) Post tranlation targeting of proteins.

(c) Biosynthesis of endoplasmic reticulum (R) and Golgi apparatus (GA), Vesiculor traffic from ER through GA.

(d) Mitochondria and cell energetics, chloroplast

5. Reseption and transduction of cellular information

(a) Introduction to signally pathway.

(b) Plasma membrane receptors.

6. Cytoskeleton and cell motility

(a) Actin and Actin binding proteins

(b) Microtubules and microtubule associated proteins

(c) Cellular motility

7. Cell cycle and Ancer.

(a) G_1 Phase, S Phase, G_2 phase: Regulation of cell proliferation, DNA replication, entry in to mitosis.

(b) Programmed cell death (Apoptosis)

(c) Cancer: Biochemistry and molecular events, Proto oncogene, Oncogene, I umar suppressor gene, Therapy.

Genetics :

1. Post-Mendilium Genetics : Development extension, application, linkage-principle mechanism, examples, gene mapping, crossing over cytological and molecular basis significance Population genetics- multiple alleles Polygenie inheritance.

2. Chromatin organization, chromatin structure, and placentation of DNA, nuclear DNA, content and C-value paradox reassociation kinetics and repeated sequence.

3. Structural and numencal alternation at chromosomes origin and meiotic behavior of duplication deficiency, inversion and translocation heterozvgote of origin haploids. Aneaploid, euploids, autopolyploids and allepolypoids

4. Mutation types of mutation and mutagens, molecular basis of gene mutation Transposatie elements-structure, mechanism of transposition, importance, mutation induced by transposition site directed metagenen DNA damage and repair mechanism.

5. Replication and transcription process in prokanotox and enkaryotes, mendilism and control, processing of RNA, splicing process, RNA editing , Antisense RNA,

6. Translational and Genetic code: Principle and mechanism of translation and protein systnesis; Genetic code- properties, experimental evidences, evolution

7. Gene regulation, Lac and *TRP* operon impokarvote, general regulatory process in eukaryote.

Bot/General/Pract/(205) (Full Marks 50)
Pteridology (F.M.20)

1. Anatomical, morphological and palynological studies of some members of Pteridophytes occurring in West Bengal, Identification up to the genus.
2. Study of some fossils (slide and megafossils).
3. Field work

** (Submission of field and laboratory records)

Palaeobotany (10 Marks)

1. Palaeobotanical field work.
2. Study of representative megafloral assemblages and determination of age.

** (Submission of field and laboratory records including permanent slides)

Palynology and Reproductive Biology (20 Marks)

1. Pollen morphological studies of some pterodophytes, gymnosperms, and angiosperms representing different morphological types using acetolysis / alkali maceration method.
2. Extraction of pollen grains from honey sample and study of the frequency of different morpho-types.
3. Study of *in vivo* and *in vitro* germination of pollen grains.
4. Morpho-anatomical study of stigma and style.
5. Study of the growth of pollen tube through stigma and style.

** (Submission of laboratory records including permanent slides)

Bot/General/Pract/(206) **(F.M.50)**
Cell Biology and Genetics (25 Marks)

1. Study of mitosis, karyotype analysis, determination of mitotic index.
2. Study of meiosis in pollen mother cells, determination of chiasma frequency and ferminalization co-efficient.
3. Study of meiosis in grasshopper.
4. Nucelolar staining.
5. Frequency distribution analysis of probability distribution and testing goodness of fit.
6. Estimation of heritability and genetic advance, ANOVA, ANCOVA, correlation coefficient.

Taxonomy : (25 marks)

1. Acquaintance with different types of taxonomic literatures – Flora, Manual, Monograph, Glossary, Index, Dictionary, Keys and Periodicales.

2. Application of taxonomic methods for identification of Species of different families of angiosperms.

3. Acquaintance with flora of local and any other phytogeographical region and preparation of field notes.

STRUCTURE OF M.Sc. SYLLABUS (SEMESTER COURSE, 2007-2008)

SEMESTER-I		
Bot/General/Theory/(101)	Microbiology (45 + 5) = 50	50
Bot/General/Theory/(102)	Mycology (45 + 5) = 50	50
Bot/General/Theory/(103)	Phycology (45 + 5) = 50	50
Bot/General/Theory/(104 Unit-I &II)	Bryology (Unit-I) (22.5 + 2.5) = 25 Anatomy (Unit –II) (22.5 + 2.5) = 25	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(105)	Microbiology (25) & Mycology (25)	50
Bot/General/Prac./(106)	Phycology (20), Bryology (15) & Anatomy (15)	50
SEMESTER-II		
Bot/General/Theory/(201)	Pteridology	50
Bot/General/Theory/(202)	Paleobotany (Unit-I), Palynology and Reproductive Biology (Unit-II).	50
Bot/General/Theory/(203)	Taxonomy of Angiosperms - & Plant Geography	50
Bot/General/Theory/(204)	Cell Biology and Genetics	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(205)	Pteridology, Paleobotany, Palynology and Reproduction Biology	50
Bot/General/Prac./(206)	Taxonomy of Angiosperms (25), Cell Biology and Genetics (25)	50
SEMESTER-III		
Bot/General/Theory/(301)	Plant Pathology (45 + 5) = 50	50
Bot/General/Theory/(302)	Gymnosperms	50
Bot/Spl./Theory/(303)	Special theory – 1 (45 + 5) = 50	50
Bot/Spl./Theory/(304)	Special theory – 2 (45 + 5) = 50	50
Internal assessment of Theory papers (10%)		
Bot/General/Prac./(305)	Plant Pathology (25), Gymnosperms (25)	50
Bot/Special/Prac/(306)	Special Practical	50
SEMESTER-IV		
Bot/General/Theory/(401)	Plant Physiology (45 + 5) = 50	50
Bot/General/Theory/(402)	Biochemistry (45 + 5) = 50	50
Bot/General/Theory/(403)	Ecology (25), Molecular Biology & Plant Breeding (25)	50

