

Botany**For M.Sc. (Previous & Final)**

There shall be 10 Compulsory papers (1 to 10) which will be covered in two years. Five compulsory papers are to be opted for M.Sc. (Previous) Exam, and remaining five papers to be opted for M.Sc. (Final) examination. There will be practical examination in both the previous & Final class.

M.Sc. (Previous)

Paper I - Phycology and Microbiology

II - Mycology and plant pathology

III - Bryophyta, pteridophytes and gymnosperms

IV - Plant Physiology and crop physiology

V - Cytology and molecular biology.

M.Sc. Final

VI - Taxonomy, Economic botany and Morphogenesis

VII - Morphology, Anatomy, embryology and tissue culture.

VIII - Ecology and soil science

IX - Biochemistry and Photobiology

X - Genetics, plant breeding and biostatistics.

Practical Examination—

M.Sc. Previous -	200 Marks
M.Sc. Final	200 marks
The broad distribution of marks is an undar :—	
1- The practicals based on 5 theory papers	140 Marks
2- Viva-Voce	20 Marks
3. Collection and report of plant collection trip	20 Marks
4. Sessional record	20 Marks
5. Plant collection tour (s) are compulsory for all candidates	

Botany (M.Sc. Previous)***Paper I*****Phycology & Micro-biology****M.M. 100**

The candidates are required to attempt five questions but not more than three questions from any section.

Section (A) Phycology

1. Classification of algae
2. Phylogeny and inter-relationship among the principal groups of algae
3. Range of structure and organization in algae.
4. Sexuality in algae.

5. Algal pigments and hormones:

6. Economic importance of algae

7. General characters of the algal classes and comparative account of structure and reproduction of the following taxa:—

A— Myxophyceae : Chroococales, Nostocales

B— Chlorophyceae : Volvocales, chaetophorales conjugales

C— Xanthophyceae : Heterosiphonales.

D— Phaeophyceae : Ectocarpales, Laminariales & Fucales.

E— Rhodophyceae : Nemalionales Rhodymeniales & Ceramiales.

F— Bacillariophyceae : Diatoms General Account.

Section (B) Microbiology

1. Classification, structure, reproduction & Economic importance of bacteria.

2. Actinomycetes : Classification, structure & antibiotics.

3. Slime molds : Structure & reproduction.

4. Viruses : Nature, properties, structure, multiplication, transmission, and bacteriophages.

5. Rickettsia : A general account.

6. Mycoplasma : A general account.

7. Cancer biology : A general account.

8. Host microbes interaction and immunity.

Paper II**Mycolog & Plant Pathology**

The candidates are required to attempt five questions but not more than three questions from any section.

Section (A) Mycology

1. A general account and classification of fungi.
2. Comparative structure, reproduction and phylogeny of the following taxa—
 - A. Phycomycetes : Chytridiales, Blastocladales, Entomophthorales, saprolegniales, peronosporales & Mucorales.
 - B. Ascomycetes : Endomycetales, protomycetales, Erysiphales, sphaeriales, and pezizales.
 - C. Basidiomycetes : Uredinales, Ustilaginales, Exobasidiales, Agaricales and Lycoperdales.
 - D. Deuteromycetes : Malanconiales and Moniliales.
3. Phylogeny of fungi; fungi as a test organism.
4. Antibiotics and elementary industrial mycology.
5. Lichens : A general account.

Section (B) Plant Pathology

1. Nature causes and classification of plant diseases.
2. Inoculum and means of dissemination.
3. Phylogeny of infected host; changes in the physiological processes, toxins and their role.
4. Genetics of host pathogen relationship. physiological specialization.

5. Control measures and defence mechanism including culture practices, chemical and biological control and resistance.
6. Symptoms causal organism, disease cycle and control measures of the following.
 - a. Rot and Damping off; Damping off of tobacco seedlings, red rot of sugarcane.
 - b. Downy mildews : Downy mildew of Bajra and Grapes.
 - c. Powdery mildew : Powdery Mildew of cucurbits.
 - d. Rusts; Rusts of wheat & linseed.
 - e. Wilts : wilts of pigeon pea.
 - f. Leaf spot & blights; Early & late blights of potato. Blast disease of rice.

paper III

M.M. 100

Bryophytes, Pteridophytes & Gymnosperms

The candidates are required to attempt five questions but not more than 3 questions from any section.

