KHALSA COLLEGE AMRITSAR

(AN AUTONOMOUS COLLEGE)

P.G. DEPARTMENT OF BOTANY

SYLLABUS

FOR

M.Sc. BOTANY SEM I & II

M.Sc. (Hons.) - BOTANY SEM III & IV

SESSION- 2015 -16

M.Sc. Botany
Scheme of Course
Semester I
Session 2016-2017

S.No.	Code (Course No.)	Subject (Course Title)
1	BOT C511	Algae
2	BOT C512	Fungi and Plant Pathology
3	BOT C513	Genetics and Evolution
4	BOT C514	Plant Physiology
5	BOT C515	Computer Programming in Botany and Ecology
6	BOT C516	Theoretical Biology
7	BOT C551	Botany Practicals I (Based on BOTC511, BOTC512 & BOTC513)
8	BOT C552	Botany Practicals II (Based on BOTC514, BOTC515 and BOTC516)

M.Sc. Botany
Scheme of Course
Semester II
Session 2016-2017

S.No.	Code (Course No.)	Subject (Course Title)
1	BOT C521	Bryophytes and Pteridophytes
2	BOT C522	Diversity and Biology of Gymnosperms
3	BOT C523	General Microbiology
4	BOT C524	Cell Biology
5	BOT C525	Computer applications, Networking and Internet
6	BOT C526	Ecological Modelling and Remote Sensing
7	BOT C561	Botany Practicals I (Based on BOTC521, BOTC522 BOTC523)
8	BOT C562	Botany Practicals II (Based on BOTC524, BOTC525 and BOTC526)
9	BOT C563	On Job Training or Assignment

M.Sc. Botany
Scheme of Course
Semester III
Session 2016-2017

S.No.	Code (Course No.)	Subject (Course Title)
1	BOT C611	Diversity and Biology of Angiosperms
2	BOT C612	Development Botany
3	BOT C613	Plant Molecular Biology
4	BOT C614	Plant Breeding and IPR
5	BOT C615	Plant Biochemistry
6	BOT C616	Applied Botany
7	BOT C651	Botany Practicals I (Based on BOTC611 and BOTC612)
8	BOT C652	Botany Practicals II (Based on BOTC613 and BOTC614)
9	BOT C653	Botany Practicals III (Based on BOTC615 and BOTC616)
10	BOT C654	Assignment/ Industry Research Report/ Institutional Training Report
11	BOT C655	Research Techniques

M.Sc. Botany
Scheme of Course
Semester IV
Session 2016-2017

Sr.No.	Code (Course No.)	Subject (Course Title)
1	BOT C621	Plant Anatomy
2	BOT C622	Structure and Metabolism of Plant Hormones
3	BOT C623	Plant Tissue Culture and Biotechnology
4	BOT C624	Analytical Techniques
5	BOT C625	Plant Morphogenesis
6	BOT C722	Plant Physiology and Metabolic Integration
7	BOT C661	Botany Practicals I (Based on BOTC621, BOTC622 and BOTC623)
8	BOT C662	Botany Practicals II (Based on BOTC624 and BOTC625)
9	BOT C663	Field Study
10	BOT C664	Seminar

M.Sc. Botany (Semester-I)

BOT C511 – Algae

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for Paper Setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Habitat and habit, Classification, organization of thallus, structure of algal cell, algal pigments and photosynthetic apparatus.
2. Algal flagella, nutrition, food reserves, reproductive diversity, life history patterns.
3. Chlorophyta (Volvox, Chlorella, Ulothrix, Cladophora, Fritschiella, Oedogonium, Zygnema, Vaucheria).
4. Charophyta (Chara, Nitella).
5. Euglenophyta (Euglena).
6. Phaeophyta (Ectocarpus, Cutleria, Sporochnus, Laminaria, Macrocystis, Dictyota, Fucus, Sargassum).
7. Rhodophyta (Bangia, Porphyra, Batrochospermum, Polysiphonia).
8. Cyanophyta (Chroococcus, Microcystis, Nostoc, Oscillitoria, Rivularia, Scytonema, Spirulina, Stigonema).
9. Cryptophyta (Cryptomonas).
10. Origin & evolution of sex in algae, economic importance of algae, bacterial and fungal pathogens of algae, algae as indicators of water pollution.

Books Recommended

1. Ahluwalia, A.S. (Ed.) (2003). Phycology. Daya Publishing House, New Delhi-110035
2. Bold, H.C. and Wynne, M.J. (1985). Introduction to the Algae. Structure and Reproduction, Prentice Hall Inc. Englewood Cliffs, New York.
3. Kumar. H.D. and Singh, H.H. (1971). A Textbook on Algae, East – West Press Pvt. Ltd. New Delhi.
4. Smith, G.M. (1955). Cryptogamic Botany, McGraw Hill Publication.

5. Smith, G.M. (1955). Cryptogamic Botany. Vol. II, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. Trivedi, P.C. (Ed.) (2001). Algal Biotechnology. Pointer Publishers, Jaipur.

Suggested Practicals

1. Sectioning and permanent mounting of thalli of various species of Cyanophyta, Chlorophyta, Charophyta, Phaeophyta, Rhodophyta.
2. Study of diversity of freshwater and sewage water algae.
3. Preparation of synthetic media and cultivation of algae
4. Interpretation of electron micrograph of some algae.
5. Biochemical analysis of pigments present available in algal species
6. Studies on habit and habitat of various algae
7. Estimation of total carbohydrates from fresh water algae.

M.Sc. Botany (Semester-I)

BOT C512 – Fungi and Plant Pathology

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. History, classification, study of structure, development, reproduction, life history of the following

GYMNOMYCOTA

(i) Acrasiomycetes - a general account
(ii) Protosteliomycetes - a general account
(iii) Myxomycetes : Stemonitis

MASTIGOMYCOTA

Haplomastigomycotina

(i) Chytridiomycetes : Chytriomyces, Allomyces
(ii) Hyphochytridiomycetes : Rhizidiomyces
(iii) Plasmodiophromycetes : Plasmodiophora

Diplomastigomycotina

(i) Oomycetes : Lagenidium, Saprolegnia, and Achlya

AMASTIGOMYCOTA

Zygomycotina

(i) Zygomycetes : Entomophthora and Pilobolus
(ii) Trichomycetes – a general account

2. History, classification, study of structure, development, reproduction, life history of the following

AMASTIGOMYCOTA

Ascomycotina (Ascomycetes)

(i) Hemiascomycetidae: Protomyces and Taphrina
(ii) Piectomycetidae : Talaromyces
(iii) Pyrenomycetidae: Melanospora and Nectria.
(iv) Discomycetidae : Monilinia and Morchella
(v) Laboulbeniomycetidae : Laboulbenia

(vi) Loculoascomycetidae : Mycospharella and Venturia

Basidiomycotina (Basidiomycetes)

(i) Teliomycetidae : Melampsora, Ustilago and Tilletia

(ii) Holobasidiomycetidae-I (Hymenomycetes) : Polyporus and Exobasidium.

(iii) Holobasidiomycetidae-II (Gasteromycetes) : Scleroderma, Clavatia and Nidularia.