Internal assessment of Theory papers (10%)		
Bot/General/Prac/(404)	Plant Physiology & Bio Chemistry	50
Bot/General/Prac/(405)	General Practical – Ecology (25) & Plant Breeding, Biometry & Molecular Biology (25)	50
Bot/Diss/(406)	Dissertation	50
	Total	1200

Special papers to be offered :-
(1) Cytogenetics & Molecular Biology, (2) Microbiology & Microbial Biotechnique
(3) Mycology & Plant Pathology, (4) Paleobotany & palynology
(5) Phycology , (6) Plant Physiology & Biochemistry
(7) Pteridology, (8) Taxonomy of Angiosperms and Bio-Systematics

Syllabus for M.Sc. (Bot.) Third semester

Bot/General/Theory/(301)

Plant pathology: **Full Marks -50, Lecture hrs: 50**

1. History of the development of Plant Pathology
2. Pathogenesis: Contact, entry and disease development
3. Plant pathogen in offence: enzymes, toxins and growth regulators
4. Host plant in defense: structural and biochemical defense-concept of horizontal and vertical resistance
5. Physiological (photosynthesis, respiration translocation of water & nutrients); and molecular changes in (protein and nucleic acid) in diseased plants.
6. Environment and Nutrition in relation to disease development; Plant disease epidemiology and disease forecasting
7. Strategies of plant disease management: Cultural, chemical, biological and integrated management
8. Symptoms, etiology and control measures of some important diseases of the following crops: Rice, Wheat, Potato, Sugarcane and Tea.
9. Seed storage: factors responsible for seed deterioration, effect of seed deterioration, mycotoxin production and control of seed deterioration.

Bot/General/Theory/(302)

Gymnosperms: Full marks 50, 50 Lecture hours

1. Introduction: Concept of Gymnospermae, general features of gymnosperms.
2. Origin of seed-habit: Origin and evolution of nucellus and integument; switchover from zooidogamy to siphonogamy - hydrasperman reproduction, prepollen, origin and evolution of gymnospermous pollen grains.
3. Progymnospermopsida: Vegetative morphology, stellar organization and reproductive structures of Aneurophytales, Archaeopteridales and Protopityales; the plexus progymnosperms as the progenitor of gymnosperms.
4. Pteridospermales: Characteristic features, evolutionary trends and geologic range of Calamopityaceae, Lyginopteridaceae, Medullosaceae and Callistophytaceae.
5. Glossopteridales: Geologic range and geographic distribution; morphology of important types of leaves, male- and female fructifications; reconstructions of *Glossopteris*-plant; organography of *Glossopteris*-seedling.
6. Caytoniales: General features, geologic and geographic distribution of Peltaspermaceae, Corystospermaceae and Caytoniaceae; morphology of *Caytonia*-fruit.
7. Cycadales: General features, geologic history; evolutionary trends of megasporophylls among extinct and extant members; geographic distribution of extant cycads in India and abroad.
8. Bennettitales: Characteristic features and geographic range of Williamsoniaceae and Cycadeoidaceae, reconstructions of *Williamsonia*-plant, comparative account of *Cycadeoidea* and *Amarjolia* fructifications.

9. Pentoxylales: Brief account of different organs and reconstruction of the *Pentoxylon*-plant; geologic and geographic occurrences in India and abroad; affinities.
10. Coniferales: Characteristic features; families of modern conifers, their distinguishing features, and distribution in India and abroad; evolution of female cone with reference to 'transition conifer' as evolutionary link between Cordaitales and Coniferales.
11. Ginkgoales: Characteristic features, antiquity, relationships with pteridosperms (peltasperms) and conifers.
12. Gnetopsida: Comparative account of the reproductive structures of *Ephedra*, *Gnetum* and *Welwitschia*; angiospermic features within the group.
13. Development of female gametophyte, pollination biology, embryogeny including polyembryony and karyology of extant gymnosperms.
14. Economic importance of gymnosperms with reference to wood, resin, essential oils, drugs and food.

Bot/Spl./Theory/(303)

1. CYTOGENETICS AND MOLECULAR BIOLOGY

Special – I **Marks: 50, 50**

Lectures

1) Cytotaxonomy and Molecular Taxonomy: Basic Principle, Modern concept and Application; Computer Assisted chromosome analysis (CHIAS) and Manipulation.
2) Specialized regions of chromosomes: Organization and Function of Centromere Telomere and Nucleolar Organizer Region (NOR).
3) Molecular Genetics Analysis of :-
    a) Plant Nodulation and Nitrogen Fixation.
    b) Host-Pathogen Interaction.
    c) Agro infection in Crown Gall Tumour Development.
    d) RUBISCO regulation and Assembly of Photosystem LHC-I and LHC- II during Photosynthesis.
    e) Pigmentation Genetics in Higher Plants.
4) Developmental Genetics: Regulatory Cascades, Cell fate and pattern, Spatio-Temporal Gene Expression in the development of *Drosophila* and *Arabidopsis*.
5) Molecular Breeding: General concept of Molecular Markers (RFLP, RAPD, AFLP markers) and their use in breeding, Quantitative Trait Loci (QTL) mapping, Marker Assisted Selection (MAS) in Crop Improvement.