Section (A) Bryophytes

1. Classification, General characteristics, Distribution and affinities of Bryophytes.
2. Comparative morphology, anatomy and reproduction of the following taxa : Calobryales, Takakiales, sphaerocarpaceae, Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Andreales and polytrichales.
3. Fossil history of bryophytes.
4. Origin and evolution of sporophytic and gametophytic generations.

Section (B) Pteridophytes

1. General Characteristics, classification, comparative morphology, anatomy reproduction, affinities and phylogeny of the following—
- Psilophytosida Psilophytales.
 - Psilotopsida; Psilotales.
 - Lycopsidea; Lepidodendrales, Isoetales.
 - Sphenopsida; Sphenophyllales, Calamitales.
 - Pteropsida; Ophioglossales; Osmundales, Filicales (Gleicheniaceae, Metoniaceae, Cyatheaceae, Adiantaceae), Salviniaceae.

Section (C) Gymnosperms

- Classification, General characteristics, distribution, affinities and phylogeny of gymnosperms.
- Comparative morphology, anatomy, reproduction and affinities of the following gymnosperms —
 - Pteridospermales; Pteridospermaceae, Lyginopteridaceae, Medullosaceae.
 - Caytoniales : Caytoniaceae.
 - Cycadales: Cycadaceae.
 - Cordaitales; cordaitaceae.
 - Ginkgoales; Ginkgoaceae.
 - Pentaxylales; pentaxylaceae.
 - Coniferales; Pinaceae, Araucariaceae, taxodiaceae, cupressaceae, podocarpaceae, cephalotaxaceae, taxaceae.
 - Gnetales; Gnetaceae (Gnetum)

PAPER IV**Plant Physiology & Crop Physiology****M.M. 100**

The candidates are required to attempt five questions but not more than three questions from any section.

Section (A) General Plant Physiology

- 1- Introduction, Scope of plant physiology, Bio-energetics, structure and function of cell and cell wall.
- 2- Soil-plant-water relations; Absorption, translocation, evaporation, osmotic quantities.
- 3- Mineral element; Absorption, translocation and role of micro and macro-nutrients (elements), deficiency and toxicity symptoms, deficiency diseases.
- 4- Translocation and mobilization of solutes (cellular traffic)
- 5- Growth and development; Dynamics of growth processes, factors effecting growth, chemical regulation of growth, mode of action and physiological effects of growth substances: auxins, Gibberellins, cytokinins, abscisic acid, phenolic compounds, ethylene, morphactins.
- 6- Physiology of seed germination, dormancy, abscission and senescence, effects of various growth substances on these processes.
- 7- Reproductive physiology: physiology of flowering, photoperiodism, vernalization, role of growth substances in flowering.

Section (B) Crop Physiology

- 1- Water requirement of crops and water logging
- 2- Physiological principles of dryland crop production

- 3- Physiology of rooting in plants
- 4- Physiology of tuber and bulb formation
- 5- Physiology of fruit ripening
- 6- Post harvest physiology of fruits and tuber crops
- 7- Stress physiology: salt, water and frost resistance in crop plants in relation to recent hypotheses
- 8- Weeds and weed control.
- 9- Role of anti-Transpirants in arid agriculture.

PAPER V

Cytology & Molecular Biology

M.M. 100

The candidates are required to attempt five questions but not more than three questions from any section.

Section (A) Cytology

- 1- History of Cytology.
- 2- Cytological techniques, killing, fixation, staining, isolation of cell and cell organelles.
- 3- Ultra-Structure of cell and cell organelles, their origin & functions
- 4- Ultra structure, organization and function of nucleus in prokaryotes and eukaryotes.
- 5- Chromosomes. Morphology, Ultra- structure, different types of chromosomes, chemical organization, functions and significance.
- 6- Euchromatin and heterochromatin. Ultra-structure, distribution and significance.