Deuteromycotina (Deuteromycetes)

(i) Hyphomycetidae : Stibella Rhizoctonia and Sclerotium

(ii) Blastomycetidae: Sporobolomyces and Cryptococcus

3. Principles and methods for the prevention and control for plant diseases, modelling and disease forecasting, plant quarantine, defense mechanisms of plants against pathogens, plant disease clinics, prediction of disease control decisions.
4. Symptomatology, identification, etiology and control measures of the following plant disease :
5. **Fungal Diseases:** Potato wart, damping-off diseases, blight of colocasis, peach leaf curl, apple scab. Wilt of cotton and arhar, anthracnose disease of chillies, Late blight of potato, Early blight of potato, stem rust of wheat, loose smut of wheat, karnal bunt of rice, powdery mildew of bajra, white rust of crucifers, tikka disease of groundnut.
6. **Bacterial Diseases**: Bacterial leaf blight of rice, ring rot of potato, citrus canker, brown rot of potato, tundu disease of wheat.
7. **Viral Diseases:** Papaya leaf curl, leaf curl of tomato and bunchy top of banana.
8. Sex hormones in fungi, heterothallism in Basidiomycetes, hyterokaryosis, parasexual cycle.
9. Mycorrhizae in agriculture and plant growth, Biological control and concept of mycoherbicides.
10. Important contributions of the following mycologists/microbiologists: E.J.Butler, K.C. Mehta, B.B. Mundkur, Robert Koch, Alexander Flemming, S.A. Waksman, W.M. Stanley and Christian Gram.
11. Important mycological and plant pathological journals and institutes.

Books Recommended

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Dube HC. (1981). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd. 3.
3. Sumbali G. (2005). The Fungi. 1st edition. Narosa Publishing India House.
4. Vashishta BR and Sinha AK. (2008). Fungi. S. Chand and Company Ltd.
5. Webster J. (1980). Introduction to Fungi. 2nd edition. Cambridge University Press.

Suggested Practicals

1. Principles & working of instruments in the Mycology & Plant Pathology laboratory.
2. Characterization of disease symptoms and identification of pathogenic organisms (stem rust of wheat, damping off disease, white rust of crucifers, early and late blight of potato, loose smut of wheat, wilt of cotton, tikka disease of groundnut, citrus canker, leaf curl of papya, yellow vein mosaic of bhindi, red rot of sugarcane, anthrocnose of chillies.)
3. To study type genus Eurotium, Mucor, Peziza, Geastrum, Nidularia, Lycoperdon, Morchella, Agaricus.
4. Comparative biochemical and physiological observations of healthy and infected leaves.
5. Ocular micrometry of spores of pathogenic fungi.
6. Obsevations on rhizosphere of infected plants.
7. Modelling for disease forecasting.
8. Studies on different defense mechanism adopted by plants against pathogenic attack.
9. Measurement of radial growth of fungi in petri plates.

M.Sc. Botany (Semester-I)

BOT C513 – Genetics and Evolution

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Fine Structure of Gene:** Classical versus molecular concept of the gene, the cis-trans complementation for functional allelism, limitation of cis-trans test, fine structure of phage T4 II Locus; fine structures of gene and "Complex loci" in eukaryotes, genes within genes in phage ϕX124, over-lapping genes; concept of split gene; pseudogenes, nucleotide sequences.
2. **Genetic Material :-** Properties and replication, proof that the genetic information is stored in DNA , the watson-crick model, the double helix, alternate forms of double helix, DNA replication, initiation and primer problem, complex replication apparatus, rolling circle replication of phage ϕ X124.
3. Genetic regulation of cell cycle, homologous chromosomes, polytene and ampbrush chromosomes. Oncogenes, biochemistry and molecular biology of cancer, genetic disorders, Correlation between mutagenicity and carcinogenecity.
4. **Mutations:** Definition, types, detection in bacteria, Neurospora, maize and Drosphila; molecular basis of mutations; induced mutations (radiation and chemical mutagenesis), DNA repair mechanisms, DNA recombination mechanism, mutagen dosage.
5. **Transposable Genetic Elements:** introduction, transposable elements in bacteria (Is elements, Tn 3 family), transposable elements in eukaryotes "Yeast Ty elements", maize transposons, Drosophila tranposons, significance of transposable elements.
6. **Somatic Crossing Over:** Molecular mechanism of crossing over, gene conversion, ordered and unordered tetrad analysis, somatic cell hybridization.
7. **Regulation of Gene Expression in Prokaryotes** : The Operon model, lac, an inducible operon, trp, a repressible operon, positive control of the lac operon by CAP and CAMP, complex regulation of ara operon, attenuation.
8. **Polyploids:** Inheritance pattern in autopolyploids (chromosome and chromatid segregation), diplodization, role of polyploidy in evolution.

9. **Paleontology and Evolutionary History:** The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.
10. **Organic evolution:** Review of theories of evolution. Hardy-Weinberg law, speciation, modes of speciation (gradual and abrupt).

Books Recommended

1. Berger, M.W. (1976). Genetic, MacMillan Publishing Co. Inc, New York.
2. Gardner, E.J. Simons, M.J. and Snustad, D.P. (2006). Principles of Genetics, John Wiley & Sons, Inc., New York, Toronto.
3. Klug and Cummings. (1997). Concepts of Genetics, Prentice Hall International Inc.,New Jersey.
4. Khush. G.S. (1973). Cytogenetics of Aneuploids, Academic Press, New York.
5. Lewin, B. (1997) Genes VI. Oxford University Press, Oxford.
6. Martz C.P. T. and Yong, W.J. (1988). Cytogenetics. Rekha Printers, New Delhi.
7. MinKoff, E.C. (1983). Evolutionary Biology. Addison -Wesley Publishing Co.,Massachussettes.
8. Schulz -Schaeffer, J., (1980). Cytogenetics of Plants, Animals and Human, SpringerVerlag, New York.
9. Verma, P.S. and Aggarwal, V.K. (2014). Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S.Chand& Co. Ltd., New Delhi.

Suggested Practicals

1. Learning the cytogenetics laboratory-methods of microcopy, fixation, staining and dehydration
2. Meiotic and mitotic studies in *Allium cepa*
3. Polyploidy induction methods in laboratory organisms-treatment with colchicine
4. Studies on chromosomal aberrations in Allium cepa-using DDT and other pesticides
5. DNA isolation, purity and quantitative estimations.
6. Gel Scoring and data analysis
7. Demonstration of principles of Genetics in *Pisum sativum*
8. Numerical exercises on pedigree analysis, gene interactions, population genetics, chi-square and probability
9. Morphological observations in chromosomes- study on polytenic chromosomes of Drosophila.
10. Karyotypic analysis of laboratory organisms-*Allium cepa, Vicia faba, Drosophila*
11. Studies of human karyotyes and genetic diseases associated.
12. Demonstration of Hardy-Weinberg Law using pea seeds.

M.Sc. Botany (Semester-I)

BOT C514 – Plant Physiology

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Properties of water, soil-plant, water relations kinetic theory, chemical and potential gradients, Raolt's Laws, rate of diffusion free energy of water, atmospheric H_2O, measurement of water potential components.
2. Energy metabolism (concept of the energy), thermodynamic principles in biology, energy rich bonds, weak interactions, coupled reactions and oxidative phosphorylations, group transfers, biological energy transducers, bioenergetics.
3. Signal transduction: Overview, receptors and G-proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signalling mechanisms e.g. two-component sensor-regulator system in bacteria and plants, sucrose-sensing mechanism.
4. Nitrogen Metabolism:Introduction, Overview of nitrogen in the biosphere and in plants, Overview of nitrogen fixation, Enzymology of nitrogen fixation, symbiotic nitrogen fixation, Ammonia uptake and transport, Overview of nitrate uptake and reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon metabolism,
5. Sulphur Metabolism: Overview of sulphate assimilation, Sulphur chemistry and function, Sulphur uptake and transport, The reductive sulphate assimilation pathway, Synthesis and function of glutathione and its derivatives.

