RTM, NAGPUR UNIVERSITY, NAGPUR.

SEMESTER PATTERN SYLLABUS
FOR B Sc. BOTANY

B. Sc. SEMESTER- I
- PAPER-I Viruses, Prokaryotes & Algae
- PAPER-II Fungi, Lichen, Plant-Pathology & Bryophyta

B. Sc. SEMESTER-II
- PAPER-I Pteridophyta & Gymnosperms
- PAPER-II Palaeobotany & Morphology of Angiosperms

B. Sc. SEMESTER-III
- PAPER-I Angiosperm Taxonomy
- PAPER-II Cell Biology, Plant Breeding & Evolution

B. Sc. SEMESTER-IV
- PAPER-I Angiosperm Anatomy & Embryology
- PAPER-II Genetics & Molecular Biology

B. Sc. SEMESTER-V
- PAPER-I Biochemistry & Plant Physiology-I
- PAPER-II Plant Ecology I

B. Sc. SEMESTER-VI
- PAPER-I Plant Physiology- II & Biotechnology
- PAPER-II Plant Ecology- II, Techniques & Ethnobotany

SEMESTER – I
PAPER – I

VIRUSES, PROKARYOTES AND ALGAE

Unit I

Virus: General characteristics and nature of Viruses, Classification of Viruses based on Host.
Ultra structure of TMV,Structure and Multiplication of T4 - Bacteriophage. Economic importance.
Mycoplasma-Morphology, Properties and Pathogenicity

Unit II

Bacteria:- Cell structure, Cilia, Flagella. Reproduction: (Binary fission, Conjugation). Economic importance. Cyanobacteria - General account, Ultra cell structure, Reproduction, Economic Importance. eg. *Nostoc.*

Unit III

Algae – Classification (Fritsch 1954), Economic importance Life history of: - *Oedogonium, Chara*.

Unit IV

Algae - Life history of *Vaucheria, Ectocarpus, Batrachospermum* Note:- Developmental stages not expected

List of Practicals :

Study of Bacterial forms from permanent micropreparation Gram staining of Bacteria
Study of Cyanobacteria: *Nostoc*. Study of Algal genera: *Oedogonium, Chara, Vaucheria, Ectocarpus, Batrachospermum*

PAPER – II
FUNGI, LICHEN, PLANT PATHOLOGY, BRYOPHYTA

Unit I

Fungi - Classification (Alexopoulos 1979), Economic importance Life history of: - *Albugo, Mucor*

Unit II

Fungi- Life history of :- *Puccinia, Cercospora* Lichens - Types, Reproduction and Economic importance

Unit III

Plant pathology: – Host, pathogen, symptoms, Causes and Control of following diseases:- Leaf curl of Papaya, Citrus canker and Red rot of Sugarcane Bryophyta:– Classification (Proskauer 1957), General characters (Hepaticopsida, Anthocerotopsida and Bryopsida), Economic importance, alteration of generation

Unit IV

Life history of: - *Marchantia, Anthoceros, Funaria* Note developmental stages not expected

List of Practicals :

Study of Fungal genera : *Albugo, Mucor, Puccinia, Cercospora*
Study of Lichen - Thallus structure, Types
Plant pathology – Leaf curl of Papaya, Red rot of Sugarcane, Citrus canker
Study of Bryophytes : *Marchantia, Anthoceros, Funaria*
Botanical Excursions (One short excursion is compulsory).

Semester I Practical examination
Question Paper
Time : 5 hrs Marks : 30

Q. 1) Gram Stain the given Bacterial strain / Stain the Cyanobacterial material [A], & Identify **04**
Q. 2) Identify & give characters of the given Algal material [B]and make a temporary Mount **04**
Q. 3) Identify & give characters of the given Fungal material [C] and make a temporary Mount **04**
Q. 4) Identify & give characters of the given Bryophytic material [D] and make a temporary Mount **04**
Q. 5) Spotting : **06**
H- Virus/Bacteria/Cyanobacteria I- Algae J- Fungi
K - Bryophyte L- Plant pathology M- Lichen
Q. 9) Viva-voce **03**
Q. 10) Practical Record & Excursion Report **05**

