

Department of Botany
VIVEKANANDA COLLEGE

Question Bank

(Theory)

B.Sc. Botany Honours

University of Calcutta

Part I

Paper I: Module I

Algae

Type A

- What is girdle lamella? Where is it found? (2)
- What is flagellar root? (2)
- What is physiological anisogamy? (2)
- Name an alga used as biofertilizer and another used as a source of carrageenan. (2)
- What is meant by haplobiontic life cycle? Give an example. (2)
- Name a motile coenobial and a heterotrichous alga. (2)
- What is meant by the term stichonematic? (1)
- Name one hydrocarbon-producing alga? (1)
- Name one potential algal genus used for β -carotene production. (1)
- What is carrageenan? (1)
- Name one potential algal genus used for biodiesel production. (1)
- Name an alga used as food. (1)

Type B

- Write a short note on the evolution of sex in algae. (5)
- Write a note on the structure and function of the heterocyst of cyanobacteria. (5)
- Write a note on auxospore formation in centric diatoms. (5)
- Briefly describe apical cap formation in *Oedogonium*. (5)
- Describe the stages of development of globule and nucule of *Chara*. (5)
- Give a brief account of the ultrastructure of plastids in algae. (5)

Type C

- Compare the reproductive structure and the mode of reproduction of two algal genera having oogamous type of reproduction. (8+7)
- With the help of suitable illustrations differentiate between unilocular and plurilocular sporangia. Add a note on the auxospore formation in pinnate diatoms with the help of a flow chart. (8+7)
- What is isomorphic alternation of generations? Enumerate the life cycle pattern of *Ectocarpus* with suitable diagrams. Mention the source and importance of algin. (3+8+4)
- Briefly describe the ultrastructure of the cyanobacterial cell. What changes are observed during heterocyst differentiation? Name one non-heterocystous cyanobacterial genus which can fix nitrogen. (8+5+2)
- What is triphasic alternation of generations? Describe the sexual reproductive process of *Polysiphonia*. State the post-fertilization changes in it with the help of diagrams. (2+6+7)
- What is apical cap? How does the nannandrous species of *Oedogonium* differ from the macrandrous species? Describe the sexual reproduction the nannandrous species of *Oedogonium*. (2+3+10)

Microbiology

Type A

- What are endoflagella? Cite one example. (2)
- All episomes are plasmids but all plasmids are not episomes. Justify. (2)
- What is Hfr strain? (2)
- What are mollicutes? (2)
- What are prions? (2)
- What are actinobacteria? (2)
- What are prions? (1)
- Name a bacterium used for amylase production. (1)
- Name a dextran-producing bacterium. (1)
- What are viroids? (1)
- What is pseudomurein? (1)
- What is conjugative plasmid? (1)

Type B

- Distinguish between Archaea and Bacteria. (5)
- Illustrate the structure and function of bacterial endospore. (5)
- Outline the industrial production of vinegar. (5)
- Describe the mechanism of generalized transduction. (5)
- Give a brief account of the structure of bacterial flagella. (5)
- Give an account of the structure of TMV. (5)

Type C

- Draw and describe the ultrastructure and development of bacterial endospores. Distinguish cell wall chemistry of Gram positive and Gram negative bacteria. (7+8)
- Enumerate the structure of a Gram negative bacterium with suitable diagrams. Briefly describe the structure and function of glycocalyx. (6+3+4+2)
- Mention the role of the various proteins associated with the bacterial genome. What is positive supercoiling? What are the characteristics of plasmid? What is plasmid compatibility? Give example of a high copy number plasmid. (5+2+4+3+1)
- What is competence? Distinguish natural and induced competence. Distinguish between generalized and specialized transduction. Write the basic difference between F^+ x F^- and Hfr x F^- conjugation in bacteria. (1+2+7+5)
- Distinguish between lytic cycle and lysogenic cycle of bacteriophages. Describe molecular mechanism of lysogeny in λ phage. Comment on the significance of lysogeny. (5+7+3)
- Discuss the different steps of TMV multiplication. Describe the mode of transmission of plant viruses. Give an outline of the commercial production of streptomycin. (5+4+6)

Paper I: Module II

Fungi & Lichen

Type A

- What is sporodochium? (2)
- What is macronematous conidiophore? (2)
- What is fruticose lichen? Give an example. (2)
- What is gymnohymenial ascocarp? Give an example. (2)
- Distinguish between pycnia and pycnidia. (2)
- What are fruticose lichens? Give an example. (2)
- What is macronematous conidiophore? (1)
- Name one predacious fungus. (1)
- What is synnemata? (1)
- What is spawn in mushroom cultivation? (1)
- What is pseudoplasmodium? (1)
- Name a dye-yielding lichen. (1)

Type B

- Parasexuality differs from sexuality: Justify. (5)
- Write a brief note on endotrophic mycorrhiza. (5)
- Write a short note on food value of *Pleurotus* sp. (5)
- Give a brief account of heterothallism in fungi. (5)
- What are the different types of lichens? Give examples. (3+2)
- State the ecological and economic importance of lichens. (5)