- 7- cell cycle, cell division, details of crossing-over and chiasmata formation.
- 8- Structural Changes in the chromosomes their significance and cytological details.

Section (B) Molecular Biology

- 1- Chemistry and Biosynthesis of DNA : Replication of DNA, DNA Polymerase and ligase (Mechanism of action) : synthesis of biologically active viral DNA replication of tumor viruses, reverse transcription.
- 2- Chemistry and biosynthesis of RNA : RNA polymerase, polynucleotide, phospholylase, replication of RNA viruses
- 3- Operon modal of regulation of protein synthesis in prokaryotes; inducible systems; repressible systems, lactose, arabinose and histidine operations lamda phase regulation.
- 4- Transcriptional control; mechanistic details of transcriptions sigma and rho factors, processing of RNA.
- 5- Post transcriptional and translational control
- 6- Molecular biology of extra-chromosomal DNA and viruses, plasmids, chloroplast mitochondrial and other organells DNA : DNA & RNA viruses amplification and cloning.
- 7- Introduction of genetic materials into cells; sexual and parasexual means of genetic transfer in bacteria, difference between prokaryotes and eukaryotes at the information transfer level; homologous and heterologous gene transfer.

PRACTICAL

1. Determination of the minimum size of quadrat by species-area-curve Method.
2. Determination of the minimum number of quadrats by species—area-curve method.

3. Determination of quantitative characters such as Density, Relative Density, Abundance and Percentage frequency of different species by quadrat method.
4. Determination of Important-Value-Index (IVI) of different species.
5. Preparation of Frequency diagram as suggested by Raunkiaer.
6. Determination of cover and basal area of dominant species.
7. Preparation of biological spectrum of a locality on the basis of life-forms.
8. Study of root system of various category of plants.
9. Determination of above and underground biomass by harvest method.
10. Germination studies in petridishes.
11. Determination of seed output and reproductive capacity.
12. Study of physical and chemical characters of the soil by rapid field tests.
13. Determination of the water holding capacity of the soil.
14. Evaluation of soil pH.
15. Determination of chlorophyll by calorimetry.
16. Estimation of calorific values of plant materials by Bomb-calorimetry.
17. Growth analysis of plants : Evaluation of relative growth rate (RGR), Net Assimilation rate (NAR), Leaf Area Ratio (LAR) and Leaf Area Index (LAI).
18. To study the productivity of any cultivated crop in terms of biomass and energy.
19. To study allelopathic effect of certain weeds on some crops.
20. To study the effect of some climatic, edaphic and biotic factors on the growth of plants.
21. To determine pore volume percentage (porosity) of the given soil sample.
22. To find out different types of soil water in the given soil sample.

Botany

M. Sc. (Final)

PAPER VI:

Morphology. Taxonomy of Angiosperms and Economic Botany

The candidate will be required to attempt Five questions in all. Question No. 1 will be compulsory, it shall be of, objective type and should cover the entire syllabus of the paper. For the remaining four questions the candidate shall attempt one question from section 'A' two from Section 'B' and one from section 'C'

SECTION—VI 'A'

Morphology

1. Origin and evolution of Angiosperms.
2. Morphology of flower and its organs particularly—
Stamens and carpel, Placentation, Ontogeny of floral organs.

SECTION-'B'

Taxonomy of Angiosperms

1. Definition, scope and importance of taxonomy as the basis of Botanical science.
2. History of Plant Taxonomy (Due emphasis is to be given to Indian work).
3. Principles of Plant Taxonomy. International Code of Botanical Nomenclature,

4. Field and herbarium techniques. Floristics, Botanical Gardens. Important Herbaria and Botanical survey etc.
5. Modern trends in Plant Taxonomy including bearing on Cytology, Embryology, Anatomy Biochemistry, Palynology, etc.
6. Important systems of Classification. Detailed study of Systems Proposed by Bentham Hooker, Engler & Prantl, Bessey Hutchinson, Takhtajan and Cronquist.
7. Vegetative and floral characters, economic importance and affinities of the following families (Special reference to the flora of Rohilkhand and the adjacent areas)