2. Microbiology and Microbial Biotechnology

Theory*:* **F.M. – 50 (45+5), 50L**

Special Paper - I :

1. Modern concept of bacterial Taxonomy:- Classical and Molecular taxonomy, Numerical taxonomy. Bergey's manual of Determinative & Systematic Bacteriology, Type culture collection centre. 5L

2 Domain of Archaea and bacteria :- Characteristics and taxonomy of Archaea ;Gram (+) and Gram (-) bacteria and their taxonomy. 2L

3. Concise account of the following groups:-

a) Mycoplasmatales b) Myxobacteria c) Stalked bacteria d) Bdellovibrio e)Actinobacteria 5L

4.**Bacterial photosynythesis**:- Photosynthetic bacteria and mechanism of bacterial photosynthesis. 5L

5.**Chemolithotrophic bacteria and others: -** types, modes of metabolism and energy transfer; heterotrophic CO_2 fixation. 5L

6. Membrane Transport system of bacteria :- Active and passive transport, facilitated diffusion , group translocation , ion transport through ionophores and protein transport. 5L

7. Aerobic , Anaerobic respiration in bacteria & Bacterial Fermentation:- EMP pathway, HMP pathway , ED pathway, Phosphoketolase pathway, Bifidum pathway ,TCA Cycle, Glyoxalate Cycle,ETC, Protonmotive force, Chemiosmotic theory ; Dentrification, Metal reduction, Sulfidogenesis, Methanogenesis, Homoacetogenesis ;Alcohol Fermentation ,Lactate Fermentation , Propionate fermentation, Butyric acid –Butanol fermentation, Mixed acid fermentation. 9L

8.Biosynthesis of Amino acids & Nucleic acids in Bacteria : Glutamate and Aspartate families of amino acids and their regulation. Purine & Pyrimidine biosynthesis. 4L

9.Fermentation Technology-Fermenter –Basic principles , types, operation, sterilization, aeration, control of temperature, surfactant. 3L

10. Microbial Fermentation of Butanol, Citric acid, and Lysine . 3L

11.Milk Microbiology:-Sources of microorganisms in milk, microbiological examination of milk and fermented milk products. 2L

12. Biofertilizers - Types , production and importance in Agriculture. 2L

3. MYCOLOGY AND PLANT PATHOLOGY

Special Theory-1 **FM- 50**

Lecture hrs: 50

1. Origin of fungi and their interrelationships
2. Role of sex hormones in reproduction of fungi
3. Genetic variation in fungi- heterocaryosis and parasexual cycle and their significance.
4. Fungal metabolism-carbon, nitrogen and vitamins.
5. Role of saprotrophs in ecosystems
6. Fungal sporocarps, spores, methods and mechanisms of spore discharge of different groups of fungi
7. Fungi and Biotechnology: i) Fungal enzymes of commercial importance, ii) fungal products-antibiotics, organic acids, and industrial alcohol, iii) gene cloning and the future of fungal biotechnology, industrial strain improvement iv) mushroom cultivation technology, fungal competitors associated with mushroom crop

4. Palaeobotany and Palynology

Special paper-I **Full marks 50, 50 Lecture hours**

1. Outline classification of rocks according to their origin and composition; sedimentary processes; diastrophic changes in sedimentary strata (dip-strike, fold, fault); unconformity.
2. Principles of correlation and stratigraphy, geochronology; stratigraphic systems and the units of classification; Standard Geologic Time Scale.
3. Prebiotic environment; chemical evolution and origin of life; Precambrian life-forms. Indian Precambrian stratigraphy; palaeobiology of Vindhyans.
4. Diversification of algae, fungi and bryophytes through ages.
5. Siluro-Devonian land floras; Permo-Carboniferous floral provinces; Devonian and Carboniferou floras of North-West India.
6. Early Mesozoic floras of Molteno and Chinle formations, later Mesozoic floras of Yorkshire and Jura.
7. Concept of Indian Gondwana Sequence, stratigraphy and correlation of Gondwana Sequence in Peninsular Indian basins, mega- and miofloristics of Peninsular Indian Gondwana formations; Indian Perigondwana floras.
8. Angiosperm palaeofloristics; Distribution of Tertiary strata in India; Palaeogene palaeofloristics and palaeoecology of Peninsular India; Neogene palaeofloristics and palaeoecology of Peninsular (Cuddalore Group and Bengal Basin) and Extrapeninsular (Siwalik Group) India.

5. Phycology, Spl Paper-I **FM- 50, LH-50**

Work done on freshwater algae with special reference to India & Contributions of Prof. M. O. P. Iyengar. 3

1. Distribution pattern of Marine algae in Indian coasts. 3
2. Endosymbiosis and origin of Eukaryotic algae 4
3. Green cyanobacteria: their taxonomic status. 3
4. Charophytes & origin of land plants. 3
5. Dinoflagellates: distinctive features & importance. 4
6. Desmids: taxonomy & importance. 4
7. A brief study of the following classes of algae: 12
    a) Prymnesiophyceae
    b) Raphidophyceae
    c) Chrysophyceae
    d) Euglenophyceae
8. Biochemical taxonomy of algae. 5
9. Fossil algae & their importance. 4