Type C

- Write a brief explanatory note on heterothallism and sexuality in fungi. Discuss the spore dispersal mechanism in fungi with suitable sketches. (8+7)
- Describe with neat sketches the asexual phases of life cycle of an endobiotic fungus. Outline the industrial production of cheese. Name the source fungus of tryptophan, α -amylase and cyclosporin A. Name one aflatoxin producing organism. (6+5+3+1)
- Describe structure and development of apothecium of a coprophilous fungus. Write a brief account of different spore forms in fungi. (4+6+5)
- Differentiate between masticomycotina and zygomycotina. Discuss spore dispersal mechanism in fungi with suitable example. Draw, label and describe the structural features of *Agaricus* (3+6+6)
- With suitable examples, describe the different types of asexual fruit bodies in fungi. Write a brief note on degeneration of sex in fungi. (10+5)
- Outline Ainsworth's (1973) classification of fungi. Schematically describe the cultivation procedure of *Pleurotus*. Explain the role of mycorrhiza in agricultural forestry. (6+5+4)

Plant Pathology

Type A

- Distinguish prophylactic and therapeutic treatment of plant diseases. (2)
- What do you mean by hypertrophic symptom? Name one. (2)
- What is meant by disease concept? (2)
- Define pathogenicity and resistance. (2)
- Distinguish between necrotroph and biotroph. (2)
- Distinguish between sign and symptom? (2)
- What is inoculum? (1)
- What is pure culture? (1)
- What is antibiosis? (1)
- What is meant by prophylaxis? (1)
- What is etiology? (1)
- Name one organomercurial fungicide. (1)

Type B

- Discuss the role of quarantine in plant disease management. (5)
- Define pathotoxin. Describe their characteristic features with suitable examples. (1+4)
- Differentiate between SAR and ISR. (5)
- Write an explanatory note on disease triangle. (5)
- Discuss the role of quarantine in plant disease management. (5)
- Write a short note on integrated plant disease management. (5)

Type C

- Describe the symptoms, disease cycle and control measures of Bacterial blight of rice. Name and describe the causal organism. (4+5+4+2)
- Evaluate the role of phytoalexin in plant defence mechanism. Write in brief the role of systemic acquired resistance (SAR) in plants. What is suppressive soil? (7+6+2)
- Explain the role of enzymes in penetration of host by the pathogenic fungi. Write in brief the role of PR protein and ROS in SAR in plants. (7+8)
- Discuss in brief the biochemical defence mechanism in host plant after pathogen infection. Characterise pathotoxin with examples. (10+5)
- Differentiate between prophylactic and therapeutic treatment of plant disease. Briefly discuss the techniques followed in biological control of plant diseases. How is it advantageous over chemical control? (4+9+2)
- Describe the symptoms, disease cycle and control measures of stem-rot of jute. Name the causal organism. (4+6+4+1)

Paper II: Module III

Bryophytes

Type A

- Define apophysis. (2)
- What is the theory of progressive sterilization? (2)
- Distinguish between chloronemal branches and rhizoidal branches. (2)
- Mention the functional difference between amphithecium and endothecium. (2)
- What is epicranoid type peristome tooth? Give an example. (2)
- Why bryophytes are called amphibious plants? (2)
- Name an Indian bryologist. (1)
- Name the largest class of bryophytes. (1)
- What are pseudoelaters? (1)
- Name a monoecious species of Anthoceros. (1)
- What is meant by stegocarpic moss? (1)
- What is calyptra? (1)

Type B

- Write short notes on Diagnostic characters of Hepaticopsida. (5)
- Write short notes on homologous theory of origin of alternation of generations. (5)
- Write short notes on algal origin of bryophytes. (5)
- Write short notes on role of bryophytes in monitoring pollution. (5)
- Write short notes on progressive sterilization of the sporophyte in bryophytes. (5)
- Write short notes on capsule of *Funaria*. (5)

Type C

- Outline Proskauer's classification (1957) of bryophytes up to class with salient characters and examples. Compare the photosynthetic tissues of *Marchantia*, *Anthoceros* and *Funaria* with proper diagrams. (6+9)
- Characterize the class Anthocerotopsida. Describe the structure of sporophyte in *Anthoceros* with illustrations. Briefly mention its evolutionary advancements. (3+6+3)
- What are the fates of the amphithecium and endothecium in *Marchantia*, *Anthoceros* and *Funaria*? Briefly describe the homologous theory. Add a note on the role of bryophytes in plant succession. (3+6+6)
- Discuss the evolution of sporophyte in bryophytes in the light of the two major schools of thoughts. Add a brief note on the algal origin of bryophytes. (10+5)
- Describe spore dispersal mechanism of *Funaria*. Briefly discuss the antithetic theory. Add note on the pteridophytic origin of bryophytes. (4+6+5)
- Compare the vegetative reproduction in *Marchantia* and *Funaria* with diagrams. Add a note on the role of bryophytes in pollution monitoring. (9+6)