Magnoliaceae	Annonaceae	Cannabinaceae
Moraceae	Cactaceae	Tiliaceae
Sterculiaceae	Euphorbiaceae	Combretaceae
Rhamnaceae	Vitaceae	Sapindaceae
Anacardiaceae	Verbenaceae	Chenopodiaceae
Nymphaeaceae	Polygonaceae	Onagraceae
Amaranthaceae	Lythraceae	Solanaceae
Rfimulaceae	Campanulaceae	Lentibulariaceae
Scrophulariaceae	orobanchaceae	Alismaceae
Oxalidaceae	Boraginaceae	Typhaceae
Butomaceae	Hydrocharitaceae	Orchidaceae
Potamogetonaceae	Commelinaceae	
Dioscoreaceae	Agavaceae	
Poaceae		

students are also expected to have a complete knowledge of the families which they have read at the B. Sc. level.

SECTION-'C'**Economic Botany**

1. Plants and their value in the service of the mankind.
 2. Fibres— Cotton Flax, Jute, Hemp and Coir, Elementary knowledge of textile and paper industries in India.
 3. Timbers Woods—their identification properties and uses. Details of Teak, Shisham, Saal, Chir, Deodar, Neem, Mango, Babul and Jamun.
 4. Tannins
 5. Dyes
 6. Gums and Resins
 7. Rubber and latex
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| General account, plant part from which these are obtained. Method of extraction and uses. |
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8. Oils—Essential oils, their properties, antibiotics methods of extraction and uses.
 9. Fatty oils General account and detailed study of ground nut, peanut, sesame. Musturd, coconut cotton seed, castor, linseed and sunflower oils.
 10. Sugars—Sugar cane and sugar beet.
 11. Medicinal plants: Details of Aconitum, Ephedra, Gugal, Atropa, Aloe; Tulsi, Neem, Bhang, opium, Catharanthus, Nuxvomica, Isabgul, Cinchona, Sarp-gandha, Artemisia and other important local plants.
 12. Spices:—Ginger, Turmeric, Asafoetida, Cinnamon, Clove. Black-peper and Chillies,
 13. Beverages: Non - alcoholic-coffee, Tea, Coca, Alcoholic- General account.
 14. Fumitories and masticatories: Tobacco, Betel and Betel nut.
 15. Concise knowledge of origin and evolution of crop plants and including their centres of origin.
 16. Ethnobotany: General account.

paper VII**Plant Anatomy, Plant Embryology & Morphogenesis**

The candidates will be required to attempt five questions, two questions from section 'A', two from section 'B' and one from section 'C'

SECTION 'A'**Plant Anatomy**

1. History of plant anatomy.
2. Techniques of Anatomy, Section cutting, Mounting and Microscopy.
3. Primary meristems. Basic structure of shoot and root apices.
4. Vascular cambium, its organization and seasonal activity, anomalous secondary growth, cork cambium, its structure, organization and its derivatives.
5. Phloem and Xylem.
6. Nodal anatomy.
7. Leaf:-general features, Epidermis structure, ontogeny. distribution and systematic value of stomata and trichomos.
8. Anatomy of flower, fruit and seed.
9. Modern trends in the study of Anatomy.

SECTION—B**PLANT EMBRYOLOGY**

1. History of Embryology.
2. Micro sporogenesis and male-gametophyte.
3. Megasporogenesis and female gametophyte.

4. Fertilization.
5. Endosperm.
6. Embryo, seed and fruit its development.
7. Apomixis, Polyembryony and Parthocarpy.
8. Experimental embryology with particular reference to the work Carried out in India.
9. Modern trends in Embryology.