Books Recommended

1. Buchanan, B.B., Gruissem, W. and Jones,R.L.(2002). Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland.
2. Dennis,D.T., Turpin, D.H., Lefebvre,D.D. and Layzell,D.B.(eds) (1997). Plant Metabolism (second edition). longman, Essex.
3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.

4. Hooykaas, P.J.J., Hall, M.A. and Libbenga,K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.
5. Hopkins,W.G.(2013). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York.
6. Lodish,H., Berk,A., Zipursky, S.I., Matsudaira, P., Baltimore, D. and Darnell,J. (2000). Molecular Cell Biology(fourth edition). W.H.Freeman and Company, New York.
7. Moore, T.C.(1989). Biochemitry and Physiology of Plant Hormones(second edition). Springer-Verlag, New York.
8. Nobel, P.S.(1999). Physiochemical and Environmental Plant Physiology (2nd Ed.). Academic Press, San Diego.
9. Salisbury, F.B. and Ross,C.W. (1992). Plant Physiology (4th edition). Wadsworth Publishing Co., California.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L. and Zeiger, E. (2010). Plant Physiology (5th edition). Sinauer Associates, Inc., Publishers, Massachusetts.

Suggested Practicals

1. Study on principles of pH metry, spectroscopy
2. Studies on preparation of various concentrations of solutions
3. Permeability observations on plasma membrane using different concentrations of organic solvents.
4. Effect of temperature on permeability of plasma membrane.
5. Preparation of standard curve of protein (e.g.BSA) and determine the protein content in unknown samples.
6. Estimation of activity of enzyme catalase
7. Estimation the activity of enzyme glutathione reductase.
8. Determination of osmotic potential of vacuolar sap by plasmolytic method.
9. Determination of the water potential of any tuber by constant weight method.
10. Determination of the water potential of any tuber by Chardakov's dye method.
11. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.

M.Sc. Botany (Semester-II)

BOT C521 – Bryophytes and Pteridophytes

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for Paper Setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Habitat and habit and distribution of Bryophytes, origin of bryophytes (including fossil records), primitive vs advanced/derived characters, economic importance.
2. Comparative morphological account of gametophytes and sporophytes and life cycle of Marchantiales, Sphaeropales, Calobryales, Jungermanniales, Metzgeriales, Anthocerotales, Sphagnales, Andreaealas and Bryales.
3. Origin of land habit, bryophytes land floras, differentiation of organs in vascular plants – telome and enation theories, significance and short comings.
4. Monophyletic vs polyphyletic origin of pteridophytes, pteridophytic life cycle with reference to alternation of generations, homologous and the antithetic theories of the origin of the sporophyte.
5. General characters and classification of pteridophytes, occurrence, comparative organography, systematics, reproduction and types of life cycle in: Psilophytales, Rhyniales, Zosterophyllales, Trimerophytales, Psilotales, Lycopodiales, Ophioglossales, Marattiales, Filicales, Marseliales and Salviniales.
6. Evolutionary trends in pteridophytes, prothallial evolution, organization and evolution of sorus in ferns, role of polyploidy and hybridization in speciation in ferns, apomictic life cycle, apogamy, apospory, heterospory and seed habit.

Books Recommended

1. Bower F.O. (1928). The Ferns, Vols. I – III. Cambridge University Press, Cambridge.
2. Bower, F.O. (1908). The Origin of Land Flora. The MacMillan Press, London.
3. Campbell, D.R. (1985). The Evolution of Land Plants (Embryophyta) Reprinted Central Book Depot, Allahabad
4. Parihar, N.S. (1992). The Biology and Morphology of Pteridophytes, Central Book Distributors, Allahabad.

5. Rashid, A. (1991). An Introduction to Pteridophytes. Vikas Publishing House Pvt. Ltd.
6. Schofield, W.B. (1985). Introduction to Bryology, MacMillan Publishing Company, New York.
7. Sinnott, E.W. (1960). Plant Morphogenesis. McGraw Hill Book Company Inc. New York, Toronto, London.
8. Smith, G.M. (1955). Cryptogamic Botany. Vol. II, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
9. Sporne, K.R. (1962). Morphology of Pteridophytes, BI Publications, New Delhi.
10. Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press,London.
11. Taylor, T.N. (1981). Palaeobotany. An Introduction to Fossil Plant Biology, McGraw Hill Book Company, New York.

Suggested Practicals

1. Morphological, reproductive and anatomical study of representative members of the bryophytes studied in theory using cleared wholemount preparation and sectioning (*Riccia, Marchantia, Porella, Pellia, Funaria, Sphagnum, Polytrichum, Pogonatum*).
2. Studies on habit and natural habitat of bryophytes.
3. Morphological, reproductive and anatomical study of representative members of the pteridophytes studied in theory using cleared wholemount preparation and sectioning (*Selaginella, Lycopodium, Equisetum, Pteris, Dryopteris, Marselia, Salvinia*)
4. Studies on habit and natural habitat of pteridophytes

M.Sc. Botany (Semester-II)

BOT C522 – Diversity and Biology of Gymnosperms

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Gymnosperms, the first seed plants, diversity of structure and complexity. Classification of gymnosperms and their distribution in India and in the globe in time and space.

2. Geological time scale and important geological formations in India.

3. Morphology, general account, structure and reproduction of Progymnosperms (aneurophytales, archeopteridales etc.): Cycadofilicales, Glossopteridales, Pentoxylales, Cordaitales, Cycadeoidales Cycadales. Ginkgoales, Coniferales, Taxales, Ephedrales, Welwitschiales and Gnetales.

4. Evolutionary tendencies in gymnosperm organography and life cycle with particular reference to male and female sporophylls, cones, ovules, seeds and archegonia.

5. Pollination mechanisms, cytology of Gymnosperms, general survey of the cytology of gymnosperms.

Books Recommended

1. Arnold, C.A. (1947) An Introduction to Palaeobotany. McGraw Hill Book Company, New York.
2. Bhatnagar, S.P., and Moitra, A. (1996). Gymnosperms. New age International, Private Limited.
3. Biswas, C., and Johri, B.M. (1997). Gymnosperms. Narosa Publishing House, New Delhi.
4. Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun

5. Chamberlain C.J. (1935) Gymnosperms: Structure and Evolution CBS Publishers and Distributors, N. Delhi.
6. Coulter, J.M., and Chamberlain, C.J. (1917) Morphology of Gymnosperms (Reprinted) Central Book Dept. Allahabad.

Suggested Practicals

1. Study of morphology, structure and reproduction in *Cycas,Pinus,Cedrus,Ginkgo,Ephedra,Taxus,Podocarpus,Gnetum*
2. Study of leaf and stem anatomy in *Pinus,Cedrus,Picea,Abies,Agathis,Taxus,Podocarpus,Araucaria,Ginkgo,Ephedra,Gnetum*
3. Study of fossils: *Williamsonia*
4. Understanding wood anatomy using T.S, T.L.S and R.L.S in *Pinus* and *Cedrus*
5. Study of secondary growth in stem and root.