Paleobotany & Palynology

Type A

- What are coal balls? (2)
- Which period is called the age of ferns? Explain. (2)
- Mention the periods of the Palaeozoic era in an ascending order. (2)
- What are pre-pollens? Give an example. (2)
- Distinguish spore from pollen. (2)
- State the chemical nature of sporopollen. (2)
- Which type of rock is best suited for preservation of fossils. (1)
- Name the index fossil of Indian Upper Gondwana. (1)
- What is amber? (1)
- Give an example of a pre-pollen. (1)
- Draw the equatorial view of a tricolporate pollen grain. (1)
- What is palaeopalynology? (1)

Type B

- Briefly describe the Middle Gondwana flora. (5)
- Write short notes on geological time scale. (5)
- Write short notes on applications of fossil study in Botany. (5)
- Briefly outline the role of palynology in solving criminal cases. (5)
- Write short notes on sporoderm stratification. (5)
- Write notes on importance of palynology in apiculture. (5)

Type C

- What is taphonomy? Describe with suitable examples the various modes of preservation of plant fossils according to Schopf (1975). Add a brief note on index fossils. (2+10+3)
- Define fossil. Describe the conditions favouring fossilization. Briefly state the importance of palaeobotany in fossil fuel exploration. (2+8+5)
- Give an account of the principles of naming plant fossils with suitable examples. Describe the principles of fossil plant reconstruction with illustrative examples. (8+7)
- Distinguish between microspores, pre-pollens and pollens. Describe with suitable sketches the NPC system. Compare sporoderm stratification according to Erdtman (1969) and Faegri (1964). (4+6+5)
- Compare and contrast spores and pollens. Describe their different apertures types with examples. State the application of palynology in relation to allergy in humans. (2+4+6)
- What is palynology? Give illustrated account of exine ornamentation pattern in spores and pollens with examples. Add a note on the importance of palaeopalynology. (2+8+5)

Embryology

Type B

- Describe different types of embryo sac development in angiosperms. (5)
- Write short note on embryogenesis in *Capsella*. (5)
- Briefly describe growth of pollen tube and its entry into the ovule. (5)
- Describe and distinguish apogamy from apospory. (5)
- Describe monosporic and bisporic embryo sac development. (5)
- Briefly describe embryogenesis in *Capsella*. (5)
- Write short note on types of polyembryony and its causes. (5)
- Write short note on microgametogenesis. (5)
- Write short note on megagametogenesis. (5)
- Write briefly on double fertilization and its significance. (5)
- Describe the events in relation to pollen germination and pollen tube growth. (5)
- Write short notes on pollen-ovule ratio and its significance. (5)

Part II

Paper III: Module V

Pteridophytes

Type A

- Name two pteridophytic taxa used as food. (2)
- Mention the morphological nature of trabeculae in *Selaginella*. (2)
- Name a pteridophyte used in agriculture and why? (2)
- Give two fern characters of *Psilotum*. (2)
- Give the geographical and geological distribution of *Calamites*. (2)
- What are parichnos strands and where are they found? (2)
- What are carinal canals? (1)
- Name a pteridophyte used as pesticide. (1)
- Give the morphological nature of elaters in *Equisetum*. (1)
- What is glossopodium? (1)
- Name two Palaeozoic arborescent (reconstructed) pteridophyte genera. (1)
- Why are the Rhynie chert beds of Scotland famous? (1)

Type B

- Write short notes on synangium of *Psilotum*. (5)
- Write short notes on prothallus of *Dryopteris*. (5)
- Describe the gametophyte of *Psilotum* with suitable diagram. (5)
- Explain the morphological nature of rhizophore. (5)
- Discuss in brief the early events in relation to the colonization of land plants. (5)
- Write short notes on hydrasperman reproduction. (5)

Type C

- Describe the gametophyte of *Psilotum* with suitable diagrams. State the morphological nature of the synangium of *Psilotum*. Mention its fern characters. (9+3+3)
- Distinguish *Equisetum* and *Calamites* on the basis of their stem anatomy and strobilar organization. State how the elementary processes of telome concept help in explaining the origin of reproductive structures in Lycopsida and Pteropsida. (3+4+4+4)
- Define telome. Describe the elementary process of the telome concept. Explain with this concept the origin of reproductive structures in Psilopsida and Sphenopsida. (2+5+4+4)
- Define heterospory. Mention the binomial of a heterosporous, ligulate pteridophyte from eastern India. Discuss the phenomenon of the origin and evolution of seed habit. How far has *Selaginella* reached the level of seed habit? (2+1+8+4)
- Describe with suitable sketches the structure of the sporophyte of *Rhynia major*. Why this fossil plant was renamed *Aglaophyton major*? Add a note on its probable gametophyte. (8+2+5)
- Name the different organ genera of *Lepidodendron*. Draw and describe the structure of its leaf cushion, stem anatomy and strobilus. (4+3+5+3)

Gymnosperms

Type A

- Mention two fern characters of *Cycas*. (2)
- What is cleavage polyembryony? In which gymnosperm does it occur? (2)
- Name two species of *Gnetum* of two different habits. (2)
- Distinguish between manoxylic and pinoxylic wood. (2)
- Mention two characters of progymnosperms that are distinct from gymnosperms. (2)
- Name a fossil plant reconstructed by Birbal Sahni and mention its geological age. (2)
- What is corallothiza? (1)
- Which gymnosperm possesses archegonium with longest neck? (1)
- Name a drug-yielding taxon of gymnosperms. (1)
- Name the source plant of Canada balsam. (1)
- For which organ was the name *Cordaites* originally used? (1)
- State the geological distribution of any palaeozoic seed fern. (1)

Type B

- State the geographical distribution of *Cycas* species in India. (5)
- Write a note on the coralloid root of *Cycas*. (5)
- Describe the embryogeny in *Pinus*. (5)
- State the economic importance of gymnosperms with examples. (5)
- Discuss the phylogenetic importance of *Archaeopteris*. (5)
- Draw and describe the structure of the seed of *Cordaites*.