6. Plant Physiology and Biochemistry

Special Theory-1

Marks 45+5

1. Polyamines, Brassionsteriods, Jasmonic acid and Salicylic acid: Chemical, structural, functional characteristics physiological role; biosynthetic pathway of polyamines.
2. Cyanide resistant respiration: Characteristics of the alternate pathway, mechanism, energetics, significance.
3. Senescence and programmed cell death : Types of cell death in plants, role of PCD in plants, senescence associated genes, pigment metabolism during senescence, impact of senescence on photosynthesis and respiration, oxidative stress and senescence metabolism, endogenous plant growth regulators and significance.
4. Physiology and biochemistry of seed development and role of plant hormones.
5. Seed viability and seed vigour: Orthodox and recalcitrant seeds, biochemical changes during seed deterioration, seed invigouration, accelerated ageing, viability tests, synthetic seeds.
6. Herbicides and their action: Chemical diversity of herbicides, selective and nonselective herbicides, general mode of action.
7. Stress physiology: Types of environmental stresses; plant response of abiotic stress; osmotic adjustment and its role in tolerance to drought and salinity; impact of salinity and water deficit stress on transport across plant membranes, stress-inducible proteins and genes.
8. Physiological basis of crop yield with special reference to source-sink relationship, designer crops, ideotypic characters of rice and sunflower.

7. Pteridology

Special Paper I: **FM-50**

1. Pteridophytic flora of India. Endangered pteridophytes and their conservation.
2. Ecological Diversity of pteridophytes- A brief mention of climates and flora of the past geological era.
3. Experimental approach to the ecology of pteridophytes.
4. Mycorrhizic association of *Azolla* with A*nabaena azollae* and myrmecophily in the genus *Lecanopteris*.
5. A brief account of the Palaeozoic and Mesozoic Lycopods, Sphenopsids and Filicopsids found in India.
6. Recent taxonomic circumscriptions of extant *Lycopodium, Selaginella*, *Equisetum* and Gleicheniaceae, Polypodiaceae.
7. Origin of arborescent Lycopods.
8. Origin and evolutionary trends in the Sphenopsids.
9. Different Systems of classification of major groups of Filicopsida.
10. Biology and control of Bracken Fern.
11. Anatomy of the petiole and rachis of Pteridophyta.
12. Morphotypes and ontogeny of stomata.

8. Taxonomy of Angiosperms and Biosystematics

Special paper –I **FM- 50**

1. Principles of the Cronquist syatem of classification and general evolutionary trends in flowering plants.
2. Circumscription and Phylogeny of Dilleniidae, Hamamelidae, Caryophyllidae, Rosidae, Asteridae; Alismatidae, Arecidae, Commelinidae, Zingiberidae and Liliidae sensu Cronquist (1988).
3. Taxonomy of Parasitic, Saprophytic and Insectivorous plants and their specializations.
4. Floristic elements and Phytogeography of India.
5. Centres of origin and diversity of cultivated plants

Bot/Spl./Theory/ (304)

1. CYTOGENETICS AND MOLECULAR BIOLOGY

Special – II **Marks:**

50

1) Ultrastructure of chromatin and its activation – Histone modifications, Chromatin remodelling complexes (CRC), Transcription and activation of Class II genes.
2) Transcription, and Translational Control In Eukaryotes : mRNA, tRNA regulation & splicing, capping, polyadenylation, RNA Editing, RNA interference, Austisense RNA, snRNAs, microRNA, silencing of RNA. Post- Translation Regulation, Protein sorting, Folding & Targeting.
3) Genomics and Proteomics: Structural Genomics - Genome anatomy of prokaryote and eukaryote, tools and strategy to decipher genome.
   Functional Genomics - Regulation of Genomic activity, Genome profiling, Microarray, Genome Projects (*Arabidopsis* & Human).
   Proteomics - Basic principles and application, 2D Gel analysis, Importance
4) Recombinant DNA Technology & Gene Manipulation: General concepts, Various vectors, Enzymes, Cloning strategy in *E. coli* (plasmid, phage, cosmid, phagmeid) and Yeast vectors (YAC), Plants (Ti / Ri plasmids of *Agrobacterium*), Genomic DNA library and cDNA library, Expression of cloned DNA and its analysis.
5) Plant Biotechnology: Plant Tissue Culture, basis principle, Tools Totipotency and Embryogenesis, Organogenesis, Micropropagation, Protoplast culture and Somatic hybridization, Genetic Engineering of plant – Manipulation of chloroplast and nuclear genome, Agroinfection and Ti / Ri plasmid based transformation.
   Biotechnology of Crop Improvement: Insect resistance, Salt tolerance, Drought tolerance, Herbicide tolerance, Molecular pharming, Cryobiology.

2. Microbiology and Microbial Biotechnology

Special Paper Theory II - **F.M. – 50**
(45+5)

50L

1. **Concise account of the following groups**:-
   a) Rickettsiales b) Chlamydiae c) Thermophiles d) Halophiles 4L

2. **Hydrocarbon Microbiology** – Organisms and pathways of Hydrocarbon utilization
Methane bacteria & Biogas Production. 3L

3. **Plasmid**- Types, Compatibility, Copy numbers, maintenance & amplification; Ti plasmid & its application in biotechnology 4L

4. Transposable **genetic elements** :-Bacterial transposons and transposon mutagenesis.Inbacteria.
3L

5. **DNA damage and repair**:- DNA damage & repair mechanisms in bacteria 2L

6**. Recombinant DNA Technology**- Principles, Enzymes, Vectors, Methods, application of Recombinant DNA Technology. 5L

7. Chemotherapy:- Sulfa drugs & their mode of action ; Antibiotics – classification, mode of actions, antibiotic assay and sensitivity test, non-medical uses of antibiotics. Antiviral drugs and their mode of action; Drug resistance – origin, causes and clinical implications. 6L

8. Interferon –Chemical nature, mechanism of action, production and application.
3L

9. **Water Microbiology**:-Bacteriological examination of domestic water, purification of water, sewage & its disposal, bioremediation of pollutants. 2L