SEMESTER – II
PAPER – I
PTERIDOPHYTA & GYMNOSPERMS

Unit I

Pteridophyta -Classification system (Smith 1952), General characters (Psilopsida, Lycopsida Sphenopsida and Pteropsida), Economic importance, alternation of generation Life history of: - *Rhynia*, *Selaginella*

Unit II

Life history of the following: - *Equisetum*, *Marsilea* Concept of heterospory and seed habit

UNIT III

Gymnosperms: - Classification (Stewart 1982), General characters, Economic importance, alternation of generation Life cycle of the following- *Cycadeoidea* (Stem and flower), *Cycas*

UNIT IV

Morphology (Vegetative and reproductive) and anatomy of the following taxa: - *Pinus*, *Ephedra*

NOTE: Developmental stages not expected.

List of Practicals

Study of Pteridophytes : *Rhynia*, *Selaginella*, *Equisetum*, *Marsilea*

Study of Gymnosperm: *Cycas*, *Pinus*, *Ephedra*

SEMESTER – II
PAPER – II
PALAEOBOTANY & MORPHOLOGY OF ANGIOSPERMS

Unit I

Palaeobotany: Geological time scale, Fossilization: Replacement theory, Infilteration theory

Types of fossils: Impression, Compression, Petrifaction, Fossil plants: Gymnosperms: *Glossopteris* (Leaf),

Unit II-

Root Morphology - Tap root & adventitious roots, Modifications for storage, Respiration & reproduction.

Stem Morphology:- Branching (Monopodial, Sympodial), modifications(Runner,Rhizome, Tuber, Bulb).

Leaf Morphology:--Typical Leaf, Types(Simple, Compound), Phyllotaxy, Venation, and modifications of leaf(Tendril,Phyllode)

Unit III-

Inflorescence: Simple (Racemose and Cymose type), Compound and Special Inflorescences.

Flower: Details of typical flower, Epigyny, Perigyny & Hypogyny, Androphore, Gynophore & Gynandrophore. Calyx & Corolla- Cohesion, Aestivation.

Unit IV

Flower: Androecium - Parts, Cohesion & Adhesion, Fixation, dehiscence . Gynoecium- Parts, Cohesion , Adhesion, Placentation. Floral formula & Floral diagram. Fruit: Classification of fruits, simple and aggregate fruits, Composite fruit.

List of Practicals

Fossils : Types, *Glossopteris*, *Cycadeoidea*

Study of Root: Types, Modifications.

Study of Stem: Branching, Modifications.

Study of Leaf: Parts, Stipules, Phyllotaxy, Veination & Modifications.

Inflorescence: Types.

Flower: Parts, Thalamus, Calyx, Corolla, Androecium, Gynoecium.

Fruits: Types.

Botanical Excursion (Two short or One long out of the state is compulsory).

SEMESTER – III
PAPER – I
ANGIOSPERM TAXONOMY

Unit I

Origin of Angiosperms (Benettitalean theory). Fossil angiospers: Flower (Sahanianthus), fruit (*Enigmocarpon*)

Angiosperm Taxonomy : Brief history, Aims, Floras, keys (Indented and Bracketed). Botanical Nomenclature: Principles (rank and ending of taxa, principle of priority, synonyms and related definition). Modern trends in Taxonomy: Cytotaxonomy (Karyotype), Phytochemistry (Proteins, flavonoids) , Taximetrics to taxonomy

Unit II

Classification of angiosperms: Natural, Artificial, Phylogenetic system of classification. Systems of classification: Bentham & Hooker and Engler & Prantl (merits and demerits)

Unit III

Study of Families (Dicot): Ranunculaceae, Brassicaceae, Fabaceae (Papilionoideae, Caesalpinioidae, Mimosoidae)

Unit IV

Study of Families (Dicot): Asteraceae, Asclepiadaceae, Euphorbiaceae Study of Families (Monocot): Alismataceae, Poaceae

List of Practicals

Study of Families covered in the theory portion

Study of fossil Angiosperms micropreparation and specimens: *Sahanianthus*, *Enigmocarpon*

Botanical Excursions (Two short or One long out of the state is compulsory).