Type C

- Give a comparative account of the development of the male and female gametophytes of *Pinus* and *Gnetum*. Describe the anatomical structure of the leaf of *Pinus*. (5+5+5)
- What is polyembryony? Differentiate the stem anatomy of *Pinus* and *Cycas*. State the modern view of the morphological nature of ovuliferous scale of *Pinus*. (2+10+3)
- What is transfusion tissue? What are the principal cell types in the transfusion tissue of *Pinus*? What is its function? Differentiate the leaf anatomy of *Pinus* and *Cycas*. (2+2+1+10)
- Draw and describe the male fructifications of *Cycas* and *Gnetum*. Discuss the angiospermic features of *Gnetum*. (5+5+5)
- State the habit of the reconstructed fossil plant *Lyginopteris oldhamia*. Describe with suitable sketches the structure of its male and female reproductive structures (mention the organ genera). What is hydrasperman reproduction? (2+5+5+3)
- State the organ genera of *Williamsonia sewardiana*. What is its distribution in space and time? Describe with labelled sketches its male and female fructification. (3+2+5+5)

Paper III: Module VI

Ecology & Plant Geography

Type A

- Differentiate between habitat and niche. (2)
- What do you mean by alpha and gamma diversity? (2)
- What are metallophytes? Give an example. (2)
- Distinguish between autogenic and allogenic succession. (2)
- Define ecocline. (2)
- Define carrying capacity. (2)
- What is meant by climax community? (1)
- What is core habitat? (1)
- What is recalcitrant seed? (1)
- What is cryoprotectant? (1)
- What is relic endemic? (1)
- Name a plant endemic to the Andaman and Nicobar region. (1)

Type B

- Write notes on role of phytoremediation to clean-up environmental pollutants. (5)
- Describe the role of seed bank in the conservation of plant diversity. (5)
- Discuss the characteristic features of a plant community. (5)
- Write a brief note on GIS in environmental monitoring. (5)
- Write a brief note on role of cryopreservation in conservation of biodiversity. (5)
- Write short notes on floristic composition of Sundarban. (5)

Type C

- Describe the various seral stages of a hydrosere. State the importance of GIS in environmental studies. (10+5)
- Define biodiversity. Briefly discuss *in situ* and *ex situ* conservation methods of biodiversity. Mention the criteria for a biodiversity hotspot. Name one hotspot in India. (2+4+4+4+1)
- What do you mean by ecotone and edge effect? What is sere? Describe the various seral stages of a xerosere. (2+2+2+9)
- Discuss briefly the floristic composition of lower Gangetic plain. Give a concise account of phytoremediation indicating its role to clean up polluted environments. (9+6)
- Enumerate the phytogeographical regions of India according to D Chatterjee (1960). Discuss the floristic composition of Eastern Himalayan region. (6+9)
- What is endemism? Prepare a concise account of the different types of endemics and the factors associated with endemism. Describe the age and area hypothesis and the epibiotic theory. (2+6+2+5)

Anatomy

Type A

- Distinguish between alburnum and duramen. (2)
- What are tylosoids? Where are they found? (2)
- What are leaf traces and leaf gaps? (2)
- Distinguish between tracheids and trachea. (2)
- What is tylosis? Where is it found? (2)
- What is the chemical composition of the middle lamella? (2)
- What is plastochrone? (1)
- What is stereome? (1)
- What is plastochrone? (1)
- What are stone cells? (1)
- What is lenticel? (1)
- What is periderm? (1)

Type B

- Write short notes on anomalous secondary growth in *Tecoma* stem. (5)
- Write short notes on the körper-kappe theory. (5)
- Write short notes on ontogeny of trachea. (5)
- Write short notes on ontogeny of sieve tube. (5)
- Write a short note on the types of stomata in monocots. (5)
- Discuss the anatomical adaptations of xerophytes. (5)

Type C

- What are stomata? Describe with suitable diagrams and examples the types of stomata in dicots and monocots. Add a note on the ontogeny of stoma. (2+4+4+5)
- What is vascular cambium? Describe with suitable diagrams the normal intra-stellar secondary growth in the dicot stem. Add brief notes on the structures of the periderm and the lenticel. (2+8+5)
- What is mechanical tissue? Briefly outline the types of mechanical tissues found in plants. Describe with suitable diagrams and examples the principles of their distribution in the plant body. (2+6+7)
- What is stele? Describe the different types of stele found in vascular plants. Add a brief note on its evolution. (2+8+5)
- What is secondary growth? Describe with diagrams the intra-stellar secondary growth in dicot stem. Add a note on the anomalous secondary growth in *Bignonia* stem. (2+8+5)
- Draw and describe the different types of or protostele. Briefly explain the lycopsid line of evolution. Add a note on the invasion and expansion theories. (8+3+4)