M.Sc. Botany (Semester-II)

BOT C523– General Microbiology

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Methods in Microbiology:** Basic principles of microscopy, micrometry, staining, sterlization methods; culture media, pure culture methods.
2. Classification of bacteria,(Bergey's system) characteristics of each group, Nutrition of bacteria, nature of virulence, toxins and extracellular enzymes of pathogenetic bacteria, conjugaton, transformation and transduction.
3. Nomenclature and classification of plant viruses, transmission of plant viruses with control measures, Viroids and origin of viruses, morphology and nature of virus particles, infection and replication with reference to TMV and bacteriophage, viral disease with special reference to encephalitis, hepatitis, AIDS, rabies, foot and mouth disease.
4. **Environmental Microbiology**: Sewage (waste water) treatment : Ecological impact of raw sewage on receiving water, public health impact of raw sewage discharge. Primary, Secondary and tertiary waste water treatments. Total coliform bacteria analysis, Fecal coliform bacteria analysis in drinking water. Land fills, composting. Bioremediation: Biodegradative organisms, advantages of bioremediations, problem associated with bioremediation, methodology of bioremediation.
5. **Aeromicrobiology:** Important airborne plant, animal and human pathogens, important airborne toxins, nature of bioaerosols aeromicrobiological pathways, sampling devices for the collection of bioaerosols.
6. **Industrial Microbiology:** The Microbe: Primary and secondary metabolites, major industrial products: foods, flavouring agents and food supplement, vitamins and beverages; organic acids; enzymes and microbial transformation; inhibitors; genetically engineered microorganisms – Human insulin and human growth hormones and vaccines.
7. **Control of Microorganisms by Physical and Chemical Means:** Fundamentals of control, physical agents, high temperature, low temperature, desiccation, osmotic pressure, radiation, surface tension and interfacial tension, filtration, characterisation of

an ideal antimicrobial chemical agent, selection of a chemical agent for practical application, major groups of antimicrobial agents.

Books Recommended

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
4. Webster, J. (1980). Introduction to Fungi, 2nd Ed., Cambridge University Press, Cambridege, London.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Suggested practicals

1. Acquaintance with working, principle, parts and precautions of most commonly used instruments in a microbiology lab
2. Calibration of microscope: determination of dimensions of microorganisms
3. Acclimatization with aseptic techniques-sterilisation,preparation and cultivation media for bacteria
4. To prepare temporary and permanent cotton plugs
5. To prepare solid and liquid culture media
6. To culture or cultivate bacteria
7. To stain and study bacteria
8. To measure bacterial cells through ocular micrometry
9. Microscopic examination of milk and curd
10. To isolate micro-organisms from mixed culture and grow a pure culture
11. Isolation of microbes from soil sample by streaking method
12. Isolation of micro organisms from given water sample by serial dilution.
13. Methylene blue reduction test for examining the microbial activity of milk
14. To study radial growth of fungi on nutrient media
15. To determine antibiotic staining of bacterial strain
16. Demonstration of Lambart Beer's law by colorimeter

M.Sc. Botany (Semester-II)

BOT C524 – Cell Biology

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Levels of Structural Organization:** Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems; comparative anatomy.
2. **Membrane Structure and Function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
3. **Structural Organization and Function of Intracellular Organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
4. **Organization of Genes and Chromosomes:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
5. **Cell division and Cell Cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Microbial Physiology: Growth, yield and characteristics, strategies of cell division, stress response.
6. **Cell Signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
7. **Cellular Communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Books Recommended

1. Alberts, B. Bracy, P. Lewis , J. Raff, M. Roberts K and Watson, J. (eds) (1994). Molecular Biology of the Cell, Garland Publishing , New York.
2. Cooper, G. M. (1997). The cell, A Molecular Approach ASM press, Washington, D. C.
3. Chandra Roy, S and DE Kumar, K. (2001) Cell Biology. New Central Book Agency (P) Ltd. Kolkata.
4. Darnell, J. Lodish, H. and Baltimore, D. (1990). Molecular Cell Biology, 2nd edition, Freeman, New York.
5. Derobertis, E. D. P. and Derobertis, E.M.F. (1987). Essentials of Cell and Molecular Biology. Hold Saunders – Philadelphia.
6. Holtzman, E. and Novikoff, A. B. (1984). Cells and Organelles. Saunder Philadelphia.
7. Hopkins, C. L. (1978). Structure and Functions of Cells . Saunders – Philadelphia.
8. Karp, G. (1984). Cell Biology 4th Edition, McGraw Hill, New York.
9. Karp G. (1999). Cell and Molecular Biology. Concepts and Experiments, 2nd Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.
10. Loewy, A. G. , Siekevitz, P, Menningee, J. R. , and Allant, J. A. N. (19991). Cell structure and Functions. An integrated Approach 3rd edition . Saunders College Publishing, Philadelphia, London.
11. Pollard. T.D. and Earnshaw, W.C. (2002) Cell Biology. Saunders, Philadelphia London. New York, St. Luis Sydney, Toronto.
12. Powar, C. B. (1990). Cell Biology. Himalaya Publishing House, Bombay.
13. Sadava, D. E. (1993). Cell Biology – Organelle, Structure and Fucntions. H. Jones and Bartlett- Boston.
14. Sheeler, P. and Binachi, D. E. (1983). Cell Biology, John Wiley, New York.

Suggested practicals

1. Understanding the cytology laboratory- components of compound/electron microscope
2. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
3. Examination of various stages of mitosis and meiosis using appropriate plants material (e.g. onion root tips, onion flower buds).
3. Calculation of Mitotic and meiotic index from dividing root tip cells and pollen grains.
4. Study on cyclosis in *Tradescantia* and *Hydrilla* leaves.
5. Observations on Barr bodies in Squamous epithelium
6. Preparation of Feulgen stained chromosomes in root tip cells
7. Effect of colchicine on chromosome movements during mitosis
8. Use of fluorescent dye to visualise cell components.

M.Sc. Botany (Semester-II)

BOT C526 – Ecological Modelling and Remote Sensing

Time: 3 Hours
Theory Lectures : 3 Credit Hours/Week **Max. Marks : 50**
Theory: 40; Int. Ass.: 10

Instructions for paper setters : The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Exponential Population Growth:** Differential equations, finite rate of increase, population doubling time, intrinsic rate of natural increase, stable age distribution, matrix model for population growth.
2. **Logistic Population Growth:** Differential model for population growth in limited environment.
3. **Dispersion:** Poisson distribution, random, uniform and aggregate patterns, Morisita's index of aggregation.
4. **Interaction Between Two Species:** Competition – Differential equations, Leslie-Gower Model, Lotka-Volterra model for predator – prey interaction, Leslie model, simple epidemics.
5. **Association Analysis and Community Classification:** Chisquare, Cole's measures and point correlation coefficient for association, ordination, continuum concept.
6. **Species Diversity:** Species area relationships, species abundance relationships – information measures of diversity. Brillouin's measure, Shannon-Weaver measure, Simpson's measure. Extinction and formation of single populations, McArthur – Wilson theory of biogeography.
7. **Production and Energy Flow:** Production in animal populations, efficiency, measurement of ingestion. measurement of production in plants, litter decomposition.
8. **Environmental Law & Policy:** Constitutional provisions, Water (prevention and control of pollution) Act, 1974, Air (prevention and control of pollution) Act, 1981, Environment Protection Act, 1986, Forest (Conservation) Act, 1980, Wildlife (Protection) Act, 1972, the concept of biosphere reserves, International environmental perspectives.
9. **Remote Sensing:** Aerial photography image interpretation, digital image processing, remote sensing in ecology and forestry, agriculture, landscape analysis, Methods & theory of remote sensing.