SECTION—C

PLANT MORPHOGENES

1. Aims and scope, including phenomenon of Morphogenesis, correlation Symmetry, Polarity, Regeneration Totipotency Sex expression and flowering.
2. Morphogenetic factors, physical, Chemical and genetical.
3. Techniques and application of plant tissue culture (with special) reference to Indian contribution).
4. Centres of Morphogenetic work done in India.
5. Modern trends in Plant Morphogenesis.

Paper VIII

Ecology, Soil science and Phytogeography.

The candidates are required to attend 5 questions, 3 questions from section A and 2 questions from section B. Q. 1 will be compulsory and it shall be of the objective type and should cover the entire syllabus and the paper.

SECTION—A**ECOLOGY**

1. Introduction and scope of ecology.
2. Environmental factors, Climatic, edaphic, biotic and topographic.
3. Plant Succession, hydrarch xerařch, succession, climax concept.
4. Biological spectrum and life forms.
5. Limnology : The freshwater environment and limiting factors. Ecological classification of freshwater organism. Brief description of lentic (standing water) and lotic (running water) communities.
6. Autecology— objectives, importance, methods of study.
7. Vegetational analysis : Methods of studying vegetation analytical and synthetic characters of the community.
8. Ecosystem concept and its components, types of ecosystem, Energy flow trophic levels, food chain and food webs, pyramid of numbers, biomass and energy, biochemical cycles.
9. Production ecology : Measurement of primary production, quantitative, measurements of primary productivity in terrestrial and aquatic environments, Ecological efficiency.

10. Ecotypic concept:- Climatic, edaphic and biotic ecotypes; Ecads Gene-ecology.
11. Pollution-air, water and soil, with special reference to nuclear and noise pollution, control, measures, remote sensing and satellite imageries, bio-indicators of pollution.
12. Important centres of ecological researches in India.

SECTION—B

SOIL SCIENCE AND PHYTOGEOGRAPHY

1. Definition, classification and physical and chemical characteristics of soil.
2. Development of soil, soil profile, effects of climate and vegetation on the developments of soil profile.
3. Different types of soils in India.
4. Problems and prospects of saline soils and alkaline soils and their reclamation.
5. Soil erosion and conservation.
6. Phytogeography—Principles and problems of plant distribution, endemism, floristic regions and vegetation types of India.

PAPER IX**Biochemistry and photo Biology****Section (A)****BIOCHEMISTRY****M. M. 100**

Attempt any five questions, All questions carry equal marks.

1. Biochemical basis of life.
2. The cell—its biochemical organisation.
3. Physical and chemical phenomenon in Biochemistry.
 - A. Laws of thermo- dynamics.
 - B. Activation of energy.
 - C. pH scale
 - D. Chemical potential.
 - E. Redox potential.
 - F. Stiocheiometry and calculation of empirical formulae in biological systems.
4. Water—The basic molecule of life : Molecular structure, Physical and chemical properties in relation of life processes.
5. Carbohydrate metabolism.
6. Carbohydrate and lipids.
7. Nucleic acids, purines, pyrimidines, nucleotide & nucleosides, molecular structure of DNA & biosynthesis, structure RNA and biosynthesis, ariulor DNA viral DNA viral RNA.
8. Biological Nitrogen fixation, Importance, source of nitrogen, and mechanism of Nitrogen fixation, Nitrogenase (structural subunits and properties, control of biosynthesis).

9. Structure and biosynthesis of amino acids and proteins, Source of Nitrite—Nitrate reduction, amides, amino acids and protein synthesis.
10. Carbon assimilation, photosynthesis & glyoxylate pathway, productivity.
11. Release of energy, importance of energy auxiliaries, Respiration, P-phosphate pathway & importance.
12. Enzymes, structure, properties, mode of action and regulation, kinetics, coenzymes.
13. Vitamins.
14. Alkaloids and steroids.
15. Biological membranes, Biochemical components, unit membrane hypothesis, molecular organization, Transport across membrane phosphorylation and Na-K pump, energisation of active transport.
16. Cyclic AMP, A metabolic rejuvenation of second, structure, biosynthesis and degradation, glycogen metabolism.
17. Biochemical control of gene expression, Induction of enzyme, repression, feedback inhibition B-Galactosidase, regulation control of enzyme synthesis operon.
18. Tools and techniques, Spectrophotometry paper chromatography column chromatography Thin layer chromatography Ion exchange chromatography, Gas liquid chromatography, gel filtration, polyacrylimide gel electrophoresis chromatofocussing atomic absorption spectrum photometry.