10. Pathogenecity of human diseases: - Pathogenecity due to invasiveness, exotoxin, endotoxin , toxoid and their practical application. 4L

11. Epidemiology, Symptoms, prevention and control of following diseases – a)Cholera b) Typhoid, c)Tuberculosis, d) Rabies e) AIDS. 6L

12. Immunotechnology- Innate & Adaptive immunity; Cell mediated and Humoral immunity; MHC types and function; Cytokines; Complement–types, pathways of fixation; Antibody diversity and Class switching; Hypersensitivity-and their types; Monoclonal antibody production and application; Ag-Ab reac--tion; Diagnostic serological test - Immunofluorescence , ELISA, RIA, RIST, RAST, and FACS; Vaccines. 8L

3. MYCOLOGY AND PLANT PATHOLOGY

Special Theory-1I **Full marks: 50**
Lecture hrs: 50

1. Epidemiology of plant diseases: Disease pyramid-components, measurement and simulation of plant disease epidemics; forecasting and remote sensing.
2. Disease incidence: Molecular basis of appresorium formation and its role.
3. Plant disease resistance: genetical and biochemical basis of plant disease resistance; systemic acquired resistance (SAR) and induced résistance. Molecular aspect of plant disease resistance- role of phenolics, phytoalexins and phytoanticipins, PCD, ROS and lipoxigenase, PR- proteins- their classes and functions in plant disease résistance. Hypersensitive reactions- the mechanism of elicitor-receptor concept. Basic knowledge about the defense enzymes of host plants, alarm signal and signal transduction mechanism.
4. Rhizosphere and phyllosphere microflora: Types, extent and effect on host plant, their importance in plant pathology

5. Deterioration of seeds in storage, biosynthesis of mycotoxins,effect of mycotoxin contamination in food and feed: control of seed deterioration and mycotoxin contamination
6. Fungicides in disease control; topical and systemic fungicides, mechanism of fungicidal action- mode of action of systemic fungicides (belonging to some common chemical groups), application of fungicides.
7. Biological control-current status, problems and future application
8. Mycorrhizae: types, distribution co-evolution, applications of mycorrhizae in agriculture and forestry and their possible use as biofertilizers. Molecular aspects of mychorrhization-molecular mechanism involved in signaling for mycorrhization and signal transduction pathway. Mycorrhizal inoculum production.
9. development of disease resistant crop varieties: mutation selection, application of tissue culture and recombinant DNA technology.
10. Host-parasite interaction: enzymes, toxins and hormonal imbalances, molecular basis of host-parasite interactions and disease development

4.Palaeobotany and Palynology

Special Theory 1I

Full marks 50, 50 Lecture hours

1. International Code of Botanical Nomenclature with special reference to the nomenclature of fossil plants.
2. Continental Drift hypothesis, Sea-floor Spreading, Plate Tectonics.
3. Evolution of miospores through ages.
4. Taxonomy of dispersed miospores with reference to Potonie's Turmal System; Microfossils other than spores and pollens.
5. Pollen analysis with reference to Quaternary vegetational history of India: Pleistocene vegetational history of Kashmir Valley, Holocene vegetational history of Western India and Bengal Basin.
6. Palaeobotany in relation to Palaeoclimatology and Palaeoecology.
7. Life as a fuel maker; sources of natural fuels; peat; coal and its varieties, constitution of coal, coal palynology; petroleum, its origin, migration and concentration, palynology in oil exploration.
8. Archaeobotany of Indian cultivated plants.

5. Phycology Special paper-II **F.M. 50,50L**

1. Phylogeny of algal plastids. 4L
2. Ultrastructure of flagella and its taxonomic importance. 5L
3. Carbon dioxide concentrating mechanism (CCM) in algae. 4L
4. Ecology of freshwater algae: factors (light, temperature, chemical & current) and distribution.

6L

5. Algae of unusual habitats: thermal algae, cryoalgae & halotolerant forms; endozoic and endophytic forms. 4L
6. Extracellular products of algae & toxic algae. 3L
7. Algae in Biotic associations.
8. Algal biotechnology with special reference to health food, biocosmetics, medicine, hydrocarbon production, biomonitoring and bioremediation. 6L
9. Control of aquatic algae. 3L
10. Biogeochemical role of algae 4L
11. Isolation, purification & growth characteristics in relation to algal culture; indoor and outdoor cultivation culture; photobioreactors. 6L

6. Plant physiology and Biochemistry**:**

Semester III: Special Theory-II
Marks 45+5

1. Concept of free energy: Thermodynamic principles, energy-rich bonds, coupled

   reactions and oxidative phosphorylation, bioenergetics.
2. Membrane transport: An overview of transport; pumps, carriers and channels; mechanism of transport of micromolecules.
3. Signal perception and transduction: An overview, receptors, specific example of plant receptors, G-proteins and phospholipid signalling, cyclic nucleotides, calcium and protein kinases.
4. The cell cycle: An overview, cell cycle regulation factors modifying the cycle, gene regulation of cell cycle.
5. Post-translational modification and folding of newly synthesized polypeptides.
6. Phytochrome and light control of development: photochemical and biochemical properties of phytochrome, localization, phytochrome functional domains, cellular and molecular mechanisms of action, PHY genes, blue light response; stomatal movement and photomorphogenesis.
7. Cellular oxidations and the mitochondrion: Pathways of ATP production, mitochondrial electron transport system, mitochondrial F_0F_1, ATPase and mechanism of ATP synthesis.
8. Secondary metabolites and plant defense: Types and their basic role; biosynthesis of indole alkaloid, *in vitro* production of indole alkaloid; physiological role of alkaloids in plants, commercial uses of alkaloids.
9. Photophysiology: Z-scheme and management of light energy.