Books Recommended

1. APHA-Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washingtonn, DC.
2. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial Plan Ecology, Benjamin/Cummings Publication Company, California.
3. Batschelet, E. (1971). Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.
4. Begon,M. Harper, J.L. and Townsend, C.R. (1996). Ecology, Blackwell Science, Cambridge.
5. Brady,N.C. (1990). The Nature and Properties of Soils. Macmillan.
6. Chapman, J.L. and Reiss, M.J. (1988). Ecology: Principles and Applications, Cambridge University Press, Cambridge.
7. De, A.K. (1990). Environmental Chemistry. Wiley Eastern Pvt. Ltd., New Delhi.
8. Heywood, V.H. and Watson, R.T. (1995). Global Biodiversity Assessment, Cambridge University Press, Cambridge.
9. Hill, M.K. (1997). Understanding Environmental Pollution. Cambridge University Press, Cambridge.
10. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
11. Krebs, C.J.(1989 Ecological Methodology. Harper and Row, New York, USA.)
12. Koromody, E.J. (1981). Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
13. Ludwig, J and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.
14. Magurran, A.E. (1988). Ecological Diversity and its Measurement. Chapman & Hall, London.
15. Mason, C.F. (1991). Biology of Freshwater Pollution, Longman.
16. Misra, R.(1968). Ecology Work Book. Oxford & IBH, New Delhi.
17. Moldan, B. and Billharz, S. (1997). Sustainability Indicators. John Wiley & Sons, New York.
18. Moore, P.W. and Chapman, S.B. (1986). Methods in Plant Ecology. Blackwell Scientific Publications, Cambridge.
19. Muller-Dombois, D. and Ellenberq, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York.
20. Odum, E.P. (1971). Fundamentals of Ecology, Saunders , Philadelphia
21. Odum, E.P. (1983). Basic Ecology. Saunders , Philadelphia.
22. Pielou, E.C. (1984). The Interpretation of Ecological Data, Wiley, New York.
23. Poole, R.W. (1974). An Introduction to Quantitative Ecology. McGraw Hill Book Co., New York.
24. Smith, R.L. (1996). Ecology and Field Biology. Harper Collins, New York.
25. Sokal, R.R. and Rohlf, F.J. (1995). Biometry. W.H. Freeman & Co. San Francisco.
26. Treshow, M. (1985). Air Pollution and Plant Life, Wiley Interscience.

Suggested Practicals

1. To determine minimum size and number of quadrats required for reliable estimate of biomass in grassland.
2. To find out association between grassland species using chi square test
3. To analyse plant communities using Bra-Curtis ordination method.

4. To determine soil moisture content, porosity, bulk density of different soil samples collected from different locations.
5. To study chlorophyll content of SO_2 fumigated and unfumigated plant leaves.
6. To determine Na, K concentration of water sample using flame photometer.
7. To determine water holding capacity of different soil samples.
8. To determine percent organic C and organic matter in different soil samples
9. To estimate chlorophyll content in SO_2 fumigated and unfumigated plant leaves.
10. To estimate rate of CO_2 evolution from different soil using soda lime or alkali absorption method
11. To determine sulphate content of water samples
12. To determine O_2 content of water sample.

M.Sc. Botany (Semester-III)

BOT C611 – Diversity and Biology of Angiosperms

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Historical perspective of plant classification, phenetic versus phylogenetic system; cladistics in taxonomy, relative merits and demerits of major system of classification, a study of phylogenetic system of classification after Engler & Prantl, Bessey, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne.
2. Principles of plant nomenclature; role of naturalists and herbalists, salient features of the International code of Botanical Nomenclature, working knowledge of botanical latin, important herbaria of the World.
3. Origin of angiosperms; inter-relationships of dicots and monocots; Phylogeny of ranales, amentiferae, centrospermae, tubifilorae and halobiales and their treatment in the modern systems of classification.
4. Principles of plant taxonomy, choice of characters, conservative vs. flexible characters; alpha taxonomy vs modern taxonomy; chemotaxonomy, cytotaxonomy, numerical taxonomy, anatomy, palynology and embryology in relation to taxonomy, statistical analysis in deriving taxonomic relationships, figurative representation of taxonomic affinities.
5. Biosystematic approach to taxonomy, biosystematic categories parameters in biosystematic analysis with particular examples of taxonomic problems; taxonomic study of agamic, hybrid and polyploid complexes; phylogenetic trees.
6. Taxonomic tools: Herbarium; floras; serology; electrophoresis; nucleic acid hybridization; computers and GIS.
7. Concepts of pytogeography and its relevance, pytogeographic regions of the world and India, approaches to phytogeography, principles and practices; factors determining vegetational types, endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socio-economic importance.

Books Recommended:

1. Arnold, C.A. (1947) An Introduction to Palaeobotany. McGraw Hill Book Company, New York.

2. Bhatnagar, S.P., and Moitra, A. (1996). Gymnosperms. New age International, Private Limited.

3. Biswas, C., and Johri, B.M. (1997). Gymnosperms. Narosa Publishing House, New Delhi.

4. Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun

5. Chamberlain C.J. (1935) Gymnosperms: Structure and Evolution CBS Publishers and Distributors, N. Delhi.

6. Cole, A.J. 1969. Numerical Taxonomy,Academic Press, London

7. Coulter, J.M., and Chamberlain, C.J. (1917) Morphology of Gymnosperms (Reprinted) Central Book Dept. Allahabad.

8. Cutter, E.G. (1971). Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.

9. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger Pub. Co., New York.

10. Esau, K. (1977). Anatomy of Seed Plants, 2nd edition. John Wiley and Sons, New York. Fahn, A. 1974. Plant Anatomy, 2nd edition. Pergamon Press, Oxford.

11. Grant W.E. (Ed.) (1984) Plant Biosystematics Academic Press, Toronto.

12. Haywood, V.H., and Moore, D.M. (1984). Current Concepts in Plant Taxonomy. Academic Press, London.

13. Heslop- Harrison, J. 1967. Plant Taxonomy. English Language Book Society & Edward Arnold Pub. Ltd., U.K.

M.Sc. Botany (Semester-III)

BOT C612 – Developmental Botany

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Pollination**: Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods of over coming incompatibilities, intra-ovarian pollination, in vitro pollination.

2. **Fertilization**: Heterospermy, differential behaviour of male gametes, discharge and movement of sperms, syngamy and triple fusion, post fertilization metabolic and structural changes in embryo sac.

3. **Endosperm**: Types, ultrastructure, cellularization in nuclear endosperm, endosperm haustoria, their extension and persistence, function, storage, metabolities, endosperm culture.

4. **Embryo**: Polarization of zygote, embryogenic types, histology and organogenesis of dicot embryos, organless (undifferentiated) embryos,delayed and differentiation of embryo, structure, cytology and function of suspensor, physiological and morphogenetical relationship of endosperm and embryo, embryo culture for rescue of hybrid embryo. Polyembryony: Types, genetic and somatic, pollen embryos.

5. **Apomixis**: Diplospermy, Apospory, Parthenogenetic Development of Embryo, Pseudogamous and Autogamous Development of Endosperm, Importance. Seed: Growth and Development, Seed Appendages.