Paper IV: Module VII

Morphology of Angiosperms

Type B

- With suitable illustrations describe the different types of aestivation of corolla. (5)
- With suitable sketches describe the different forms of corolla. (5)
- With sketches describe the different types of attachment of anther to the filament. (5)
- With suitable illustrations describe different types of dry fruits. (5)
- Describe cyathium and verticillaster inflorescences with sketches and examples. ($2\frac{1}{2}+2\frac{1}{2}$)
- Distinguish between gynostagium and gynostemium. Describe cohesion of stamens with suitable drawings and examples. ($2\frac{1}{2}+2\frac{1}{2}$)
- Draw and label the different parts of an angiospermic ovule. Make suitable drawings to distinguish between amphitropous and campylotropous ovules. Cite an example of each (3+1+1)
- Distinguish between simple and composite fruits. Describe hesperidium and balausta with examples. ($2+1\frac{1}{2}+1\frac{1}{2}$)
- Distinguish between racemose and cymose inflorescences. Describe helicoids and scorpioid cymes with sketches and examples. (1+2+2)
- Distinguish between marginal and parietal placentations. Make suitable drawings to explain axile and free-central placentations and cite one example to each. ($2+1\frac{1}{2}+1\frac{1}{2}$)
- Distinguish between aggregate and multiple fruits. With examples define cypsela and caryopsis. ($2+1\frac{1}{2}+1\frac{1}{2}$)
- Distinguish between syngenesious and synandrous anthers. Describe adhesion of stamens with suitable drawings and examples. ($2\frac{1}{2}+2\frac{1}{2}$)

Taxonomy of Angiosperms

Type A

- Name two botanic gardens in West Bengal. (2)
- Name the largest herbarium in India and state its acronym. (2)
- Distinguish between bracketed and indented keys. (2)
- Distinguish between α -taxonomy and β -taxonomy. (2)
- Distinguish between phenetics and cladistics. (2)
- What is autonym? Give an example. (2)
- Define taxometrics. (1)
- What is phenon line? (1)
- Define apomorphy. (1)
- Define lectotype. (1)
- Define plesiomorphy. (1)
- Explain the author citation: *Swertia beddomei* Clarke in Hook.f. (1)

Type B

- State importance of herbaria in taxonomic study. Define acronym, give example. (3+2)
- Discuss the importance of botanica gardens with special reference to conservation. (5)
- Mention the cytological characters used in taxonomic study. State one example of to show how cytological characters are used to solve taxonomical problems. (3+2)
- Mention the plesiomorphic features of a monocotyledonous family studied by you. Mention the systematic position of this family according to Bentham and Hooker. (4+1)
- State diagnostic features of the family Orchidaceae and state its advanced features (3+2)
- Name the phytochemical characters used in taxonomic study. State how plastid characters are used to solve taxonomical problems. (2+3)

Type C

- Why is Bentham and Hooker's classification considered pre-Darwinian in concept and post-Darwinian in publication? Give an outline of this classification up to series. Mention three merits and three demerits. (1+8+6)
- Distinguish between natural and phylogenetic systems of classification. Give a broad outline of Cronquist's system of classification (1988) up to sub-classes. Mention the merits and demerits. (2+8+2½+2½)
- Define nomenclature type. Define the nomenclature type used in ICBN. Define single and double author's citations. Explain the use of *et al.* and *ex* along with the names of authors. Mention 4 rules for valid publication of the name of a taxon. (1+7+1+2+4)
- Comment on the rule of priority. With an example give the limitations of the principle of priority. Mention the rules of effective publication. Mention the primitive features of the family Magnoliaceae. Write five principles of ICBN. (3+2+2+3+5)

- State salient features of Leguminosae and Cucurbitaceae. Name the subfamilies of Leguminosae and state their distinguishing features. Give botanical names of two economically important plants belonging each of the two families. (8+3+4)
- State salient features of Umbelliferae (Apiaceae) and Gramineae (Poaceae). Mention their systematic positions according to the classification of Bentham and Hooker. Give botanical names of an economically important plant belonging to the families Solanaceae and Palmae and state their respective uses. (9+2+4)

Part III

Paper V: Module IX

Biochemistry

Type A

- What is Henderson–Hasselbalch equation? (2)
- Why pH 7 is considered as neutral pH? (2)
- Name two metallozymes. (2)
- What is meant by anomer? Cite example. (2)
- What do you understand when a fatty acid is abbreviated as 18:1 (Δ^9)? (2)
- What do you mean by covalent and non-covalent bonds? (2)
- Define buffer. (1)
- Define isozymes. (1)
- What is isoelectric point? (1)
- Why all proteins do not have quaternary structure? (1)
- Name a sulphur-containing amino acid? (1)
- What are membrane lipids considered amphipathic molecules? (1)