7. Pteridology

Special Paper Theory II: FM- 50

1. The contribution of pteridophytes to an understanding of the life history of vascular plants (Sexuality in gametophytic growth; Significance of isolation in relation to cyclic alternation, determination of femaleness in free sporing homosporous plants; relationship between heterospory and anisospory; cyclical alternation in heterosporous plants.)
2. Cytogenetics of ferns: Chromosome numbers and morphology; polyploidy; cytogenetic analysis of species complexes; apospory, apogamy and apomixes; hybridization.
3. Role of cytology in Fern Taxonomy.
4. Genetics and Reproductive Biology of ferns: Nature of fern breeding systems: homozygosity Vs heterozygosity, genetic load.
5. Experimental investigation of fern sporophyte development (Shoot Apical Meristem, Lateral Primordia and Leaf determination, Induction of sporogenous tissue.
6. Structure and development of spore wall.
7. Culture of fern gametophytes. Photomorphogenesis in Fern gametophytes.

8. Taxonomy of Angiosperms and Biosystematics:

Special Theory II: F.M.=50

1. Biosystematics principles,practice, limitations and scope ;phenotypic plasticity ;
2. Biodiversity: general concept, importance, assessment of variation and isolation.
3. Distribution of endemic plant families in the southern hemisphere of the globe.
4. Conservation: Principles, categories of threatened plants (IUCN), strategies of conservation, Red Data Book.
5. Botanic Garden, Herbaria and Botanical Survey of India.

Molecular markers in Plant Systematics and phylogenetic analysis: Nuclear ribosomal DNA, Chloroplast DNA and Mitochondrial DNA.

Bot/General/Pract./ (305)

Plant Pathology Full Marks: 25

1. Study of different types of symptoms of plant diseases
2. Study of some important plant pathogens in relation to suspect and symptoms produced by members of a) Phycomycetes b) Ascomycetes c) Basidiomycetes d) Deuteromycetes.
3. Principles of sterilization and application of sterilization technique
4. Isolation of plant pathogens from diseased plants
5. Inoculation technique of different plant parts and study of Koch's postulates

** Students are required to submit field and laboratory records, preserved and dried specimens and permanent slides.

Gymnosperms Full marks 25

1. A comparative study of the vegetative and reproductive parts of extinct gymnosperms.
2. A comparative study of the vegetative and reproductive parts of extant Cycads and Conifers.
3. Fieldwork.
   ** (Submission of field and laboratory records including permanent slides).

Bot/Spl./Pract./ (306)

1. Cytogenetics and Molecular Biology:

Practical **FM: 50**

1) Comparative study of karyotypes of selected plant materials (both from root tips and leaf tips).
2) Scanning of chromosome aberrations (Mitotic and meiotic).
3) Effect mutagenic agent on plant system to note chromosomal irregularities.
4) Demonstration of alkaline phosphate activity of plant chromosome.
5) Chromosome banding technique.
6) Extraction, identification and estimation of plant DNA, RNA and protein.
7) Gel electrophoresis study of plant genetic DNA and plant protein.
8) PCR amplification on selected DNA fragment extracted from plant material.
9) Restriction digestion of genomic DNA and construction of restriction map.
10) Transformation of *E. coli* by suitable plasmids, transposon mutagenesis.
11) Micropropagation and induction of embryogenesis (Somatic and Gametic).
12) Demonstration of sophisticated instruments: Ultracentrifuge, fraction collector, Gel documentation, HPLC, PCR, AAS

2. Microbiology and Microbial Biotechnology

Practical

F.M. – 50

1. Quantitative estimation of Sugar, Protein, DNA and RNA by colorimetric method.
2. Separation of mixture of sugars and amino acids by paper Chromatography and Thin Layer Chromatography method and their identification.
3. Microbial growth measurement by turbidity, total count, construction of growth curve, determination of generation time..
4. Determination of MIC of antibiotic by tube dilution assay method. Assay of antibiotic by agar cup assay method.
5. Determination of phenol co-efficient.
6. Determination of thermal death point of bacteria.
7. Enrichment culture
   a) Aerobic N_2 fixing bacteria b) Nitrifying bacteria c) Photosynthetic bacteria d) Endospore forming bacteria e) Cellulase producing bacteria, f)Phosphate solubilizing bacteria.
8. Effect of pH, temperature and substrate concentration on bacterial amylase activity.
9. Determination of quality of milk by methelene blue reductase test method
10. Physio-biochemical test for identification of bacteria:-

a) Catalase b) Protease, c) Amylase d) Acid & Gas Production, e) Indole production f) V-P Test, g) Lysine decarboxylase , h)Citrate utilization test.

11 Isolation of Plasmid / genomic DNA from bacteria and Agarose gel Electrophoresis of isolated DNA. DNA amplification by PCR. Restriction enzyme digestion, electrophoresis & documentation. SDS-PAGE of protein and determination of Mol. wt.. , Transposon mutagenesis. Transformation of E. coli by suitable plasmids.