SECTION (B)

PHOTOBIOLOGY

1. **Bioluminescence.**
2. **Phytochromes.**
3. **Photoblasticity in seeds.**

paper-X**Genetics, plant breeding and biostatistics**

The candidates will be required to attempt five questions, two from section 'A' and two from section 'B' and one from section 'C'

SECTION (A)**GENETICS**

1. Mendelism and interaction of factors, chisquare test.
2. Linkage, chromosome mapping, interference, and coincidence.
3. Qualitative and quantitative characters, multiple gene hypothesis.
4. Fine gene analysis : Nature and concept of gene, types of genes, structure, function and expression.
5. Allelism, multiple alleles, pseudoalleles, isoalleles and pleiotropy.
6. Genetics of microbes, virus, bacteria and Neurospora, E. coli and cancer.
7. Sex determination and sex linked inheritance. (Special reference to plants).
8. Ex.ra-nuclear inheritance.
9. Gene mutation, molecular basis of mutation, their induction, isolation and significance.
10. Genetic engineering, gene recombination technology, gene counselling, gene therapy and clinical genetics.

SECTION (B)**PLANT BREEDING**

1. Plant breeding : Introduction, objects and significance.

2. Methods of plant breeding in relation to self pollinated and cross pollinated crops.
 - (a) Introduction and acclimatization.
 - (b) Selection, Mass, Pureline and clonal.
 - (c) Hybridization : Techniques, types, significance and achievements. Back-cross methods of breeding.
 - (d) Breeding for disease pest, frost, drought and lodging resistance.
3. Hybrid vigour (Heterosis) theories and significance.
4. Male sterility and incompatibility.
5. Role of mutations in evolution and plant breeding.
6. Variation in chromosome number. Its role in evolution and plant breeding of crops.
7. Genome analysis, Monosomic analysis, Chromosome substitution and Allelic substitution.
8. A concise account of the plant breeding work done in India on wheat, Maize, Cotton, Sugar cane and potato. Latest evolved varieties suitable for different agro-climatic regions of the country.

SECTION (C)

BIOSTATISTICS

1. Statistics and its application in genetics and agriculture.
2. Introduction to statistical constants : Mean, Mode, Median Deviation, S.D. and S. F.
3. Normal distribution curve, Representation by graphs and Population.
4. Correlation.
5. Analysis of variance, 't' test 'F' test and C.D.

M.Sc. Final**Botany Practical**

It will be of 12 hours duration spread over two days and shall carry 200 Marks. The broad distribution shall be as under—

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|---|---------|
| 1. Taxonomy : Two plants for description. | 12+8=20 |
| 2. Anatomy : Normal or Anomalous structures, one material. | 12 |
| 3. Embryology : Embryo dissection, study of pollen grains and their germination (Vivo & vitro) | 06 |
| 4. One Ecology experiment under field conditions. | 12 |
| 5. One soil Science experiment. | 05 |
| 6. One experiment from Biochemistry. | 20 |
| 7. One experiment from Photobiology. | 05 |
| 8. Seed or flower mixture showing F_2 segregation for Mendelin. ratio or modifications. | 15 |
| 9. Preparation of a twig for hybridization, underfield or lab and the method applied. | 10 |
| 10. An exercise on Biometry or Genetics. | 05 |
| 11. Spots : 1 to 10. | 30 |
| This will be from Marphology. Eco. Botany (2-3) Embryology, Ecology, soil ecology, soil sci. Biochemistry and cytogeneties. | |
| 12. Viva-voce. | 20 |
| 13. Collections and Excursions. | 20 |
| 14. Sessional practical rccord. | 20 |

Total m.m. 200