Type B

- Water behaves both as an acid and a base: explain. (5)
- What is free energy? What is its significance in a biochemical reaction? (2+3)
- Elucidate the allosteric regulation of enzymes with a suitable example. (5)
- Describe the major forms of RNA on the basis of their structure and function. (5)
- The peptide bond is rigid and planar: explain. (5)
- Describe with diagrams the α -helix. How is it stabilized? (5)

Type C

- Deduce the Michaelis-Menten equation of enzyme kinetics involving a single substrate and a single product. Classify enzymes according to IUBMB at the level of classes only with one example for each. (6+6)
- What is phosphorylation? Distinguish between oxidative and photophosphorylation. Describe the chemiosmotic model of ATP synthesis in mitochondria. (2+3+10)
- Define symport and antiport with examples. Distinguish between active and passive ion uptake in plants. What is G-protein? Mention its role in signal transduction. (3+5+2+5)
- Describe the structure of nucleotides. State the salient features of the Watson and Crick model of DNA along with sketches. Distinguish between B- and Z-DNA. (3+7+5)
- Distinguish between simple and compound lipids. Describe with suitable examples and diagrams the structure of phosphoglycerides. Explain their amphipathic nature. Describe the different glycosphingolipids with examples. (3+7+2+3)
- What are stereoisomers and enantiomers? Distinguish between monosaccharides and polysaccharides. Give a brief account of the polysaccharide types in plants. (2+3+10)

Pharmacognosy

Type B

- Discuss the importance of pharmacognosy in modern medicine. (5)
- Give an outline of interrelationship of basic metabolic pathways with secondary metabolite biosynthesis. (5)
- What are crude drugs? Write down the differences between primary and secondary metabolites. (2+3)
- Write a short note on the organoleptic evaluation of drugs. (5)
- Write a short note on the classification of drugs on the basis of chemical constituents and therapeutic effects with examples. (5)
- Write a short note on the protective action of flavonoids against pathogens and herbivores. (5)

Type C

- Mention the source plant, parts used and uses of the following pharmacologically active constituents: vinblastin, digitoxin, curcuminoid, quinine and catechin. (5+5+5)
- Mention the source plant, parts used and uses of the following pharmacologically active constituents: gingerol, diosgenin, curcuminoid, reserpine and strychnine. (5+5+5)
- Write down chemical and pharmacological classification on drugs. Write a brief note on protective action of secondary metabolites against pathogenic microbes and herbivores. (8+7)
- With suitable examples explain how terpenoids, phenolics and alkaloids play important roles in the defence of plants against pathogens and herbivores. (5+5+5)
- Define primary and secondary metabolites. Describe the different modes of evaluation of drugs with examples. (5+10)
- Mention the importance of pharmacognosy in modern medicine and the physical evaluation of drugs. Name two secondary metabolites. Comment on the role of secondary metabolites in plant defence against pathogenic microbes. (4+3+2+6)

Paper V: Module X

Plant Physiology

Type A

- Explain why the water potential of a cell is usually a negative value. (2)
- Name the plant and plant parts where brassinosteroid was first identified. (2)
- Distinguish between osmotic pressure and turgor pressure. (2)
- What is the soil-plant-atmosphere continuum concept? (2)
- Comment on the dual activity of RUBISCO. (2)
- What is the triple response of ethylene? (2)
- What is incipient plasmolysis? (1)
- Name one antitranspirant. (1)
- Why diffusion pressure deficit is called suction pressure? (1)
- Draw the chemical structure of kinetin. (1)
- What is the significance of the Emerson enhancement effect? (1)
- What is biological clock? (1)

Type B

- Comment on the role of blue light in the opening and closing of stomata. (5)
- Describe the mechanism of phloem loading and unloading. (5)
- Point out the amphibolic role of the TCA cycle. (5)
- Write a short note on nitrate assimilation in plants. (5)
- Mention the role of ethylene in fruit ripening.
- Enumerate the different methods of breaking seed dormancy. (5)

Type C

- Crassulacean acid metabolism is an eco-physiological adaptation of the desert plants: justify, with biochemical details. How do CAM plants differ from C_4 plants? (10+5)
- Why oxidative pentose phosphate pathway is called shunt pathway? Schematically describe the pathway with the structures of the substrates and products, and name the enzyme involved in each case. Mention the significance of the pathway (2+10+3)
- Why is CO_2 fixation in C_4 pathway more expensive than C_3 pathway? Reactions of the dark phase of photosynthesis are light-regulated: justify. (7+8)
- Write the biochemical events involved in nitrogen fixation in symbiotic plants. What are nodulin and *nif*-gene cluster? (7+4+4)
- Name a natural and a synthetic auxin and give their chemical structures. Describe and schematically represent the different steps of IAA biosynthesis from tryptophan. Briefly state the mechanism of GA-induced α -amylase synthesis in cereals. (3+8+4)
- What is photoperiodic induction? Discuss the role of phytochrome in flowering. Why do *Hyoscyamus* (LDP) and *Xanthium* (SDP) both flower when under 14-hr light, 10-hr dark photoperiod? Comment on the role of low temperature in flower induction. (2+5+3+4)