6. **Embryology & Taxonomy:** Diagnostic embryological characters, Primitive and advanced characters, comparative embryology and intraspecific, inter and intrafamilial and inter and intraordinal relationships.

7. **Role of embryology in plant breeding:** Embryology of hybrids, disfunction of endosperm, arrested development of embryo.

Books Recommended:

1. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.

2. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.

3. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd. Bombay – New Delhi.

4. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.

M.Sc. Botany (Semester-III)

BOT C613 – Plant Molecular Biology

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. The Law of DNA constancy and C-value paradox, DNA sequencing. Organization of transcriptional units; mechanism of transcription of prokaryotes and eukaryotes; RNA processing (capping polyadenylation, splicing, introns and exons); ribonucleo–proteins, structure of mRNA.
2. Recombinant DNA technology, host cell restriction, restriction endonucleases, DNA ligases, topoisomerases, gyrases and methylases. Cloning strategies, selection and screening of recombinant clones, genomic DNA and cDNA libraries, biological and physical containment of recombinant DNA clones. Agarose gel electrophoresis, Southern/Northern/ Western blotting.
3. Cloning vehicles, plasmids, bacteriophages, viruses, cosmids, Ti-plasmid, CaMv plasmid, construction of plasmid vectors, M13 vectors, their use in cloning and sequencing, expression vectors, lysogeny and lytic cycles in bacteirophages.
4. Genetic colonization of plants by Agrobacterium infection and tumour growth, Ti – plasmids, neoplastic transformation of plant cells, organization of T-DNA, nucleotide sequences of T-DNA. PCR, DNA fingerprinting by RAPDs and RFLPs.
5. Genomics and proteomics: Genetics and physical mapping of genes, molecular markers of introgression of useful traits, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Books Recommended:

1. Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1 – 5. McGraw Hill Publishing Company, New York.

2. Bhojwani, S.S. and M.K. Razdan (1983), Plant Tissue Culture. Theory and Practice Elsevier science publications Amsterdam.

3. Draper J.R. Scott, P. Armitage, R. Walden, (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.

4. Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York

5. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.

6. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.

7. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.

8. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.

9. Shaw C.H. (1988), Plant Molecular Biology – A Practical Approach IRL Press Oxford.

M.Sc. Botany (Semester-III)

BOT C614 – Plant Breeding and IPR

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Primary and secondary centres of diversity, utilization of wild plants in crop improvement, introduction and domestication as methods of plant breeding.
2. Types and introduction, vegetative sexual and apomictic, their effects on generating and fixing genotypic variation, male sterility and self incompatibility mechanisms.
3. Breeding systems of crop species; systems of mating in sexually reproducing species and their genetic consequences. Breeding methods for self and cross pollinated crops; pureline and mass selection, recurrent selection and clonal selection.
4. Hybridization in self and cross pollinated crops. Inbreeding depression and hybrid vigor, genetic and physiological basis of heterosis, hybrid varieties, synthetic and composite varieties.
5. Breeding for disease resistance, classification of resistance, responses of the host to pathogens, variability systems of pathogenic fungi, breeding disease resistant varieties; multiline varieties.
6. Heritability, genetic advance, correlation of characters, path analysis, Plant Design,analysis multiple comparison test, discriminant function and cluster analysis, factoral design.
7. Mutations, aneuploidy and polyploidy as methods of plant improvement, interspecific and intergeneric hybrids, role of genetic engineering.
8. Intellectual Property Rights: (IPR/TRIPS), International Intellectual Property System; Plant Variety Protection; the regular patent systems, trade secrecy and material transfer agreements, biosafety and product labelling considerations; laws and conventions related to intellectual property rights.

Books Recommended:

1. Allard, R. W. (1960), Principles of Plant Breeding. John Wiley & Sons, N. York.

2. Anonymous (1997). National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.

3. Arora. R.K. and Nayar, E.R. (1984). Wild Relatives of Crop Plants in India. NBPGR Science Monograph No.7. Baker, H.G. (1978). Plants and Civilization (3d ed). C.A. Wadsworth, Belmont.

4. Bole, P.V. and Vaghani, Y. (1986). Field Guide to Common Indian Trees. Oxford University Press, Mumbai.

5. Chandel, K.P.S.,Shukla. G. and Sharma, N. (1996) Biodiversity in Medicinal and Aromatic Plants in India: Conservation and Utilization.National Bureau of Plant Genetic Resources, New Delhi.

6. Chrispeels, M.J. and Sadava, D. (1977). Plants, Food and People. W.H. Freeman and Co.,San Francisco.

7. Conway, G. (1999). The Doubly Green Revolution: Food for All in the *21st* Century. Penguin Books.

8. Conway, G. and Barbier, E. (1990). After the Green Revolution, Earthscan Press, London.

9. Conway, G. and Barbier, E, (1994). Plants, Genes and Agriculture. Jones and Bartlett Publishers, Boston.

10. Council of Scientific & Industrial Research (1948-1976). The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products. New Delhi. Raw Materials IXII, Revised Vol-III (1985-1992) Supplement (2000).

M.Sc. Botany (Semester-III)

BOT C615 – Plant Biochemistry

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Cellular Chemistry:** Covalent and noncovalent interactions, hydrogen bond, electrostatic interactions, hydrophobic interactions, Van der Walls forces and their significance, structure and properties of water and its biological significance, pH and its significance, pH scale, Handerson-Haselbach equation, isoelectric point, buffers (inorganic and organic) and their importance, ATP-the energy currency, phosphorylation / dephosphorylation of proteins.

2. **Metabolism of Carbohydrates:** Overview of intermediary metabolism, carbohydrates and lipids of physiologic significance, glycolysis and oxidation of pyruvate, citric acid cycle, catabolism of acetyl-CoA, metabolism of glycogen, gluconeogenesis and control of the blood glucose, pentsephosphate pathway and other pathways of hexose metabolism like uronic acid fructose metabolism pathways.

3. **Lipid Metabolism:** Biosynthesis of fatty acids, oxidation of fatty acids, ketogenesis, metabolism of fatty acids, ketogenesis, metabolism of acylglycerols and sphingolipids, lipid transport and storage, cholesterol, synthesis, transport and excretion, integration of metabolism and provision of tissue fuels.

Books Recommended:

1. Dryer, R.L. and Lata, G.F. (1989). Experimental Biochemistry, Oxford University Press, New York.

2. Murray, R.K., Grammer, D.K., Mayes, P.A. and Rodwell V.W. (1990). Harper's Biochemistry. Prentice Hall International Inc., London.

3. Nelson, D.L. and Cox, M.M. (2000). Lehninger's Principles of Biochemistry. Worth Publishers, New York.

4. Stryer, L. (1995). Biochemistry W.H. Freeman & Co., New York.

5. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold, London.

6. Zubay G. (1993). Biochemistry. WCB Publishers, IOWA.

7. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.

8. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.

9. Goldsby, R.A. Kindt, T.J., Oxborne B.A., Kuby, J. (2003). Immunology.W.H. Freemen & Company, NewYork.

10. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA.

11. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford.

M.Sc. Botany (Semester-III)

BOT C616 – Applied Botany

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Food plants:** History and nature of food plants, major and minor cereals, legumes and pulses, vegetables, fruits and nuts, vegetable oils and fats. Extraction of sugar from sugar cane . Flow diagram of the process with a critical study of the steps involved, problems faced by the sugar industry in India. Bye-products of sugar industry, distillation of alcohol and other products with special reference to distilleries in Punjab. Food adjuncts: Spices condiments and other flavouring agents, beverages, fumitory and masticatory materials.