12. Standard Quality analysis of water-

a) Presumptive test b) Confirmed test c) Completed test d) IMVIC test

13 Isolation of Rhizobium from nodule of Leguminous plant .Production of *Rhizobium* inoculant in laboratory fermenter.

14. Demonstration of the operation of following Instruments

a) Spectrophotometer UV-Vis, b) Lyophilizer c) Sonicator d) Fraction collector e)GC-MS f) Laboratory fermenter g) Chemostat h) Cold Centrifuge i) Ultracentrifuge j) Atomic Absorption k) HPLC l) SEM m) PCR n) Gel documentation System

3. MYCOLOGY AND PLANT PATHOLOGY

PRACTICAL **FM 50**

1. Identification of fungi by microscopic examination: i) members of Mastigomycotina of particular interest ii) members of Ascomycotina of particular interest iii) members of Basidiomycotina of particular interest iv) members of Deuteromycotina of particular interest
2. Study of hyphal types in fungal sporocarps
3. Estimation of total phenols in diseased and healthy host tissue.
4. Study of symptomatology and histopathology and identification of some plant diseases: a) diseases of particular interest caused by fungi of different groups b) some common diseases of plants caused by bacteria and viruses
5. Methods of differential staining of host and fungal pathogens in diseased tissues
6. Determination of role of pectic enzymes produced by pathogens in host tissue maceration
7. Determination of role of cellulase enzymes produced by pathogens in host tissue decay
8. Laboratory testing of fungicides: a) standard procedure for preparation of calibrated spore suspension b) standard procedure for preparation of stock solution of test chemicals c) standard procedure for fungicidal bioassay using spore germination technique.
9. Antibiotic bioassay: preparation of nutrient agar medium, preparation of standard dose of antibiotics and bioassay of antibiotics following standard protocols.
10. Study of mycorrhizal association on root samples of some common plants.
11. Demonstration of ELISA and GEL electrophoretic techniques

4. Palaeobotany and Palynology Special Paper **Full marks 50**

Practical

1. Field techniques in palaeobotany.
2. Laboratory preparations of fossils preserved as impressions, incrustations and petrifactions.
3. Study of megafossil assemblages from different geological horizons especially from India.
4. Study of spore / pollen morphology of some extant representatives of pteridophytes, gymnosperms and anbiosperms.
5. Laboratory extraction techniques of spores and pollen grains from coal, shale and other sedimentary rocks. Quantitave analysis of spore-dispersae in rock samples from different geologic horizons. Graphic representation of data for the determination of horizon and age.
6. Extraction, identification and quantitative analysis of spore / pollen assemblages from air and soil.

5.Phycology

Practical

F.M. 50

1. Collection, fixation & preservation techniques for different types of algae for different purposes.
2. How to study, describe, & prepare key up to species level using standard characters.
3. Study of Indian marine algae.
4. Determination of plankton; species diversity index and algal pollution index of a water body using phytoplankton; study of common phytoplanktons.
5. Culture of algae.
6. Cytology of algae.

6.Plant Physiology and Biochemistry

Practical Marks 50

1. Quantitative estimation of ascorbic acid in plant tissue.
2. Evaluation of seed viability by reliable physiological and biochemical methods.
3. Quantitative estimation of proline in salt-stressed leaf-tissues.
4. Effect of water stress on root metabolic activity.
5. Colorimetric estimation of Iron.
6. Extraction and estimation of fat.
7. Separation of amino acids by paper chromatographic technique.
8. Extraction and estimation of nucleic acids from plant samples.
9. Extraction and estimation of the enzyme catalase and amylase form plant samples.
10. Separation of phenolic compounds by thin layer chromatography
11. Purification of protein by SDS-PAGE

7. Pteridology: Practical

Marks 50

1. Study of different types of venation patterns and stomata through leaf clearings
2. Study of epidermal emergences
3. Study of petiole anatomy in different groups of Pteridophytes
4. Morphoanatomical studies of members of the following families: Polypodiaceae, Thelypteridaceae, Pteridaceae, Davalliaceae, Hymenophyllaceae, Dryopteridaceae, Athyriaceae, Azollaceae
5. Study and preparation of slides of spores through acetolysis method
6. Meiotic study of chromosomes from sporangia

8. Taxonomy and Biosystematics: Practical
Marks 50

1. Study of the representative species selected from the Subclasses mentioned in the Theory Syllabus.
2. Phytography as per the pattern followed in the recent Floras.
3. Application of ICBN with examples and problems.
4. Application of objective methods in taxonomy.

Syllabus for M.Sc. (Bot.) Fourth (IV) semester:

Bot/General/Theory/(401)

Plant Physiology **Marks 45+5**

1. A general discussion on phytohormones and plant growth regulators: Definitions; members of phytohormone family; growth promoting and retarding chemicals; general mode of hormone action; hormone binding proteins; second messengers; gene activation; examples of target cells for hormone action; a brief idea about modern techniques for hormone assay.
2. Auxins : Biosynthesis and degradation/deactivation of IAA; a brief account of the auxin structure and activity relationship; antiauxins and auxin antagonists; mechanism of auxin action – acid growth theory, auxin mutants.
3. Gibberellins : Chemical and structural characteristics of gibberellins; biosynthesis of GA_s, antigibberellins and their site of action, role of gibberellins in cereal seed and gene mediated action. germination, dwarfism and flowering; mode of action of gibberellins, gibberellin mutants.