Paper VI: Module XI

Cell Biology

Type A

- What is meant by karyotype? (2)
- What is histone tail? What is its function? (2)
- Define ribozyme and cite an example. (2)
- What is apoptosis? (2)
- What is MPF? (2)
- State the two functions of the centromere. (2)
- What are protamines? (1)
- What is SAR? (1)
- What is RNA world?
- Which is the basic repeating unit present in telomeric DNA? (1)
- What are apoptotic bodies? (1)
- What is apoplatic movement? (1)

Type B

- Write short notes on the chemical composition of eukaryotic chromatin. (5)
- Write short notes on histone tails. (5)
- Write short notes on nuclear lamina. (5)
- Write short notes on nuclear pore complex. (5)
- Write short notes on apoptosis. (5)
- With the aid of schematic diagrams only explain how cell cycle checkpoints function and how MPF triggers mitosis. (5)

Type C

- What is NOR? Describe with suitable diagrams the ultra-structure of the nucleolus. Describe the mechanism of ribosome biogenesis. (2+5+8)
- Describe with diagrams the packaging of DNA into eukaryotic chromosomes. What is packing ratio? Describe with labelled diagrams the structure of nucleosome. (4+2+9)
- What is organellar DNA? Give a brief account of chloroplast DNA. Describe with suitable sketches the origin of the eukaryotic cell according to the endosymbiotic theory. (2+6+7)
- What are the major phases of the cell cycle? What is the significance of the G₀ phase? What are cell cycle check points? Describe the role played by MPF in cell cycle regulation. (2+2+4+7)
- Discuss the dynamics of chromosome movement with illustrations. Mention the structural organization of the telomere and how it protects its DNA? (10+3+2)
- Describe cell cycle regulation in *Saccharomyces cerevisiae*. Add a note on the structure of its centromeric DNA. What is the function of the centromere? (10+2+3)

Plant Breeding & Biometry

Type A

- Give two differences between pedigree and bulk method. (2)
- Mention two applications of back cross method in plant breeding. (2)
- Mention two limitations of cytoplasmic male sterility. (2)
- State Hardy-Weinberg law and define null hypothesis. (2)
- State the law of addition of probability and write down its formula. (2)
- Mention two factors on which Hardy-Weinberg equilibrium depends. (2)
- Write the full form of NBPGR. (1)
- What is hybrid seed? (1)
- Define restorer line in male sterility. (1)
- Give the formula to calculate mode from grouped data with regular class interval. (1)
- Define sample. (1)
- What is standard error of the mean? (1)

Type B

- Compare the procedure in pure line and mass selection. (5)
- Characterize male sterility and state its significance in crop improvement. (5)
- Mention the use of DNA markers in plant breeding. (5)
- What is hybrid vigour? Describe the method of hybrid seed production. (1+4)
- Write a note on different devices adopted for maintaining the germplasm. (5)
- Discuss the theories to explain genetic causes of heterosis. (5)
- What is students t- test? Distinguish between paired and unpaired t- test. (1+4)
- Explain the addition and multiplication rules of probability using suitable examples. (5)
- What is meant by chi-square test? What is its significance? (2+3)
- A tall homozygous pea plant (TT) bearing yellow pods (YY) was crossed with a dwarf plant (tt) having green pods (yy). The F_1 plants were all tall and yellow podded and on selfing gave rise to F_2 plants in the following frequencies: tall yellow 120, tall green 10, dwarf yellow 10 and dwarf green 20. Using chi-square analysis, determine whether the genes T and Y assort independently. Tabulated $\chi^2 = 7.8$ at p 0.005 for 3 degrees of freedom. (5)
- A variety of rice was grown in 10 different plots supplied with fertilizer (NPK) and was measured for its yield (in quintals/hectare). Another 10 plots of similar size and growth conditions but without NPK served as control. Determine whether the fertilizer has a significant effect on the yield of rice.

Plot no	1	2	3	4	5	6	7	8	9	10
Yield with NPK	10	12	8	14	12	9	7	7	13	6
Yield without NPK	13	9	14	12	10	13	15	11	14	10

Tabulated $t = 2.10$ at p 0.005 for 18 degrees of freedom. (5)

- Grain lengths of a rice variety are as follows:

Grain length (mm)	9-11	12-14	15-17	18-20
No of plants	3	5	9	3

Calculate mean, coefficient of variation and standard error. (1+2+2)

- From the supplied data:

Class value	48	50	52	54	56	58
Frequency	8	32	75	52	28	5

Calculate mean, median, mode and standard deviation. (1+1+1+2)

- From the supplied data:

Class Interval	15-17	18-20	21-23	24-26	27-29	30-32	33-35	36-38	39-41
Frequency	5	6	8	12	22	18	15	9	5

Calculate arithmetic mean, median, standard deviation and standard error. (1+1+2+1)

- According to height 200 jute plants were grouped as follows:

Frequency	15	25	65	50	40	5
Height of plants (cm)	60	62	64	66	70	76

Calculate the mean height and the standard deviation. (2+3)