SEMESTER – III
PAPER – II
CELL BIOLOGY, PLANT BREEDING & EVOLUTION

Unit I

Structure of typical plant cell. Ultrasturcture and functions of: Cell wall, Cell Membrane (Fluid mosaic model), Nucleus, Endoplasmic reticulum (RER and SER)

Unit II

Ultrastructure & Functions of: Golgi Complex, Vacuoles, Ribosomes (70S and 80S), Mitochondria, Chloroplasts, Glyoxysomes & Peroxisomes

Unit III

Chromosome organization: Morphology (chromatid, chromomere, centromere, telomere, secondary. constriction, satellite, karyotype), Molecular organization (Nucleosome model). Sex Chromosome : Structure of sex chromosome in plants (XY type in *Melandrium*). Cell cycle: Various phases of cell cycle and their significance (G1, S, G2 and M phase). Cell division in plants: Mitosis, Meiosis and their significance

Unit IV

Plant Breeding- Definition and objective, Pure line selection, Hybridization (emasculation, bagging, crossing, labelling), Colonal selection, Heterosis (Definition and scope). Biostatistics- Mean, Mode, Median, Standard deviation, Standard error, Student's t- test. Population genetics: Hardy-Weinberg's law. Evolution- Origin of life (Millers theory), Neo-Darwinism

List of Practicals

Study of Cell organelles with the help of photographs/ Slides

Study of mitosis in plant material

Study of meiosis in plant material

To calculate standard error from the given data (Atleast 10 problems to be solved)

To calculate the student's t-value from the given data (Atleast 10 problems to be solved)

SEMESTER – IV
PAPER – I
ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit I

Basic body plan & Modular type of Growth. Meristems : Classification of meristems based on origin and position. Permanent tissue and their functions: Simple tissue (parenchyma, collenchyma, sclerenchyma), Complex tissue (xylem and phloem) & Secretary tissue (laticiferous and glandular).

Unit II

Apical meristem of Root and Shoot: Apical cell theory, tunica-corpus theory, Types of root apex according to Newman. Primary structure of root in dicot (Sunflower) and monocot (Maize). Primary structure of stem in dicot (Sunflower) and monocot (Maize). Types of vascular bundles- dicots and monocots. Cambium (structure, types, function)

Unit III

Periderm, growth ring, sap wood, heart wood. Secondary growth (Sunflower stem) and anomalous secondary growth in *Bignonia* and *Dracena* stem. Anatomy of leaf: Dicot (Nerium), monocot (Maize). Senescence and abscission of leaves.

Unit IV

Pollination: Types and adaptation, significance. Structure of anther, Microsporogenesis, ultrasturcture of pollen grain and male gametophyte. Types of ovules, structure of anatropous ovule. Megasporogenesis and female gametophyte (polygonum type). Double fertilization and triple fusion, endosperms and its types, development of dicot embryo (Onagrad type).

List of practicals

Study of simple tissue, complex tissue and secreatory tissue from permanent slides
Study of types of vascular bundles
Study of internal structure of dicot and monocot root using hand section and prepare temporary mounts -Sunflower, Maize
Study of internal structure of dicot and monocot stem using hand section and prepare temporary mounts -Sunflower, Maize
Study the growth ring in woods-Teak wood
Study of internal structure of secondary growth and anomalous secondary growth using hand section and prepare permanent micropreparations - Bignonia stem and Dracena stem.
Study of internal structure of leaves- Nerium, Maize
Study of types of ovules, anther structure, pollen grains, adaptations for pollination
To calculate the percent pollen germination in the given specimen
Botanical Excursions (One short tour is compulsory).

SEMESTER- IV
Paper-II
Genetics & Molecular Biology

Unit- I

Mendelism: - Laws of inheritance (Law of segregation and independent assortment). Interaction of genes: Allelic- Incomplete dominance (1:2:1 ratio in *Mirabilis jalapa*); Non-allelic- Complementry (9:7 ratio) and Dominant epistasis (12:3:1 ratio). Linkage: Definition, Theory of linkage (Coupling and Repulsion theory), types (complete and incomplete), significance

Unit- II

Crossing over: Definition, theories (Breakage and reunion, copy choice), significance. Variation in chromosome number: Polyploidy (auto- and allo-), aneuploidy (nullisomics, monosomics, trisomics and tetrasomics), significance. Structural changes in chromosome: Deletion & deficiency, duplication, inversion and translocation