4. Cytokinins: Chemical and structural characteristics, biosynthesis and degradation; role of cytokinins in cell division, organogenesis, embryogenesis; mode of action, cytokinin mutants.
5. Abscisic acid : Chemical and structural characteristic, biosynthesis and degradation; role of ABA in seed maturation, germination, gravitropism and stomatal closure; mode of action, ABA mutants.
6. Ethylene : Hormonal status; chemical characteristics, biosynthesis and metabolism; Yang cycle; factors regulating ethylene biosynthesis; mode of ethylene action; its role in higher plants, ethylene mutants.
7. Seed dormancy : Types, control mechanism, chemical and physical manipulative methods of breaking seed dormancy; ecological significance of dormancy.
8. Flowering : Photoperiodic control, hormonal regulation; nature of floral stimulus; experimental evidence to prove the mobile nature of floral stimulus,ABC model of flowering, second messenger and flowering.
9. Senescence : Types of senescence, biochemical indices of senescence, physiobiochemical changes occurring during leaf senescence, senescence regulatory genes.
10. Fruit ripening : Climacteric and nonclimacteric fruits; hormonal regulation of fruit ripening, biochemical changes occurring during fruit ripening.

Bot/General/Theory/(402)

Plant Biochemistry

Marks 45+5

1. Carbohydrate metabolism : Glycolysis-control and significance; pentose phosphate pathway, its control and significance; Gluconeogenesis; control and significance.
2. Glyoxylate cycle: Control and significance;
3. Lipids: Biosynthesis and degradation, energetics of β-oxidation.
4. Enzyme kinetics: Deduction of Michaelis-Menten equation, Lineweaver-Burk plot; enzyme inhibition, isozymes, allosteric enzymes, ribozymes and abzymes.
5. Amino acids : Classification and structures, properties, determination of amino acid sequence in a polypeptide.
6. Proteins : Primary, secondary and tertiary structures; protein targeting in endoplasmic reticulum, chloroplast and mitochondrion; Ramachandran plot.
7. Photorespiration : Compartmentalized reactions; structural and functional characteristics of Rubisco and its regulationC-2 cycle, energetics and significance of the cycle.
8. Photosynthetic carbon reduction cycle: Different modes of CO_2 concentrating mechanisms, energetics and significance.
9. Principles and applications of chromatography, tracer techniques.

Bot/General/Theory/(403)

ECOLOGY: Marks 25, 25 lecture hours

1. **Scope of plant ecology**; its relation to other disciplines and relevance to human civilization.

2. The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

3. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

4. **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.

5. Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

6. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

7. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.

8. Ecosystem: Structure and function; energy flow and mineral cycling; primary production and decomposition; some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine)

9. Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

10. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Molecular Biology & Plant Breeding **Marks: 25**

1) DNA & RNA Metabolism: DNA topology, DNA damage and repair transcription, processing, regulation, post-transcriptional control and gene silencing, Protein synthesis and its regulation, protein targeting
2) Gene expression: Principles of gene regulation; Regulation of gene expression in prokaryotes and eukaryotes.
3) Bio-signalling: Signal perception, molecular mechanisms of signal transduction and regulation
4) Centre of origin & diversity of crops, Principle & technique in plant breeding & its genetic basis, Breeding method for self & cross pollinated crops, Ploidy, Heterosis, Mutation Breeding
5) Population Genetics: Polygene hypothesis, Gene frequency in population & Hardy-Weinberg Law, Genetic drift

Bot/General/Prac/(404)

General Practical Plant Physiology, and Biochemistry, **Marks: 50**

Plant Physiology **Marks 25**

1. Determination of water potential of plant samples by Chardakov's method.
2. Quantitative estimation of accumulated chloride ion in cell sap.
3. Study of photolysis of water by demonstration of Hill reaction.
4. Effect of high temperature stress on membrane deterioration in terms of electrical conductivity test.
5. Effect of respiratory inhibitor on the rate of respiration.
6. Quantitative estimation of dissolved oxygen due to photosynthesis by Winkler's method.
7. Effect of sodium azide on water uptake by plants.
8. Bioassay of IAA by wheat coleoptile test.

Biochemistry 25 marks

1. Quantitative estimation of amino acids by spectrophotometric method using ninhydrin reagent.
2. Quantitative estimation of protein by spectrophotometric method using folin-Ciocalteau reagent.
3. Quantitative estimation of carbohydrate by spectrophotometric method using Anthrone reagent.
4. Determination of Acid value of fat sample.
5. Determination of total titratable acidity of cell sap.
6. Preparation of a standard curve for IAA and determination of unknown concentration of IAA.
7. Preparation of a standard curve for phenolic compound and determination of the concentrations of unknown phenolic compound.
8. Spectrophotometric estimation of reducing sugar by 3, 5,- dinitrosalicylic acid (DNS).

Bot/General/Prac/(405)- FM- 50

Ecology

Marks 25

1. Determination of species area curve by Quadrat method.
2. Determination of density, frequency and basal cover of species.
3. Determination of association index of species.
4. Determination of index of similarity / dissimilarity between two communities.
5. Estimation of organic matter content of soil.
6. Determination of total soluble salts of soil / water.
7. Some field tests for the determination of soil texture.
8. Determination of nutrient content of soil by kit- method.
9. Colorimetric determination of nitrogen and phosphorus of soil.
10. Determination of dissolved oxygen in unpolluted and polluted water.
11. Determination of biodiversity in a plant community.

Plant Breeding Biometry Molecular Biology **Marks: 25**

Practical

1. Vegetative propagation: Layering, cutting, inarching, grafting, T-budding.
2. Weathering of micropropagules.

3. Isolation of chlorophyll mutants following irradiation and / or with chemical mutagens (Demonstration).
4. Diallel-breeding analysis
5. Genotype-Environment Interaction, Correlation coefficient.
6. Different techniques of emasculation and hybridization in self and cross pollinated plants.
7. Yield component analysis.
8. Isolation of plant nuclear DNA and protein and their spectrophotometric analysis (Demonstration).

Bot/Diss/(406)

Dissertation of Special Paper(S): **FM: 50**