Plant Biotechnology

Type B

- Write notes on the composition of plant tissue culture medium. (5)
- Briefly describe the methods of protoplast culture. (5)
- Write short note on the production of synthetic seeds. (5)
- Write short note on the stages of micropropagation. (5)
- Write a short note on different methods of direct gene transfer in plants. (5)
- Schematically outline the different methods of micropropagation. (5)

Type C

- What is aseptic manipulation? Briefly discuss the different sterilization techniques used in plant tissue culture. Add a detailed note on the application of plant tissue culture in crop improvement with suitable examples. (2+5+8)
- What is callus? What are calliclones? Give a detailed protocol of callus culture with suitable sketches. Add a note on the applications of callus culture. (2+1+7+5)
- What is micropropagation? What are the advantages of *in vitro* propagation over conventional propagation? Compare zygotic and somatic embryogenesis. Discuss the methods of synthetic seed production and its significance. (2+3+4+6)
- What is androgenesis? Anther culture is essentially pollen culture: explain. Schematically describe the protocol for pollen culture. Add a note on the applications of haploid culture in crop improvement. (3+2+6+4)
- Outline the major steps in the isolation of plant protoplasts and add a note on the importance of osmoticum. Enumerate the methods of protoplast fusion and state its significance. (5+2+5+3)
- Briefly describe the different methods of direct gene transfer. Briefly explain with suitable sketches *Agrobacterium*-mediated gene transfer. Add a note on the role of transgenic plants in crop improvement with suitable examples. (4+6+5)

Paper VI: Module XII

Genetics & Molecular Biology

Type A

- What is meant by tautomerism? (2)
- Differentiate between complete and incomplete linkage. (2)
- What is meant by tautomerism? (2)
- State the central dogma. (2)
- What is complementation test? (2)
- What is Shine-Dalgarno sequence? State its function. (2)
- What is pseudodominance? (1)
- What is the primary cause of production of aneuploids? (1)
- What is FISH?
- Define cistron. (1)
- What are Okazaki fragments? (1)
- Which termination codons are recognized by RF1? (1)

Type B

- Describe the meiotic pairing configurations of trisomics. (5)
- Reciprocal translocations result in high degree of pollen sterility: justify. (5)
- Write a short note on synthetic allopolyploids. (5)
- Write short notes on the ABC model in *Arabidopsis*. (5)
- Write short notes on the Ac-Ds system in maize. (5)
- Briefly describe the development of the one-gene one-polypeptide concept. (5)

Type C

- Crossing over involves physical exchange of homologous chromosome segments during meiosis: give experimental proof. Explain the origin of amphidiploids during evolution. Name an amphidiploids crop mentioning its somatic chromosome number. (8+5+2)
- What is base substitution and frame shift mutation? Name two base analogues and discuss the molecular mechanism of their incorporation and its effects. Add a note on DNA repair mechanisms. (1+2+8+5)
- What is semi-conservative replication? Briefly describe with suitable diagrams the mechanism of DNA replication on *E. coli*. Explain the high fidelity of this process. (3+8+4)
- Define genetic code and state its properties. Justify degeneracy based on the wobble hypothesis. Discuss triplet-binding technique of deciphering the genetic code. (7+4+4)
- Briefly describe the mechanism of amino acid activation. Describe with suitably labelled diagrams the steps involved during translation in a bacterial cell. State the differences between the translation in prokaryotic and eukaryotic cells. (3+9+3)
- Characterize restriction endonucleases? Briefly describe pBR322. Outline the steps of the gen cloning. Distinguish between genomic and cDNA library. (3+3+6+3)

- A homozygous recessive plant (*abc*) was crossed with a homozygous dominant plant (*ABC*). The F_1 hybrid was test crossed with the following results: *ABc* 4, *aBC* 173, *AbC* 26, *aBc* 24, *Abc* 167, *abC* 6, *abc* 298 and *ABC* 302. Are the loci linked? Give reason. Determine the relative order and map distances between the loci. Calculate the coefficient of co-incidence and interference. (1+12+2)
- A three factor test cross yields the following data: *ABC/abc* 475, *abc/abc* 469, *Abc/abc* 7, *aBC/abc* 8, *ABc/abc* 0, *abC/abc* 0, *AbC/abc* 18 and *aBc/abc* 23. Give the gene order and map distances between them. Determine the coefficient of co-incidence and interference. (13+2)
- Three recessive genes are found in corn: *btl* (brittle endosperm); *gl* (glossy leaf) and *rg* (ragged seedling). A trihybrid of was test crossed producing the following off springs: *btl gl rg* 441, *btl gl+* 58, *+ +rg* 53, *+gl+* 11, *+++* 421, *btl + rg* 14, *+gl rg* 1 and *btl++* 1. What is the order of the three genes? Calculate the map distances between the three genes. Calculate the coefficient of coincidence and interference. (2+10+3)
- A plant heterozygous for three gene pairs (*AaBbCc*) was test crossed and 1000 progenies of the following genotypes were obtained : *ABc* 424, *abC* 376, *aBc* 9, *AbC* 6, *abc* 90, *ABC* 95, *aBC* 0 and *Abc* 0. Draw a linkage map showing the order of genes. Calculate coefficient of coincidence and interference? (10+3+2)