2. **Forest Products:** Wood & Oak, gums and resins, rubber,oils.Physical characteristics of Indian woods, methods of seasoning and chemical treatment of specialized use, fire proofing of the wood. Industrial manufacturing of packing material and plywood and the classifications of plywoods according to their use. Some important commercial woods: *Dalbergia* spp., *Shorea robusta*, *Tectona grandis, Cedrus deodara*, Bamboo-the 'green gold' of India.

3. **Industrial plant products:** Fibre yielding plants, essential oils, fatty oil and waxes, tanning and dyeing materials, rubber and other latex yielding products, gums and resins, sugars, starches and other cellulose products. Manufacturing of paper and board from raw plant material. Manufacturing of crude and high quality paper, recycled paper.

4. The rubber plants of India, extraction of raw rubber and its chemical processing for the manufacturing of finished rubber. Fibres: Classification of fibres, physical and chemical processes involved in the manufacuring of fibres from different types of fibre yielding plants.

5. Sources of gums and resins and their classifications according to their chemical nature. Extraction of the raw resin and down the line processing for terpentine and other products.

6. Essential oil yielding plants of India, their use in perfumary

7. Sources of natural dyes in India and their extraction methods, merits and limitations of plant based dyes.

Books Recommended:

1. Kochhar S. L. (1998). Economic Botany in the Tropics. MacMillan India Limited, Delhi.

2. Pandey B P (1984). Economic Botany (3rd Ed.). S. Chand & Company Ltd., New Delhi.

3. Trotter H (1982). The Common Commercial Timbers of India and Their Uses. The Controller of Publications, Delhi.

4. Brown H P (1989). An Elementary Manual on Indian Wood Technology (Reprinted). International Book Distributors, Dehra Dun, India.

5. Shankar Gopal Joshi (2000). Medicinal Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

6. Ambasta S P (1994). The Useful Plants of India. (3rd Ed.). Publications & Information Directorate, New Delhi.

M.Sc. Botany (Semester-IV)

BOT C621 – Plant Anatomy

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **The shoot and root system:** primary structure and basic vasculature, the root-stem transition, secondary growth in stems and roots , the origin of cambium and its activity, anamalous secondary growth, polycyclic vasculature, secondary meristems, origin and function , the role of pericycle, phellogen., phellem, phelloderm, distribution of sclerenchyma in leaves, stem and roots.

2. **Nodal anatomy:** types of nodes in dicots and monocots, the node-internode transition, formation of leaf and branch traces.

3. **Histology of wood** : growth rings, types and ultrastructure of tracheids, vessels and wood rays , longitudinal parenchyma and its arrangement , grain and texture , knots, formation of resin cavities and tyloses, anatomy and chemistry of lignification, physical and anatomical features of common hard and soft woods of India , importance of density and weight in commercial utilization of woods, keys for identification of common Indian woods and their economic importance , techniques and methods in wood technology.

4. **Floral anatomy:** the anatomy of floral axis and the whorls, the leaf origin of carpel, evidences from anatomy of essential and accessory whorls.

5. **Fruit and seed anatomy**: gross and ultrastructural surface features of the fruits and seeds, role in taxonomy, internal anatomy of dicot and monocot seeds, organ and cellular anatomy of typical monocot and dicot seeds.

6. **Laticifers and lenticels**: types and distribution, anatomy in relation to physiological roles,

7. **Functional anatomy**: Anatomy of leaf in relation to photosynthesis and transpiration, modification of the root stem and leaf anatomy in relation to habit and habitat with special reference to aquatics, nitrogen fixers, xerophytes parasites and mycorhizas.

Suggested Readings:

1. Cutter, E.G., 1969, Part 1 Cells and Tissues, Edward Arnold , London.

2. Cutter, E.G., 1971, Plant anatomy: Experiment and interpretation, part II , Organs Edward Arnold , London.

3. Esdu, K., 1977, Anatomy of seed plants , 3rd edition. John Wiley and Sons, New York.

4. Hartman, H.T. and Kestler, D.E., 1976. propagation : Principles and practices, 3rd edition, Prentice Hall of India Pvt.Ltd., New Delhi.

5. Mauseth, J.D., 1998, Plant anatomy. The Benjamin Cumming publishing company Inc. Menlo Park, California, USA.

6. Brown, H.P. 1989. An elementary manual on Indian Wood Technology. R. P.S Publishers.

7. Trotter, H. 1982. The common commercial timbers of India and their uses. Controller of Publications Delhi.

M.Sc. Botany (Semester-IV)

BOT C622 – Structure and Metabolism of Plant Hormones

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. General features of plant hormones, their analysis, and quantitation : Discovery of auxin and other hormones , characteristics of plant hormones , hormone vs plant growth regulator, hormonal responses to a physiological state, bioassays, hormone extraction, analysis, and quantitation, determination of hormone synthetic pathways, regulation of hormone levels (hormonal homeostasis).
2. Auxins : Structure of auxins, physiological roles of IAA, IAA biosynthesis in higher plants, regulation of IAA levels (IAA homeostasis), inhibitors of IAA action, other naturally occuring auxins, synthetic auxins, structural diversity of auxins.
3. Gibberellins: Discovery, structure of gibberellins (GAs) in higher plants, physiological roles of GAs in higher plants, terpenoid pathway, biosynthesis of GAs, regulation of GA levels in the plant, endogenous levels, why are there so many GAs? , other substances with GA-like activity.
4. Cytokinins : Discovery , biological functions and bioassays , structure of cytokinins, occurrence of cytokinins in the cytoplasm and as components of tRNA, relative distribution of natural cytokinins among plants, biosynthesis in higher plants , regulation of cytokinin levels, synthetic compounds with cytokinin-like activity, cytokinin antagonists (anticytokinins).
5. Brassinosteroids : Discovery , structure and distribution , physiological roles and bioassays, biosynthesis of brassinolide, synthesis mutants and their wild-type genes, inhibitors of brassinosteroid biosynthesis, brassinosteroid structure and biological activity regulation of castasterone and brassinolide levels.
6. Abscissic Acid : Discovery, structure and occurrence in plants and fungi, physiological roles of abscisic acid (ABA), biosynthesis of ABA, carotenoid and/or ABA synthesis, mutants, ABA synthesis inhibitiors, regulation of ABA levels.
7. Ethylene: Discovery as a hormone, structure, distribution, and internal concentrations, physiological roles and bioassays, biosynthesis in higher plants, ethylene synthesis mutants,

regulation of ethylene levels in the plant, synthetic compounds that produce ethylene, inhibitors of ethylene action.

8. Jasmonates and other Defense-Related Compounds: Introduction, discovery, distribution, and structure of jasmonates, physiological roles of jasmonates , biosynthesis of jasmonic acid (JA) , JA synthesis mutants, JA synthesis inhibitors, regulation of endogenous levels of JA.

9. Microbial Synthesis of Plant Harmones: Microbial associations with plants, infection by *Agrobacterium*, tumor induction by *Pseudomonas*, microbial genes involved in IAA and CK biosynthesis, expression of bacterial genes in higher plants, biology of genetic transformation by *A. tumefaciens*, production of plant hormones by other microorganisms.