Unit- III

Mutation: Spontaneous and induced, substitution and frame-shift mutations, physical and chemical mutagens, application of induced mutations in crop improvement. DNA damage and repair: Photoreactivation, excision repair. Structure of DNA (Watson and Crick model). Semi conservative method of DNA replication in eukaryotes. Concept of gene, structure of eukaryotic gene, overlapping genes

Unit- IV

Satellite and repetitive DNA. Genetic code: Definition and characteristics. t-RNA (Clover leaf model). Gene expression in prokaryotes: Transcription and translation. Organization of genetic material: Split gene, overlapping gene. Regulation of gene expression (Lac operon model)

List of practicals

To prove the Mendel's law of segregation with the help of coloured beads.
To prove the Mendel's law of independent assortment with the help of coloured beads.
From the given data workout the type of gene interaction in the given cross (Atleast 10 problems of each type mentioned in theory syllabus).

SEMESTER – V
PAPER – I BIOCHEMISTRY & PLANT PHYSIOLOGY-I

Unit I

Carbohydrates: Definition, properties and role; Classification: Aldoses and ketoses; monosaccharides, disaccharides and polysaccharides; Structure of Glucose and starch. Lipids: Definition, properties and role; fatty acids, oils and waxes, phospholipids, sphingolipids, sterols. Aminoacids- Chemistry of amino acids present in proteins (Classification), peptide bond

Basics of Enzymology: Nomencleture, Characteristics and properties of Enzymes, factors affecting enzyme activity, Holoenzyme, Apoenzyme, Co-enzymes & Co-factors, Regulation of Enzyme Activity (Enzyme-Substrate Complex Theory), Mechanism of Action (Lock & Key Model, Induced Fit Model)

Unit II

Plant-water relations: Properties of water, diffusion, diffusion pressure deficit and its significance; Osmosis: Concept, types, osmotic potential and its significance; Imbibition: concept and significance. Water conduction through xylem: Root pressure theory, cohesion-adhesion theory; transpiration; stomatal opening mechanism with reference to K+-malate hypothesis. Phloem transport: Munch hypothesis

Unit III

Mineral nutrition: Role and deficiency symptoms of macro- and micro- nutrients (N, P, Fe, Mn, B , Ca); Solute transport: passive (Donnan's equilibrium), active (carrier concept). Lipid metabolism: Glyoxylate cycle and beta- oxidation. Respiration: Structure of ATP, types (aerobic and anaerobic respiration), respiratory substrates and Respiration quotient, glycolysis, Kreb's cycle, oxidative phosphorylation (ETS), chemiosmotic potential theory; fermentation (alcohol and lactic acid), photorespiration

Unit IV

Photosynthesis: concept, definition, significance, photosynthetic pigments and their role, action spectra, Emerson's enhancement effect, red drop mechanism; photolysis of water (Hill's reaction), cyclic and non-cyclic photophosphorylation, Light independent reactions: C3, C4 and CAM pathways and their significance; factors affecting photosynthesis. Nitrogen metabolism: Mechanism of biological nitrogen fixation, importance of nitrate reductase

List of practicals

To study the effect of various chemicals on permeability of membranes.
To study the ascent of sap in suitable plant material.
To separate chlorophyll pigment by paper chromatography.
To determine the RQ of given plant material.
To perform microchemical tests for determination of reducing and non-reducing sugars, starch, cellulose, oils and proteins.
To study the effect of light intensity and quality, CO2 concentration and temperature on rate of photosynthesis by suitable method.
To determine osmotic potential of the cell sap by plasmolytic method.
To study the activity of enzyme amylase, catalase and peroxidase.

SEMESTER – V
PAPER – II PLANT ECOLOGY - I

Unit I

Ecology: definition, branches and significance of ecology. Climatic Factors: Atmospheric (Gaseous composition), Light & Temperature (effect on vegetation)

Unit II

Edaphic Factor : Pedogenesis, Soil profile, Soil properties (physical and chemical). Physiographic factor- Biotic Factor: Interactions between plants and animals and human, Interaction between plants growing in a community, Interactions between plants and soil microorganisms.

Unit III

Ecosystem: Biotic and Abiotic components, Food chain, Food web, Ecological pyramids. Biogeochemical Cycles: Nitrogen

Autecology (definition, importance), ecad, ecotype- characteristics and importance. Synecology (or community ecology)- Study of community: analytical (quantitative- frequency, density, abundance; qualitative- Life forms, Raunkier's Biological spectrum) and synthetic characters (presence, fidelity, dominance)

Unit IV

Plant succession: Definition, Causes of succession, Hydrosere, Xerosere. Plant adaptations: Morphological, Anatomical & Physiological responses of Hydrophytes, Xerophytes, Halophytes (with one example)

List of practicals:

To determine frequenct, density, abundance of the community by quadrate method.
To determine the homogeneity of vegetation by Raunkiers frequency diagram.To study the morphological and anatomical characteristics of anyone hydrophyte and xerophyte.
To study the morphological characteristics of cladode, phylloclade, phyllode and pneumatophores.
To determine the water holding capacity of the given soil samples.
To determine the water rising capacity of the given soil samples.
To determine the soil moisture of the given samples.
Botanical Excursions (One short tour is compulsory).

SEMESTER – VI
PAPER – I
PLANT PHYSIOLOGY-II & BIOTECHNOLOGY

Unit I

Growth: Concept, growth curve, phases of growth. Phytochromes: Pr and Pfr forms, their role
Circadian rhythms and biological clock. Plant growth regulators: Role of auxin, cytokinins, gibberilins, ABA and ethylene
Plant movements: Tropic and nastic movements

Unit II

Photoperiodism: physiology of flowering, photoperiodism and vernalization, role of florigen. Senescence and abscission
Seed dormancy: Causes and role, methods to break seed dormancy. Plant defence: Definition: Hypersensitive response and Systemic acquired resistance; Role of secondary metabolites (Terpenes and phenolic compounds)

Unit III

Plant tissue culture: History, definitions of- totipotency, explant, asceptic culture, in vitro, micropropagation; methods of sterilization (autoclaving, dry heat, chemicals), culture media (MS media). Callus and organ culture (shoot tip, leaf disc, anther, ovary, ovule and endosperm) and its application. Protoplast culture and its application, cybrid production. Cell suspension culture and its application

Unit IV

Genetic engineering: Tools- Enzymes (Restriction enzymes, ligases, DNA polymerases), Vectors (Plasmid vectors- cloning and expression vector). DNA library: cDNA and gDNA library. Introduction of rDNA into host: Calcium chloride mediated cell transformation. *Agarobacterium tumefaciens* mediated gene transfer, structure of Ti plasmids. Advantages and disadvantages of transgenic plants

List of Practicals

To determine seed viability by a convenient method
Principle and working of: oven, autoclave, laminar air flow hood
To study the structure of following vectors on the basis of photographs and diagrams: plasmid vector, Binary vector
To study the effect of various plant growth regulators on the growth and development of plants

SEMESTER – VI
PAPER – II
PLANT ECOLOGY, TECHNIQUES & ETHNOBOTANY

Unit I

Principles of Phytogeography, Distribution (wides, endemics, discontinuous species), Theories (Landbridge and continental drift), Climatic regions of India, Phytogeographic regions of India (Chatterjee 1962; Name, distribution area, typical vegetation)

Unit II

Environmental Pollution: Agricultural. noise and thermal pollution, Control of environmental pollution, Environmental management
Natural resources- types (renewable and non-renewable), factors for depletion; conservation of forest and water resources

Unit III

Principle, types and application of: microscopy (Light, fluorescent, phase contrast, electron), centrifugation, electrophoresis (SDS-PAGE and Agarose), spectroscopy (UV-Vis), chromatography (Paper chromatography, Thin layer chromatography)

Unit IV Ethnobotany

Introduction, definition, branches & importance of ethnobotany
Ethnic societies of India & their contribution
Plants of Ethnobotanical importance: classification of ethnobotanical plants on the basis of their use; Source of (5 each): vegetables, fruits and seeds, medicinal plants and narcotics (family, parts used and tribal area)

List of Practicals

Principle and working of: spectrophotometer, microscope etc.
To determine the DO of water samples from different sources.
To study the dust holding capacity of leaves.
To estimate transparency, pH and temperature of different water bodies
To estimate salinity (chlorides) of different water samples.
To determine the percent leaf-area injury of different leaf samples collected around polluted sites.
To study the plants of ethnobotanical importance.
Botanical Excursions (One short tour is compulsory).

List of Reference Books

SEM I & II

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