Books Recommended:

1. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.
3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
4. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.
5. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York.
6. Lodish, H., Berk, A., Zipursky, S.l., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). Molecular Cell Biology. W.H. Freeman and Company, New York.
7. Moore, T.C. (1989). Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York.
8. Nobel, P.S. (1999). Physiochemical and Environmental Plant Physiology. Academic Press, San Diego.
9. Salisbury, F.B., and Ross, C.W. (1992). Plant Physiology, Wadsworth Publishing Co., California.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.-D. and Govindjee (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L., and Zeiger, E. (1998). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.
12. Thomas, B., and Vince-Prue, D. (1997). Photoperiodism in Plants. Academic Press, San Diego.
13. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford.

M.Sc. Botany (Semester-IV)

BOT C623 – Plant Tissue Culture and Biotechnology

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

a. Cytogenetics and differentiation in cell and tissue culture, plant regeneration from callus, shoot apex culture and anthers.
b. Micropropagation : Stages, somatic embryogenesis,usefulness, hardening of micropropagated plantlets, advantages and disadvantages, application of the technique in crop improvement.
c. Somaclonal variations and isolation of useful mutants at cellular level, disease resistance, herbicide resistance and salt tolerance. Production of pathogen free plants through tissue culture. Production of artificial seeds, their use and application.
d. Techniques for the production of transgenic plants: Concept, vectorless transgenosis, gene targeting tools, crop improvement through transgenics, benefits and risk of producing transgenic plants, commercialization of transgenics.
e. Cell culture and secondary metabolites like cinnamic acid, shikonin, coumarins, lignins, flavonoids, fatty acids and related compounds production.
f. Cryobiology of plant cell cultures and establishment of plant banks, freeze preservation technology, factors influencing revival of frozen cells and future prospects. Terminator technology, verminator technology, apprehensions and challenges.
g. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

Books Recommended:

1. Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1 – 5. McGraw Hill Publishing Company, New York.

2. Bhojwani, S.S. and M.K. Razdan (1983), Plant Tissue Culture. Theory and Practice Elsevier science publications Amsterdam.

3. Draper J.R. Scott, P. Armitage, R. Walden, (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
4. Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
5. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
6. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.
7. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
8. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.
9. Shaw C.H. (1988), Plant Molecular Biology – A Practical Approach IRL Press Oxford.

M.Sc. Botany (Semester-IV)

BOT C624 – Analytical Techniques

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. Principles and application of light, phase contrast, fluorescence scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.
2. Principles and applications of gel filteration, ion-exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid (HPLC) chromatography, electrophoresis and electrofocussing, ultra centrifugation (velocity and buoyant density).
3. Principles of biophysical methods used for analysis of biopolymeric structure, X-ray diffraction fluorescence UV/CD, visible NMR and ESR spectroscopy, hydrodynamic methods, Atomic absorption and plasma emission spectroscopy.
4. Principles and techniques of nucleic acid: hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and South Western blotting techniques; Polymerase chain reaction.

Books Recommended :
1. Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
2. Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
3. Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England

M.Sc. Botany (Semester-IV)

BOT C625 – Plant Morphogenesis

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours

Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.

Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.

Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Correlation:** Physiological and genetic correlations.
2. **Polarity:** Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes, physiological manifestations of polarity, developmental patterns.
3. **Symmetry:** Inorganic and organic symmetries, radial symmetry bilateral symmetry, dorsiventral symmetry, development of symmetry.
4. **Differentiation:** Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.
5. **Regeneration:** Regeneration in lower plants, regeneration in higher plants, reconstitution, restoration, reproductive regeneration.
6. **Tissue Mixtures:** Stock – scion interrelations, chimeras, somatic mutations.
7. **Abnormal Growth:** Abnormal development of organs, production of new types of organized structures, amorphous structures.
8. **Morphogenetic Factors:** Introduction to factors, light, water temperature, physical factors like tension, compression, balancing and swaying, ultrasonics, gravity, bioelectical effects, genetic factors, chemical factors in general.

Books Recommended:

1. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., new York.
2. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.
3. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd. Bombay – New Delhi.
4. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.

M.Sc. Botany (Semester-IV)

BOT C722 – Plant Physiology and Metabolic Integration
(Optional Paper)

Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
(Theory: 40; Int Ass: 10)

Time for Examination: 3 Hours
Instructions for paper setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.

Section A (8 Marks): It will consist of one question having eight parts. Candidates will be required to attempt all the parts each part carrying one mark. Answer to any part should not exceed four lines.
Section B (14 Marks): It will consist of ten questions. Candidates will be required to attempt seven questions, each question carrying two marks. Answer to any of the questions should not exceed two pages.
Section C (18 Marks): It will consist of five questions. Candidates will be required to attempt three questions, each question carrying six marks. Answer to any of the questions should not exceed four pages.

1. **Light, Hormones and Cell Signalling Pathways:**
Chloroplast development, Rubisco gene expression, mediation of photomorphogenetic responses by light receptors, hormones, initiation of regulatory cascades by hormones.
2. **Long Distance Transport:** Introduction , Overview of diffusive and convective transport in plants, Importance of channel dimensions in defining the transport properties of the apoplast and symplasm. Comparison of xylem and phloem transport. Transpirational water movement in the xylem, Symplasmic transport via plasmodesmata, Phloem transport, Intercellular transport of endogenous macromolecules.
3. **Nitrogen and Sulphur:** Introduction, Overview of nitrogen in the biosphere and in plants, Overview of nitrogen fixation, Enzymology of nitrogen fixation, symbiotic nitrogen fixation, Ammonia uptake and transport, Overview of nitrate uptake and reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon metabolism, Overview of sulfate assimilation, Sulfur chemistry and function, Sulfur uptake and transport, The reductive sulfate assimilation pathway, Synthesis and function of glutathione and its derivatives.
4. **Signal Perception and Transduction:** Introduction, Overview of signal transduction, receptors, specific examples of plant receptors, G-proteins and phospholipid signaling, Cyclic nucleotides, Calcium, Protein kinases : primary elements in signal transduction, Particulars pathways of signal transduction associated with plant growth regulators, The future of plant cell signal transduction research.
5. **Senescence and Programmed Cell Death:** Types of cell deaths observed in animals and plants, PCD in the life cycle of plants, Overview of senescence, Pigment metabolism during senescence, Protein metabolism in senescence, Impact of senescence of photosynthesis, Impact of senescence on oxidative metabolism, Degradation of nucleic acids during senescence, Regulation of metabolic activity in senescing cells, Endogenous plant growth regulators and

senescence, Environmental influences on senescence, Examples of developmental PCD in plants, Examples of PCD as a plant response to stress, Further questions and future directions for PCD research.

Recommended Books:

1. Fosket, Donald E., 1994. Plant Growth and Development. A Molecular Approach. Academic Press, Inc. California.
2. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
3. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.
4. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
5. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.
6. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York.
7. Lodish, H., Berk, A., Zipursky, S.l., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). Molecular Cell Biology. W.H. Freeman and Company, New York.
8. Moore, T.C. (1989). Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York.
9. Nobel, P.S. (1999). Physiochemical and Environmental Plant Physiology. Academic Press, San Diego.
10. Salisbury, F.B., and Ross, C.W. (1992). Plant Physiology, Wadsworth Publishing Co., California.
11. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.-D. and Govindjee (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
12. Taiz, L., and Zeiger, E. (1998). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.
13. Thomas, B., and Vince-Prue, D. (1997). Photoperiodism in Plants. Academic Press, San Diego.
14. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford.