Khalsa College Amritsar

(An Autonomous College)

Session 2019-20

Syllabus: Botany

ESTD. 1892

Post-Graduate Department of Botany

M.Phil. Botany
Scheme of Courses
Semester I
Session 2019-2020

S.No.	Code (Course No.)	Subject (Course Title)	Periods/ Week	Marks		
				Theory	Int. Ass.	Total
1	BOT-MP 101	Research Methodology	6	75	25	100
2	BOT-MP 102	Elective-I	6	75	25	100
3	BOT-MP 103	Seminar – I	3	37	13	50
4		Research work for Dissertation				
Total			**15**	**250**		

* List of Elective Courses
1. BOT-MP 102 E-1 - Plant Hormones, Biochemistry & Metabolism
2. BOT-MP 102 E-2 - Bioinformatics and Internet Resources
3. BOT-MP 102 E-3 - Advanced Wastewater Technologies
4. BOT-MP 102 E-4 - Nutraceuticals and Herbal Remedies

M.Phil. Botany
Scheme of Courses
Semester II
Session 2019-2020

S.No.	Code (Course No.)	Subject (Course Title)	Periods/ Week	Marks		
				Theory	Int. Ass.	Total
1	BOT-MP 201	Advanced Analytical Techniques	6	75	25	100
2	BOT-MP 202	Elective-II	6	75	25	100
3	BOT-MP 203	Seminar – II (Dissertation based)	3	37	13	50
4		Dissertation				
Total			**15**	**250**		

* List of Elective Courses
1. BOT-MP 202 E-5 - Organic Farming Theory and Practice
2. BOT-MP 202 E-6 - Molecular Toxicology
3. BOT-MP 202 E-7 - Function and Dynamics of Biodiversity
4. BOT-MP 202 E-8 - Advanced Environmental Ecology
5.BOT-MP 202 E-9 - Advanced Plant Tissue Culture Techniques

M.Phil. (BOTANY) SEMESTER-I

BOT-MP 101 - Research Methodology

Time: 3 Hours **Max. Marks: 100**
Theory: 6 Periods/Week **Theory: 75; Int. Ass.: 25**

1. **Basic Concepts:** Research process, problem identification, research designs, informalexperimental designs. Completing randomized design, randomized block design, latin square design, factorial designs
2. **Sampling Designs**: Random sampling, complex random sampling, non-probabilitysampling, measurement and scaling techniques. Data collection.
3. **Processing and Analysis of Data**: Central tendency, dispersion, asymmetry, correlation,regression analysis, multiple correlation and regression, partial correlation, association, index numbers, time series.
4. **Sampling and Testing of Hypothesis**: Concept of probability, probability,normal distribution, Poissondistribution, χ-square test, t-test. Sampling distribution, central limit theorem, Sandler's A-test, standard error, population mean, population proportion, sample size, confidence intervals, null hypothesis and alternative hypothesis, level of significance, two tailed and one tailed tests, Z-test, t-test, x^2-test, F-test, testing of correlation coefficients, One way ANOVA, two way ANOVA Tukey's HSD.
5. **Non-Parametric Tests:** Sign test, Fisher-Irwin test, Mc Nemer test, Wilcoxon Mali test,Wilcoxon, Mann-Whitnery test, Kruskal-Wallis test, one sample runs test. Spearman's rank correlation, Kendall's coefficient of concordance.
6. **Multivariate Analysis**: Multiple regression, multiple discriminant analysis, multipleanalysis of variance, canonical correlation analysis, Factor analysis, cluster analysis, path analysis. Computational techniques.
7. **Survey of Literature**: The students will be required to review literature in theirrespective disciplines and submit an assignment for evaluation.

References:

1. Kothari, C.R.(2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.
2. Arya, P.P. and Pal, Y.(2001) Research Methodology in Management: Theory and Case Studies. Deep and Deep Publishers Pvt. Ltd., New Delhi.

M.Phil. (BOTANY) SEMESTER-I

BOT-MP 102 E-4 – Nutraceuticals and Herbal Remedies

Time: 3 Hours **Max. Marks: 100**
Theory: 6 Periods/Week **Theory: 75; Int. Ass.: 25**

1. **Introduction to Herbs and Ayurveda:** Concept of tridosha, role of pancha karma inayurveda, origin of Charka samhita, comparison of ayurveda with other systems of healing likes unani, siddha, homeopathy and yoga.
2. **Herbal Product Formulations** for skin and healthcare, brain tonics and anti-agingproducts; their manufacturers and suppliers; export market hub of herbs.
3. **Nutraceuticals:** General introduction, classification of nutraceuticals, inorganic mineralsupplements, vitamin supplements, dietry fibres, antioxidants, health drinks, natural sweeteners, cereals and grains, polyunsaturated fatty acids.
4. **Herbal Cosmetics:** Formulation and manufacturer of hair dyes, face wash and soaps,skin care creams and lotions, anti- aging creams, shampoos, perfumes, mouthwash, toothpastes.
5. **Herbal medicines** for diseases like asthma, Alzheimer's disease, dengue fever, diarrhoea, epilepsy, goitre, gout, hypertension, jaundice, leukemia, obesity, and ulcer of stomach, eczema and diabetes.
6. **Herbal Pesticides:** General introduction, methods of pest control, manufacturer andexporter of eco guard crop protector - biodegradable pest control products, natural organic pesticides and insecticides and their benefits over chemical pesticides.

References:

1. Leyel, C. F. 2004. Types of Herbs. Srishti Book Distributors, New Delhi (India).
2. Singh, M. P. and Panda, Himadri 2005. Medicinal herbs with their formulations. Volume 1 & 2. Daya Publishing House, Delhi.
3. Murthy, N. A. and Pandey, D. P. 1998. Ayurvedic Cure for Common Diseases. Orient Paperbacks, Delhi.
4. Rangari., V. D. 2003. Pharmacognosy and Phytochemistry. Vol. II. Career Publications, Nashik.
5. Ojha D. and Kumar, A. 1978. Pancha Karma Therapy in Ayurveda. Chaukhamba Amarabharti Prakashan, Varanasi.
6. Sharma, S. 1983. The System of Ayurveda. Neeraj Publication House, Delhi.
7. Verma, H. K. 1998. A Comprehensive Book of Ayurvedic Medicine for General Practitioners. Kalyani Publishers, New Delhi.

8. Nadkarni, K.M. 1998. India Materia Medica Vol. II. Popular Book Depot, Bombay 7, Dhootapapeshwar Prakashan Ltd. Panvel.

M.Phil. (Botany) SEMESTER-II

BOT-MP 201: Advanced Analytical Techniques

Time: 3 Hours **Max. Marks: 100**
Theory: 6 Periods/Week **Theory: 75; Int. Ass.: 25**

1. **Principles of Analytical Methods**: Titrometry, Gravimetry, Colorimetry, Spectrophotometery, Chromatography, GLC, HPLC, Atomic Absorption Spectrophotometry and Flame Photometry.
2. **Histochemical and immunotechniques**: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.
3. **Biophysical methods**: Molecular analysis of biomolecules using UV/visible, fluorescence, UV, circular dichroism, NMR and ESR spectroscopy, molecular structure determination using X-ray florescence and X-ray diffraction and NMR; Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.
4. **Molecular biology & Recombinant DNA methods**: Isolation, purification and sequencing of RNA, DNA (genomic and plasmid) and protein, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional Electrophoresis and electrofocussing gels; Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; Isolation, separation and analysis of carbohydrates and lipids molecules using RFLP, RAPD and AFLP techniques.
5. **Microscopic techniques**: Visualization of cellular and sub cellular components by light microscopy, resolving power of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze fracture methods for EM image processing methods in microscopy.
6. **Radiolabeling techniques**: Detection and measurement of radioisotopes normally used in biology; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

Books Recommended:

1. Brown TA (2001) Gene cloning and DNA analysis, An Introduction, 4th Edition, Blackwell Scientific Publication, Oxford, UK
2. Friefelder, D (1982) Physical Biochemistry, Applications to Biochemistry and Molecular Biology, WH Freeman and Company
3. Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry: Principles and Techniques, Cambridge University Press, UK.

4. Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd., Chichester, England.
5. Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd., Chichester, England.

M.Phil. (BOTANY) SEMESTER-II

BOT-MP 202 E-8 - Advanced Environmental Ecology

Time: 3 Hours **Max. Marks: 100**
Theory: 6 Periods/Week **Theory: 75; Int. Ass.: 25**

1. **Water Chemistry:** Chemistry of water, concept of DO, BOD, COD, sedimentation coagulation,filtration,Redox potential.
2. BOD test procedure, determination of BOD and Modelling of BOD, Calculation of BOD constants using Least square and Fujimoto methods. Interrelationship between BOD, COD and TOC.
3. Box model, point source stream pollution. Dissolved oxygen model (oxygen sag curve). Basic design of Screening, sedimentation. Filtration, Softening Break point chlorination.
4. Physico-chemical and bacteriological sampling including MPN test and analysis of water quality. Standards for water quality and wastewater discharge.
5. **Solid waste management with vermicomposting**:Resource recovery or reclamation, organic waste processing, composting,anaerobic digestion, vermiculture and vermicomposting, essential precautionary steps in vermicomposting, vermiculturing and protein production, vermiwash, overall benefits, economics and marketing. Fermentation.
6. **Bioremediation**: Types of bioremediation, use of fungi, algae and bacteria in biosorption, cautions for using bioremediations, biodegradation of oilspills, TNT wastes, dye stuff wastes, pesticides and xenobiotics.
7. **Polymers and plastic degradation**: Introduction, polymer synthesis, polymer degradation, photochemical degradation, biodegradation of naturally occurring polymeric substances, disposable synthetic polymers, polymer recycling, carry bags- a menace, role of microorganisms in degradation of polymers and plastic.
8. **Biofertilizer**; Bacteria, bacterization, mass cultivation of microbial inoculants, green manuring. the blue green algae, algalization. *Azolla*. Present status and improvements.
9. **Biomass production technology**: Introduction, plant biomass, sources of biomass, forest biomass, crop residues (cereals, leguminous crops, sugar cane etc.), aquatic biomass, wastes as a source of energy, composition of plant biomass (cellulose, hemicellulose and lignins). Biomass conversion, biological and non-biological processes, useful products of biomass (ethyl alcohol, methanol, methane). Applications and future prospects.

Reference:

1. Benefild. L.D., Jedkins.J.F. Jr. and Weand.B.L. (1985). Process chemistry for Water and Wastewater Treatment. Prentice Hall Inc., New York.
2. Cornwell. D.A. and Davis. M (1999). Introduction to Environmental Engineering. McGraw-Hill.New York.

3. Eckenfelder, W.W.Jr (!989). Industrial Water Pollution Control. McGraw-Hill Book Company, New York.
4. Elangovan. R. and Saseetharan, M.K. (1995). Unit Operation in Environmental Engineering. New Age International, New Delhi.
5. Fair, G.M. Geyer.J.C. and Okum.K (1979). Water and Wastewater Engineering. Vol.2. John Wiley, New York.
6. Alexander, M.(1999). Biodegradation and Bioremediation. Acadamic Press, San Diego.
7. Abbasi. S.A. and Ramasami. E. (1999). Biotechnological Methods of Pollution Control. Universities Press, Hyderabad.
8. Manahan. S.E. (2009). Environmental Science and Technology. Lewis Publishers. New York.
9. Rittmann. D.E. McCarty.P.L.(2001). Environmental Biotechnology: Principles and Applications. McGraw Hill, .New York.

M.Sc. Botany
Scheme of Courses
Semester I
Session 2019-2020

S.No.	Code (Course No.)	Subject (Course Title)	Hours /Week	Marks		
				Theory/ practical	Int. Ass.	Total
1	BOTC511	Phycology	3	37	13	50
2	BOTC512	Mycology and Plant Pathology	3	37	13	50
3	BOTC513	Genetics and Evolution	3	37	13	50
4	BOTC514	Plant Physiology	3	37	13	50
5	BOTC515	Introduction to Computers and Basic Bioinformatics	3	37	13	50
6	BOTC516	Theoretical Biology	3	37	13	50
7	BOTC551	Botany Practical I (Based on BOTC511, BOTC512 & BOTC513)	6.5	56	19	75
8	BOTC552	Botany Practical II (Based on BOTC514, BOTC515 and BOTC516)	6.5	56	19	75
Total			**31**	**450**		

Int. Ass. = Internal Assessment

M.Sc. Botany
Scheme of Courses
Semester II
Session 2019-2020

S.No.	Code (Course No.)	Subject (Course Title)	Hours /Week	Marks		
				Theory/ practical	Int. Ass.	Total
1	BOTC521	Bryology	3	37	13	50
2	BOTC522	Diversity and Biology of Gymnosperms	3	37	13	50
3	BOTC523	General Microbiology	3	37	13	50
4	BOTC524	Cell Biology	3	37	13	50
5	BOTC525	Pteridology	3	37	13	50
6	BOTC526	Ecological Modelling and Forest Ecology	3	37	13	50
7	BOTC561	Botany Practical I (Based on BOTC521, BOTC522 BOTC523)	6.5	56	19	75
8	BOTC562	Botany Practical II (Based on BOTC524, BOTC525 and BOTC526)	6.5	56	19	75
9	BOTC563	On Job Training or Assignment	1	Satisfactory/ Not Satisfactory		
Total			**32**	**450**		

@ In addition to the courses listed above, a candidate may be required to study additional optional course/s in Botany or other disciplines, as may be approved by the Board of Control. The marks obtained in such papers will be entered in the transcript but will not add to total marks obtained by the candidate for the award of the degree.

Int. Ass. = Internal Assesement

M.Sc. Botany
Scheme of Courses
Semester III
Session 2019-2020

S. No.	Code (Course No.)	Subject (Course Title)	Hours /Week	Marks		
				Theory/ practical	Int. Ass.	Total
1	BOTC611	Plant Morphogenesis	3	37	13	50
2	BOTC612	Developmental Botany	3	37	13	50
3	BOTC613	Plant Molecular Biology	3	37	13	50
4	BOTC614	Plant Breeding and IPR	3	37	13	50
5	BOTC615	Plant Biochemistry	3	37	13	50
6	BOTC616	Applied Botany	3	37	13	50
7	BOTC651	Botany Practical I (Based on BOT C611, BOT C612 and BOT C613)	6.5	37	13	50
8	BOTC652	Botany Practical II (Based on BOT C614, BOT C615 and BOT C616)	6.5	56	19	75
9	BOTC653	Assignment	1	Satisfactory/ Not Satisfactory		
10	BOTC654	Seminar	2	20	5	25
Total			**34**	**450**		

@ In addition to the courses listed above, a candidate may be required to study additional optional course/s in Botany or other disciplines, as may be approved by the Board of Control. The marks obtained in such papers will be entered in the transcript but will not add to total marks obtained by the candidate for the award of the degree.

Int. Ass. = Internal Assessment

M.Sc. Botany
Scheme of Courses
Semester IV
Session 2019-2020

Sr.No.	Code (Course No.)	Subject (Course Title)	Hours /Week	Marks		
				Theory/ practical	Int. Ass.	Total
1	BOTC621	Plant Anatomy	3	37	13	50
2	BOTC622	Structure and Metabolism of Plant Hormones	3	37	13	50
3	BOTC623	Plant Tissue Culture and Biotechnology	3	37	13	50
4	BOTC624	Analytical Techniques	3	37	13	50
5	BOTC625	Diversity and Biology of Angiosperms	3	37	13	50
6	BOT C724	Hazardous Chemicals *	3	37	13	50
7	BOTC661	Botany Practical I (Based on BOT C621, BOT C622 and BOT C623)	6.5	56	19	75
8	BOTC662	Botany Practical II (Based on BOT C624 and BOT C625)	4.5	56	19	75
9	BOTC663	Field Study	Satisfactory/ Not satisfactory			
10	BOTC664	Research Techniques	3	Satisfactory/ Not satisfactory		
Total			**32**	**450**		

* List of Optional Papers
1. BOT C724 - Hazardous Chemicals
2. BOT C725 – Immunology

@ In addition to the courses listed above, a candidate may be required to study additional optional course/s in Botany or other disciplines, as may be approved by the Board of Control. The marks obtained in such papers will be entered in the transcript but will not add to total marks obtained by the candidate for the award of the degree.

Int. Ass. = Internal Assessment

M.Sc. (BOTANY) SEMESTER-I

BOT C511 – Phycology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, Comparative account of important system of classification (Fritsch and Lee).
2. Organization of thallus, structure of algal cell, algal pigments and photosynthetic apparatus. Algal flagella, nutrition,
3. Comparative account of food reserves, reproductive diversity, life history patterns.
4. Chlorophyta (*Volvox, Hydrodictyon, Cladophora, Fritschiella, Oedogonium, Zygnema, Vaucheria*).
5. Charophyta (*Chara*).
6. Phaeophyta (*Ectocarpus, Laminaria, Macrocystis, Dictyota, Fucus, Sargassum*).
7. Rhodophyta (*Porphyra, Batrachospermum, Polysiphonia*).
8. Cyanophyta (*Nostoc, Oscillitoria, Rivularia, Spirulina, Stigonema*).
9. Rhythms and bioluminescence in Dinoflagellates, algal blooms.
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 andReproduction, 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. Kumar. H.D. (1999). Introductory Phycology, East – West Press Pvt. Ltd. New Delhi
5. Trivedi, P.C. (Ed.) (2001). Algal Biotechnology. Pointer Publishers, Jaipur.
6. Fritsch F.E. (1945). The Structure and Reproduction of Algae. Vol. II. Cambridge Univ. Press. Cambridge, London.

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 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 – Mycology and Plant Pathology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. Introduction to fungi; history of mycology, general characteristics of fungi and fungi like organism, somatic structures and hyphal forms, modes of reproduction, life cycle patterns, growth and differentiation, fungal nutrition, fungal nomenclature, classification and phylogeny.

2. KINGDOM: FUNGI

General Characteristics, Life history & Classification of the following:

Phylum: *Chytridiomycota*

Monoblepharis

Phylum: *Neocallimastigomycota*

Neocallimastrix

Phylum: *Blastocladiomycota*

Allomyces

Phylum: *Zygomycota*

Rhizopus, Phycomyces, Pilobolus, Entomophthora,

Phylum: *Glomeromycota*

Glomus

Phylum: *Ascomycota*

Saccharomyces, Morchella, Peziza, Aspergillus, Claviceps, Glomerella

Mitosporic: Fungi

Pyricularia, Veriticillium

Phylum: *Basidiomycota*

Agaricus, Amanitia

3. KINGDOM: CHROMISTA

History, classification, structure, development, reproduction, life history of the following:

Phylum: *Oomycota*

Saprolegnia

4. KINGDOM: PROTOZOA

History, classification, structure, development, reproduction, life history of the following

Phylum: Mycetozoa

Physarum, Stemonites, Dictyostelium, Plasmodiophora

5. 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.

6. Symptomatology, identification, etiology and control measures of the following plant disease:

Causal Organism	**Disease**
Synchytrium	Potato Wart
Taphrina	Peach Leaf Curl
Venturia	Apple Scab
Erysiphe	Powdery Mildew of Bajra
Alternaria	Early Blight of Potato
Cercospora	Tikka Disease of Groundnut
Fusarium	Wilt of Cotton and Arhar
Helminthosporium	Brown Spot Disease in Rice
Colletotrichum	Anthracnose Disease of Chillies
Puccinia	Rust of Wheat
Ustilago	Loose Smut of Wheat
Tilletia	Karnal Bunt of Rice
Pythium	Damping-off Disease
Phytophthora	Late Blight of Potato, Blight of *Colocasia*
Albugo	White Rust of Crucifers

7. Origin and evolution of Sex in fungi including hormonal control, heterothallism, homothallism & parasexual cycle.

8. Economic importance of Fungi with respect to role in industry, Medicine, Mycorrhizae in agriculture, Biological control, Edible fungi, mushroom cultivation.

Books Recommended

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4th 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.
6. Hait G. (2016). A Textbook of Mycology. New Central Book Agency (P) Ltd. London.

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 papaya, yellow vein mosaic of bhindi, red rot of sugarcane, anthrocnose of chillies.)
3. To study type genus: *Saccharomyces, Rhizopus, Mucor, Peziza, 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: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 ϕX174, 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 X174.
3. **Genetic regulation of cell cycle**: Homologous chromosomes, polytene and lampbrush 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* transposons, 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. **Palaeontology 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.
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: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 relations, 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.
1. **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.
2. 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.
3. 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,
4. 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-I

BOTC 515- Introduction to Computers and Basic Bioinformatics

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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.

Basic Computers
MS-Word-2003

Overview of word processing software, creating, saving and opening a new file in MS-Word, various formatting tools, paragraphs and sections, indents and outdents, lists and numbering, types of lists, Headings, styles, fonts and font size. Editing, positioning and viewing texts, Finding and replacing text, inserting page breaks, page numbers, book marks, symbols and dates, Inserting header, footer, mail merge.

MS-Excel-2003

Worksheet: Introduction to worksheet, worksheet basics, building a worksheet, moving within worksheet, entering data into worksheet, saving & quitting worksheet, opening and moving around in an existing worksheet,
Working with Formulae: cell referencing, use of formulae, auto sum, copying formulae, absolute & relative addressing, working with ranges- creating , editing and selecting ranges,
Previewing & Printing Worksheet: page setting, print titles, adjusting margins, page break, headers and footers.
Graphs and Charts: using wizards, various charts type, formatting grid lines & legends, previewing & printing charts.

MS–Power Point

Introduction to MS Power Point, presentation overview, power point elements, exploring power point menu, entering information, presentation creation. Opening and saving presentation, slide view, slide sorter view,.notes view, outline view, printing slides, formatting and enhancing text formatting

Bioinformatics

1.Introduction to Bioinformatics, History of Bioinformatics, milestones, objectives and applications of Bioinformatics.
2.Introduction to Biological Databases, Types of Databases,
3.Literature Databases: PUBMED, PUBMED Central, European PUBMED Central
4.Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISSPROT,UNIPROT.
5.Database Retrieval and Deposition Systems: SRS, Entrez, Bankit, Seqin, Webin
6.Biotechnological Databases: EST, SNP
7.Databases for species identification and classification: GBIF, taxonomy browser at NCBI.
8.Plant Genome Databases: TAIR, Rice Genome Annotation Project, Maize GDB
9.Structural Databases: PDB, NDB
10.Carbohydrates and lipid databases: GlycoSuiteDB, LIPIDAT

SUGGEESTED PRACTICALS

1) Introduction to MS Word, Creating Table in MS Word, Page Formatting, Printing, Page Layout
2) Mail Merge
3) Creating Slide Presentation in MS PowerPoint, Viewing the Slideshow, Adding Images in MS PowerPoint, Inserting Sound and Videos in MS PowerPoint
4) Introduction to MS Workbook
5) Creating different worksheets in MS Excel, Inserting Charts in MS Excel, Introduction to various functions in MS Excel
6). Introduction to various Literature Databases: PUBMED, Google Scholar, Scopus
7) Introduction to Nucleotide databases i.e. NDB, GenBank, EMBL and DDBJ
8) Introduction to protein databases i.e. PDB, SWISS-PROT
9) Carbohydrates and lipid databases: GlycoSuiteDB, LIPIDAT
10) Plant Genome Databases: TAIR, Rice Genome Annotation Project, Maize GDB

Books Recommended

1. Mount D. W. (2004).Bioinformatics & Genome Analysis.Cold Spring Harbor Laboratory Press.
2. Baxevais B.F. and Quellette F. (2004). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience.
3. Eidhammer I., Jonassen I. and Taylor W. R. (2004). Protein Bioinformatics: An Algorithmic Approach to Sequence and Structure Analysis. Mathematics.
4. Orengo C.A., Jones D.T. and Thornton J.M. (2003). Bioinformatics: Genes Proteins and Computers. Bios Scientific Pub.
5. Bourhe P. E. and Weissig H. (2003). Structural Bioinformatics (Methods of Structural Analysis).Wiley-Liss.
6. Sinha, P.K. (1998). Computer Fundamentals.BPB Publications, New Delhi.
7. Peter Norton's (1998). Introduction to computers, Tata McGraw-Hill Publishing Company Limited, New Delhi

M.Sc. (BOTANY) SEMESTER-I

BOT C516 – Theoretical Biology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. **Linear Function:** y=ax and y=ax+b
2. **Power Function:** $y=ax^n$, quadratic equation.
3. **Periodic Function:** Sine and cosine, trigonometric relations.
4. **Exponential and Logarithmic Functions:** Exponential function $y=aq^x$, logarithmic function.
5. **Probability:** Concept of probability, permutations and combinations, normal distribution.
6. **Differentiation and Integration:** Limit Growth rates, instantaneous rate of change, differentiation of some important functions, product rule and quotient rule of differentiation, chain rule of differentiation.
7. **Integration:** Integrals, definite integral, rules of integration, second derivative.
8. **Exponential and Logarithmic Functions:** $d/dx(e^x)$, d/dx(ln x), integral of 1/x.
9. **Statistics:** Mean, standard deviation, standard error, 't' test, chi square test.
10. One way ANOVA, simple linear regression and correlation.
11. **Matrix Operations**: Addition, subtraction, multiplication, inversion, latent root, latent vector.

Books Recommended

1. APHA-Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, DC. 23rd edition
2. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial Plan Ecology. Benjamin/Cummings Publication Company, California. 3rd edition
3. Batschelet, E. (1971). Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin. 2nd edition

4. Begon, M. Harper, J.L. and Townsend, C.R. (1996). Ecology, Blackwell Science, Cambridge. 6th edition
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. 6th edition
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. 3rd edition
13. Ludwig, J and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.

M.Sc. (BOTANY) SEMESTER-II

BOT C521 Bryology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, 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 (*Riccia, Marchantia,Targionia,Cyathodium,Lunularia*)
3. Sphaeropales (*Sphaerocarpus*)
4. Calobryales (*Calobryum*)
5. Jungermanniales (*Porella*)
6. Metzgeriales (*Pellia*)
7. Anthocerotales (*Anthoceros*)
8. Sphagnales (*Sphagnum*)
9. Andreaealas (*Andrea*)
10. Bryales (*Funaria*)
11. Origin of land habit, Evolution of gametophyte and sporogonium in liverworts and mosses (taking examples of above mentioned orders)
12. Spore dispersal, Peristome teeth in mosses, Palynology of Bryophytes, Methods to conserve Bryophytes at national level.
13. Morphogenetic changes in moss protonema, Characteristic endohydric, ectohydric and myxohydric bryophytes.

Books Recommended

1). Bower, F.O. (1908). The Origin of Land Flora. The MacMillan Press, London.
2). Campbell, D.R. (1985). The Evolution of Land Plants (Embryophyta) Reprinted Central Book Depot, Allahabad

3).Smith, G.M. (1955). Cryptogamic Botany. Vol. II, Tata McGraw Hill Publishing Co. Ltd.New Delhi.
4) Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press, London.
5) Taylor, T.N. (1981). Palaeobotany.An Introduction to Fossil Plant Biology, McGraw Hill Book Company, New York.
6) Kumar, S.S.(1984) An Approach towards Phylogenetic Classification of Mosses, Jour. Hattori Bot. Lab. Nichinan, Japan.
7) Goffinet, B. and Shaw, A.J.(2000) Bryophyte Biology, Cambridge University Press, Cambridge, pp. 476

Suggested Practicals

1. Morphological, reproductive and anatomical study of representative members of the bryophytes studied in theory using cleared whole mount preparation and sectioning (*Riccia, Marchantia, Porella, Pellia, Funaria, Sphagnum, Polytrichum*).
2. Studies on habit and natural habitat of bryophytes.
3. Study of Peristome teeth (WM).
4. Study of Scales, rhizoids (WM).
5. Study of dehiscence pattern of sporogonium.

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: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 pathogenic 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 supplements, vitamins and beverages; organic acids; enzymes and microbial transformation; inhibitors; genetically engineered microorganisms – Human insulin andhuman 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: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 proteins, 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. (1991). 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

BOTC525 - Pteridology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. Origin of land floras, differentiation of organs in vascular plants – Telome and Enation theories, significance and short comings.
2. 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.
3. General characters and classification of pteridophytes, occurrence, comparative organography, systematics, reproduction and types of life cycle in:
4. Rhyniales (*Rhynia, Psilophyton*)
5. Psilotales (*Psilotum*)
6. Lycopodiales (*Lycopodium*)
7. Sellaginallales (*Sellaginella*)
8. Equisetales (*Equisetum*)
9. Ophioglossales (*Ophioglossum*)
10. Marattiales (*Marattia*)
11. Filicales (*Pteris, Dryopteris*)
12. Marseliales (*Marsilea*)
13. Salviniales (*Salvinia, Azolla*)
14. 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.
15. Spore structure, pattern of spore germination in ferns, Utility of fern for phytoremediation.

Books Recommended

1) Bower F.O. (1928). The Ferns, Vols. I – III. Cambridge University Press, Cambridge.
2) Parihar, N.S. (1992). The Biology and Morphology of Pteridophytes, Central Book
3) Rashid, A. (1991). An Introduction to Pteridophytes. Vikas Publishing House Pvt. Ltd. Distributors, Allahabad.
4) Sinnott, E.W. (1960). Plant Morphogenesis. McGraw Hill Book Company Inc. New York, Toronto, London.
5) Sporne, K.R. (1962). Morphology of Pteridophytes, BI Publications, New Delhi.
6) Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press,London.
7) Taylor, T.N. (1981). Palaeobotany. An Introduction to Fossil Plant Biology, McGraw Hill Book Company, New York.
8) Sporne, K.R.(1982) The morphology of Pteridophytes, B.I., Publications, Bombay, Delhi, Madras.

Suggested Practicals

1. Morphological, reproductive and anatomical study of representative members of the pteridophytes studied in theory using cleared whole mount preparation and sectioning (*Selaginella, Lycopodium, Equisetum, Pteris, Dryopteris, Marsilea, Salvinia*).
2. Studies on habit and natural habitat of Pteridophytes.
3. Study of spore morphology.
4. Study of spore germination on Knop's medium.

M.Sc. (BOTANY) SEMESTER-II

BOT C526 – Ecological Modelling and Forest Ecology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks: 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, 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. **Interaction Between Two Species:** Competition – Differential equations, Leslie-Gower Model, Lotka-Volterra model for predator – prey interaction, Leslie model, simple epidemics.
4. **Association Analysis and Community Classification:** Chisquare, Cole's measures and point correlation coefficient for association,continuum concept.
5. **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.
6. **Production and Energy Flow:** Production in animal populations, efficiency, measurement of ingestion. Measurement of production in plants, litter decomposition.
7. Forest types, climatic region of India, Central, characters and distribution of different forest type of India, Salient features of Indian forest act 1972, different methods employed for conservation of forest, Social and urban forestry.
8. **Environmental Law & Policy:** Constitutional provisions, Water (prevention and control of pollution) Act, 1974, Air (prevention and control of pollution) Act, 1981, Environment ProtectionAct, 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.
5. Chapman, J.L. and Reiss, M.J. (1988). Ecology: Principles and Applications, Cambridge University Press, Cambridge.
6. De, A.K. (1990). Environmental Chemistry. Wiley Eastern Pvt. Ltd., New Delhi.
7. Heywood, V.H. and Watson, R.T. (1995). Global Biodiversity Assessment, Cambridge University Press, Cambridge.
8. Hill, M.K. (1997). Understanding Environmental Pollution. Cambridge University Press, Cambridge.
9. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
10. Krebs, C.J.(1989 Ecological Methodology. Harper and Row, New York, USA.)
11. Koromody, E.J. (1981). Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
12. Ludwig, J and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.
13. Magurran, A.E. (1988). Ecological Diversity and its Measurement. Chapman & Hall, London.
14. Mason, C.F. (1991). Biology of Freshwater Pollution, Longman.
15. Misra, R.(1968). Ecology Work Book. Oxford & IBH, New Delhi.
16. Moldan, B. and Billharz, S. (1997). Sustainability Indicators. John Wiley & Sons, New York.
17. Moore, P.W. and Chapman, S.B. (1986). Methods in Plant Ecology. Blackwell Scientific Publications, Cambridge.
18. Muller-Dombois, D. and Ellenberq, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York.
19. Odum, E.P. (1971). Fundamentals of Ecology, Saunders , Philadelphia
20. Odum, E.P. (1983). Basic Ecology. Saunders , Philadelphia.
21. Pielou, E.C. (1984). The Interpretation of Ecological Data, Wiley, New York.
22. Poole, R.W. (1974). An Introduction to Quantitative Ecology. McGraw Hill Book Co., New York.
23. Smith, R.L. (1996). Ecology and Field Biology. Harper Collins, New York
24. Forest Ecology (3rd Edition) by James P. Kimmins Publisher Benjamin Cummings (2003)

25. Introduction of Forestry and Natural Resources (2013) by Donald L. Grebner, bettinger and Siry, Publisher Academic Press.
26. Forest Ecosystem by David A. Perry, Ram Oren and Stephan C. Hart (2nd Edition, 2008) Publisher Johns Hopkins University Press.
27. Introduction to remote sensing (5th Edition,2011) by Jmes B. Compbell and Randolph H. Loynne, Publisher The Guilford Press.

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

M.Sc. (BOTANY) SEMESTER-III

BOT C611 – Plant Morphogenesis

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, genetic factors and chemical factors in general.

Books Recommended

1. Ainsworth C (2006) Flowering and its Manipulation, Annual Plant Reviews, Vol. 20. Blackwell Publishing, Oxford, U.K. 2. Brown, TA. (2002) Genomes, BIOS Scientific Publishers Ltd, Oxford, UK.

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

Suggested Practicals

1. Emasculation, bagging, hand pollination to study pollen germination, seed set and fruit development. Study of cleistogamous flowers and their adaptations.
2. Study of nuclear and cellular endosperm through dissection and staining.
3. Isolation of zygotic globular, heart shaped, torpedo stage and mature embryos from suitable seeds.
4. Study of seed dormancy and methods to break dormancy.
5. To Study the primitive and advanced characters of plants in angiosperms.
6. Study of various methods of asexual reproduction and vegetative reproduction.
7. To Study the effects of light, gravity, humidty temperature on plants.
8. To study effect of bending on plant morphogenesis.

M.Sc. (BOTANY) SEMESTER-III

BOT C612 – Developmental Botany

Time: 3 Hours **Max. Marks : 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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**: Apospory, Parthenogenetic Development of Embryo, Importance. Seed: Growth and Development, Seed Appendages.
6. **Embryology & Taxonomy:** Diagnostic embryological characters, Primitive and advanced characters, Role of embryology and palynology in taxonomy.
7. **Role of Embryology in Plant Breeding:** Embryology of hybrids, disfunction of endosperm, arrested development of embryo.

Books Recommended

1. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.
2. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.
3. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd. Bombay – New Delhi.
4. Parihar, NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II – Pteridophyta, Central Book Dept. Allahabad.
5. Raghavan, V (2000) Developmental Biology of Flowering Plants, Springer, Netherlands
6. Raghavan, V (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press.
7. Richards, AJ (1986) Plant Breeding System, George Allen and Unwin.
8. Shivanna, KR (2003) Pollen Biology and Biotechnology, Science Publisher.
9. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.

Suggested Practicals

1. Examination of the following with the help of hand sections, dissections and prepared longitudinal, transaction of Flowers:
    A. Transmitting tissue/canal in the stigma and style.
    B. Various types of flowers and placentation.
    C. Special types of flowers with emphasis on vasculature of androecium and gynoecium.
2. Study from permanent preparations, development and structure of anther, pollen, ovules, megasporogenesis, embryo sac, endosperm and embryo.
3. Study of microsporogenesis and gametogenesis in sections of anther.
4. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescentia*, *Brassica*, *Petunia*, *Solanum melongena*).
5. Test for pollen viability using strain and *in vitro* pollination. Pollen germination using hanging drops, sitting drop culture and suspension culture.
6. Estimating percentage and average pollen tube length *in vitro*.
7. Field study of several types of flowers with different pollination mechanisms (wind, insects, bird pollination)

M.Sc. (BOTANY) SEMESTER-III

BOT C613 – Plant Molecular Biology

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks : 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, lysogenic 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 for transgenic plants, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Books Recommended

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
5. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
6. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
7. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Suggested practicals

1. Identification of the parts of bright- field microscope and demonstration of its use and care.
2. Perform basic microbiological techniques such as sterile plating and isolation of single colonies.
3. Isolation of DNA from biological samples.
4. Characterization of isolated DNA using agarose gel electrophoresis.
5. Graph and analyze agarose gel data.
6. Genetic transformation of bacteria.
7. Screening and selection of transformants.
8. Demonstration of PCR technique.
9. Spectrophotometric estimation of DNA.
10. Demonstration of DNA sequencing technique.

M.Sc. (BOTANY) SEMESTER-III

BOT C614 – Plant Breeding and IPR

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks : 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 vigour, 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, multiple comparison test, discriminant function and cluster analysis.
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, biosafety; laws and conventions related to intellectual property rights.

Books Recommended

1. Agrawal, R.L. (1998). Fundamentals of Plant Breeding and Hybrid Seed Production. Oxford and IBM Publ. Co. Pvt. Ltd., New Delhi.
2. Allard, R. W. (1981), Principles of Plant Breeding. John Wiley & Sons, N. York.
3. Anonymous (1997). National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
4. Bhandari, M.M. (1974). Practicals in Plant Breeding. A Manual cum practical record. Oxford and IBH Publ. Co. New Delhi.
5. Chopra, F.L. (Ed.) (2001). Plant Breeding: Theory and Practice. (Reprint 1994). Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.
6. Gupta SK. 2005. Practical Plant Breeding. Agribios
7. Poehlman, J.M. and Sleper, D.A. (1995). Breeding Field Crops (4th Edition) Panima Publishing Corporation, New Delhi.
8. Raghuvanshi, R.K., Chauhan, A.K.S and Sidhigui, B.A. (1995). Practical Excercises in Cytology, Genetics, Plant Breeding and Biostatistics (1st Edition). CBS Publishers and Distributors, New Delhi.
9. Roy Darbeshwar(2000). Plant Breeding - Analysis and Exploitation of Variation. Narosa Publishing Hourse, New Delhi.
10. Sharma, A.K. and Sharma A. (1999). Plant Breeding. Lecture Notes on Patents. November 1999). Technology Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology(DST), Technology Bhavan, New Mehrouli Road, New Delhi.
11. Sharma, J.R. (1994). Principles and Practice of Plant Breeding, Tata McGraw Hill Publ. Comp. Ltd., New Delhi.
12. Singh, B.D. (2005), Plant Breeding - Principles and Methods, Kalyani Publishers, Ludhiana.
13. Singh, BD. 2006. Plant Breeding. Kalyani.
14. Singh, S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding
15. Stoskopf, N.C., Tames D.T. and Chrisie B.R. (1993). Plant Breeding -Theory and Practice. West view Press, Boulder
16. Sundararaj, D.D. and Thulsidas G. (1993). Botany of Field Crops (2nd Edition), MacMillan India Ltd., New Delhi.
17. Vijendra, L.D (1998). Plant Breeding. New Age International Publishers, New Delhi.

Suggested Practicals

1. Floral biology in self and cross pollinated species.
2. Selfing and crossing techniques.
3. Numerical exercises on probability and biostatistics
4. Maintenance of experimental records.
5. Learning techniques in hybrid seed production.
6. To study Breeders kit.
7. Studies on centres of origin of various useful crops.
8. To study Vegetative Propagation in –Potato , Onion bulb, Sugarcane, Ginger.
9. To perform exploration for determination of male sterility.
10. To perform Field exploration for determination of Dichogamy, Heterostyly and Dioecy.
11. To estimate Pollen viability in *Zea mays* and *Hibiscus*.

M.Sc. (BOTANY) SEMESTER-III

BOT C615 – Plant Biochemistry

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks : 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, 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, pentose phosphate 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.
4. **Enzymology:** Introduction to enzymology, history of enzymes, nomenclature and classification. Specificity of enzymes: group specificity, absolute specificity, stereochemical specificity. Mechanism of enzyme catalysis: Activation energy, Nature of active sites, enzyme-substrate complex, induced fit hypothesis, strain and distortion theory.
5. **Enzyme Kinetics:** Michaelis-Menton Equation, Lineweaver-Burk plot. Regulation of enzyme activity and concentration: Brief account of enzyme induction and repression, covalent modification, isoenzymes and allosteric enzymes.

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. Longman, Essex.
3. Dryer, R.L. and Lata, G.F. (1989). Experimental Biochemistry, Oxford University Press, New York.
4. Goldsby, R.A. Kindt, T.J., Oxborne B.A., Kuby, J. (2003). Immunology.W.H. Freemen & Company, NewYork.
5. Murray, R.K., Grammer, D.K., Mayes, P.A. and Rodwell V.W. (1990). Harper's Biochemistry. Prentice Hall International Inc., London.
6. Nelson, D.L. and Cox, M.M. (2000). Lehninger's Principles of Biochemistry. Worth Publishers, New York.
7. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA.
8. Tryer, L. (1995). Biochemistry W.H. Freeman & Co., New York.
9. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford
10. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold, London.
11. Zubay G. (1993). Biochemistry. WCB Publishers, IOWA.

Suggested practicals

1. Preparation of the solutions of different concentrations.
2 Preparation of the inorganic and organic buffers of different conc. and pH.
3. Preparation of the standard curve of protein and determine the protein content in unknown samples by Lowry's method.
4. Estimation of the protein content in given plant sample by Bradford's method.
5. Estimation of the protein content in given plant sample by Biuret's method.
6. stimation of the carbohydrates in given plant sample by Anthrone's reagent.
7. Estimation of the carbohydrates in given plant sample by Dubois's method.
8. Estimation of the activity of enzyme catalase.
9. Estimation of the activity of enzyme peroxidase.
10. Preparation of the standard curve of proline and determine the proline content in unknown samples by Bates's method.
11. SDS-PAGE for soluble proteins extracted from the given plant material and comparison of their profile by staining with Coomassie brilliant blue.

M.Sc. (BOTANY) SEMESTER-III

BOT C616 – Applied Botany

Time: 3 Hours
Theory Lectures: 3 Credit Hours/Week **Max. Marks : 50**
Theory: 37; Int. Ass.: 13

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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; functional foods.
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; soils; bio-fuel producing plants.
4. **Fibres:** Classification of fibres, physical and chemical processes involved in the manufacuring of fibres from different types of fibre yielding plants.

5. The Rubber Plants of India, Extraction of Raw Rubber and its Chemical Processing for the Manufacturing of Finished Rubber.
6. 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.
7. Essential oil yielding plants of India, their use in perfumary.
8. Sources of natural dyes in India and their extraction methods, merits and limitations of plant based dyes.

Books Recommended

1. Ambasta S P (1994). The Useful Plants of India. (3rd Ed.). Publications & Information Directorate, New Delhi.
2. Brown H P (1989). An Elementary Manual on Indian Wood Technology (Reprinted). International Book Distributors, Dehra Dun, India.
3. Kochhar S. L. (1998). Economic Botany in the Tropics. MacMillan India Limited, Delhi.
4. Pandey B P (1984). Economic Botany (3rd Ed.). S. Chand & Company Ltd., New Delhi.
5. Shankar Gopal Joshi (2000). Medicinal Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Trotter H (1982). The Common Commercial Timbers of India and Their Uses. The Controller of Publications, Delhi.
7. Wickens GE (2004) Economic Botany: Principles and Practices, Springer, ISBN 978-0-7923-6781-9.

Suggested practicals

To study economic importance, distribution, centres of origin of following specimens:

1. Study of morphology and microchemical tests for stored food material for cereals: Wheat (*Triticum aestivum),* Rice (*Oryza sativa)* , Maize *(Zea mays)*
2. Study of morphology and microscopic study of fibres:
   Cotton (*Gossypium sp*, Jute (*Corchorus capsularis*), Flax (*Linum usitatissimum)*
3. Sugar yielding plant:
   Sugarcane (*Saccharum officinarum)*
4. Study of morphology of oil yielding plants:
   Groundnut (*Arachis hypogea*), Mustard (*Brassica sp)*,Coconut (*Cocos nucifera*),Castor (*Ricinus communis)*, Soyabean (*Glycine max)*and performing tests for oil.
5. Study of morphology and alkaloid present in spices:
   Ginger (*Zingiber officinale)*, Turmeric (*Curcuma longa)*,Coriander (*Coriandrum sativum)*,Clove (*Eugenia aromaticum*), Black Pepper (*Piper nigrum)*, Cinnamon (*Cinnamomum zeylanicum*)
6. Study of morphology and medicinal value for medicinal plants:
   Amla (*Emblica officinalis)*, Bahera (*Terminalia belerica)*, Harhar (*Terminalia chibula)*, Sarpagandha (*Rauwolfia serpentine*), Ashwagandha (*Withania somnifera*), Liquorice (*Glycyrrhiza glabra*), Poppy (*Papaver somniferum*), Arjuna (*Terminalia arjuna)*

7. Study of morphology and nutrition value for pulses:
   Green Gram (*Phaseolus aureus*), Black Gram (*Phaseolus mungo)*, Pigeon Pea (*Cajanas cajan)*, Kidney Bean *(Phaseolus vulgaris)*
8. Study of morphology of plants producing fruits
   Citrus (*Citrus sp)*, Apple (*Malus pumila)*, Mango (*Mangifera indica)*, Banana (*Musa sapientum)*, Pineapple (*Ananas comosus)*, Grapevine (*Vitis sp)*
9. Vegetables:
   Potato (*Solanum tuberosum*), Radish (*Rapahnus sativus*), Turnip (*Brassica rapa*)
10. Study of morphology of Beverages:
    Tea (*Thea sinensis*), Coffee (*Coffea arabica*) and knowledge of processing method.

M.Sc. (BOTANY) SEMESTER-IV

BOT C621 – Plant Anatomy

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, stems 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 hard and soft woods of common trees grown in India, importance of density and weight in commercial utilization of woods.
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.

Books Recommended

1. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
2. Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom.
3. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
4. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
5. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.

Suggested practicals

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Study of xylem and phloem elements using maceration, staining, light and electron. micrographs (xerophytes, hydrophytes and halophytes).
3. Study of secretory structures (nectaries and laticifers).
4. Study of leguminous roots with different types of nodules.
5. Anatomical studies of young and mature stem of *Helianthus*.
6. Comparative anatomy of dicot and monocot root, stem and leaf.
7. To study anomalous stem behaviour in stem(*Mirabilis jalapa.,Nyctanthes, Boerhaavia diffusa, Bignonia sp., Dracaena sp.)*
8. Study of anatomical features in xerophytes e.g. (leaf of *Nerium*. stem and leaf of *Calotropisprocera*, phyllocladode of *Ruscus sp.*)
9. Study of anatomical features in hydrophytes e.g. (*Nelumbo* petiole, *Hydrilla* stem and leaf, *Eichhornia crassipes* petiole, leaf lamina, *Typha sp.*)
10. To study anatomy of storage roots ofe.g. (*Raphnus sativa*, *Beta vulgaris*,)
11. To study anatomy of halophytes e.g. (*Chenopodium* stem).
12. To study permanent tissues slides.

M.Sc. (BOTANY) SEMESTER-IV

BOT C622 – Structure and Metabolism of Plant Hormones

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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, hormones vs plant growth regulators, 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 in 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 abscissic acid (ABA), biosynthesis of ABA, carotenoids 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 Hormones:** 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.

Suggested Practicals

1. Study the effect of IAA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
2. To study the effect of IBA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
3. Study the effect of Gibberellins on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
4. Study the effect of Cytokinin on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
5. Estimation of the catalase activity by Aebi's Method.
6. Study of bioassays of Auxins, Gibberellins, Cytokinin, Ethylene, Absicisic Acid and Brassinosteroids.
7. Study of antagonistic effect of cytokinin/ethrel on senescence behavior of leaves of different field crops.

M.Sc. (BOTANY) SEMESTER-IV

BOT C623 – Plant Tissue Culture and Biotechnology

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. Cytogenetics and differentiation in cell and tissue culture, plant regeneration from callus, shoot apex culture and anthers.
2. Micropropagation: Stages, somatic embryogenesis, usefulness, hardening of micropropagated plantlets, advantages and disadvantages, application of the technique in crop improvement.
3. 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 uses and applications.
4. 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.
5. Cell culture and secondary metabolites like cinnamic acid, shikonins, flavonoids and related compounds production.
6. 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.
7. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

Books Recommended

1. Bhojwani, SS and Dantu, PK (2013) Plant Tissue Culture : An introductory text, Springer Publications.
2. George, F.E., Hall, M., Klerk G. J (2008) Plant propagation by Tissue culture 3rd edition Vol I , Springer Publications.
3. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.

4. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.
5. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
6. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell,
7. Tissue and Organ Culture, Springer Verlang, Berlin.

Suggested Practicals

1. To study the functions and operations of various instruments used in PTC like Laminar Air Flow, Autoclave, incubators, oven, Distilllation unit, Weighing balance, pH meter etc.
2. Laboratory design set up of PTC lab.
3. Sterilisation techniques.
4. Different types of Enclosures used in PTC.
5. Preparation of stock solutions and media preparation.
6. Selection, preparation and inoculation of explant.
7. Synthetic Seed Production.
8. Micropropagation and its different steps.
9. Significance of growth hormones in culture.
10. Induction of callus from different explants.
11. Anther culture and ovary culture.

M.Sc. (BOTANY) SEMESTER-IV

BOT C624 – Analytical Techniques

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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 density gradient).
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 Southwestern blotting techniques; Polymerase chain reaction.

Books Recommended

1. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
2. Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
3. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
4. Sheehan, D. (2000). Physical Biochemistry : Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
5. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
6. Wilson K. and Walker J. (Eds.) (2012). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K. Riley, T. and Tomilson, C. (1987).

Suggested practicals

(Experiments based on following techniques):

1. Paper Chromatographgy
2. Thin Layer chromatography
3. Column chromatography
4. Gel Filtration Chromatography
5. Ion Exchange Chromatography
6. Affinity Chromatography
7. Electrophoresis: PAGE and SDS-PAGE
8. UV-Vis Chromatography
9. Demonstration of PCR
10. Centrifugation
11. Flourescent Microscopy

M.Sc. (BOTANY) SEMESTER-IV

BOT C625 – Diversity and Biology of Angiosperms

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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; 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 helobiales and their treatment in the modern systems of classification.
4. Principles of plant taxonomy, alpha taxonomy vs modern taxonomy; chemotaxonomy, cytotaxonomy, numerical taxonomy, anatomy, palynology and embryology in relation to taxonomy.
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 phytogeography and its relevance, phytogeographic 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. Angiosperm Phylogeny Group (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.
2. Cole, A.J. 1969. Numerical Taxonomy,Academic Press, London
3. Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition)
4. Crawford DJ (2003) Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.: Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun
5. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger Pub. Co., New York.
6. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. Sinauer Associaes, Inc., Massachusetts.
7. Nei M and Kumar S (2000) Molecular Evolution and Phylogenetics. Oxford University Press, New York.
8. Raven PH, Begr LR, Hassenzahl DM (2008) Environment. 6th edition. John Wiley & Sons, Inc., New York.
9. Semple C and Steel MA (2003) Phylogenetics. Oxford University Press, Oxford.

Suggested Practicals

1. Description of specimen from representatives. Locally available families. This list is indicative only
    - Ranunculaceae: *Ranunculus, Delphinium*
    - Brassicaceae: *Brassica, Iberis*
    - Malvaceae: *Hibiscus*
    - Rutaceae: *Murraya,Citrus*
    - Fabaceae: *Lathyrus,Cassia, Acacia, Mimosa*
    - Rosaceae: *Rosa, Prunus*
    - Asteraceae: *Helianthus, Ageratum, Sonchus*
    - Apiaceae: *Coriandrum, Foeniculum*
    - Apocynaceae: *Vinca, Nerium,Thevetia*
    - Asclepiadaceae: *Calatropis*
    - Solanaceae: *Petunia, Solanum,Datura*
    - Euphorbiaceae:*Euphorbia, Phyllanthus*
    - Lamiaceae:*Ocimum, Salvia*
    - Chenopodiaceae:*Chenopodium*
    - Liliaceae:*Asparagus, Asphodelus*
    - Poaceae:*Triticum, Avena*
2. Location of key character and use of keys at family level.
3. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated.
4. Training in using flora and herbaria for identification of specimens described in the class.
5. Comparison of different species of a genus and different genera of family to calculate similarity coefficients.

M.Sc. (BOTANY) SEMESTER-IV

BOT C724 - Hazardous Chemicals
(Optional Paper)

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. **Physical Properties of Chemicals**: Vapour pressure, vapour density, solubility, octanol/ water partition, coefficient odour.
2. **Toxic Properties :** Absorption and excretion, detoxification and bioactivation, common terms used for toxicology.
3. **Target Organs:** Injury to: liver, kidney, immune system, respiratory tract, skin, eyes, nervous system, cardiovascular system, carcinogens and teratogens.
4. **Combustible and Explosive Properties:** Flashpoint and autoignition temperature of some chemicals, explosive properties.
5. **Aldehydes:** Acrolein.
6. **Alkaloids:** Nicotine, Morphine, Heroin, LSD, Colchichine.
7. **Amines:** Ethylenimine, aniline, benzidine, O-toluidine, Phenylhydrazine.
8. **Azodyes:** Acid Yellow 3, Sudan orange, acid red 18, acid blue-9, acid green-3.
9. **Chlorohydrins:** Ethylene, chlorohydrin.
10. **Nitriles:** Acrylonitrile, acetonitrile.
11. **Cyanides:** HCN, Sodium cyanide, potassium cyanide, cyanogen.
12. **Organic Isocyanates:** Methyl isocyanate.
13. **Dioxins**: 2,3,7,8 – Tetrachlordibenzo-p-dioxin (TCDD).
14. **Epoxy Compounds:** Ethylene dioxide.
15. **Halogenated Hydrocarbons:** Chloroform, carbon tetrachloride, dichlorobenzene.
16. **Aromatic Hydrocarbons:** Benzene, Xylene.
17. **Polynuclear Aromatics:** Benzo -α- pyrene, Benzo - α- anthracene.
18. **Toxic Gases:** Arsine, Mustard Gas, Phosgene.
19. **Explosives:** Nitroexplosives – Nitroglycerine, dynamite, Nitrocellulose, 2,4,6-Trinitrotoluene, Picric acid.

20. **Pesticides:** Structure, LD_{50}/ LC_{50} , health hazards and exposure limit of following pesticides:
    (i) **Carbamates:** Aldicarb, Carbaryl, Carbofuran, Methiocarb.
    (ii) **Organochlorines**: Aldrin, Dieldrin, Endrin , Heptachlor, Chloradane, Endsulphan, DDT, Methoxychlor, Lindane.
    (iii) **Organophosporus Pesticides:** Parathion, Dichrotophos, Monocrotophos, Chloropyriphos.
21. **Herbicides:** 2,4 D, 2,4, T, Silvex, Atrazine, Metribuzin, Monouron, Diuron, Paraquat, Tribunil, Alchlor

Book Recommeded

1. Patnaik, P. (1999). A Comprehensive Guide to the Hazardous Properties of Chemical Substances. Wiley, New York.

M.Sc. (BOTANY) SEMESTER-IV

BOT C725 - Immunology
(Optional Paper)

Time: 3 Hours **Max. Marks: 50**
Theory Lectures: 3 Credit Hours/Week **Theory: 37; Int. Ass.: 13**

Instructions for Paper Setters: The question paper will consist of three sections. Candidate will be required to attempt all the sections.
Section A (7 Marks): It will consist of one question having seven 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 (12 Marks): It will consist of nine questions. Candidates will be required to attempt six 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. **An Overview of the Immune System:** Historical perspective, an introduction to the immune system – innate and adaptive immunity. Immunodeficiencies : secondary immunodeficiency disorders.
2. **Antigens and Antigen Recognition:** Antigens: prerequisites for immunogenicity, relative immunogenicity of different types of molecules, Molecules that enhance immunogenicity. Activators of lymphocytes: antigens, superantigens, mitogens. Antigen recognition by cells of innate immunity & adaptive immunity.
3. **Antibodies:** Gamma globulins; structure, bifunctional property of antibodies, determining bifunctionality, cross reactivity, Antigen antibody interactions: primary interactions, secondary interactions. Classification of antibodies: Isotypes, Allotypes, properties & biological functions of antibody isotypes, IgG, IgE, IgM, IgD, IgA, Monoclonal antibodies
4. **Cells and Tissues of Immunity:** Lymphoid tissues: primary & secondary lymphoid tissues, cells of innate immunity : phagocytes, antigen presenting cells, natural killer cells, Eosinophils, mast cells and basophil, B- cells, secondary immune responses.The major histocompatibility complex, antigen process and antigen presentation, complement.
5. The immune system in Health & Disease, specially AIDS.

Books Recommended

1. Goldsby, R.A. Kindt, T.J., Oxborne B.A., Kuby, J. (2003). Immunology.W.H. Freemen & Company, NewYork.
2. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA.

M.Sc. (CHEMISTRY) SEMESTER-II

CH414 (b): Biology for Chemists
For Medical Students

Time: 2 Hours **Max. Marks: 25**
Theory Lectures: 30 Hrs. **Theory: 19; Int. Ass.: 06**

Instructions for paper setters and candidates

1. Examiner will set total of ten questions comprising THREE questions from each unit carrying 3 marks and ONE compulsory question of short answer type of 4 marks covering the whole syllabi.
2. The students are required to attempt SIX questions in all, atleast ONE question from each unit and a Compulsory question.

UNIT-I

1. The Organization of life (10 Hrs.)

- Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids.
- The life of cells- The cell theory, general characteristics of cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cells, Cell organelles.
- Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: meristematic tissue, permanent tissues.

UNIT-II

2. Genetics(10Hrs.)

- The basic principle of heredity: Mendel's laws, monohybrid cross, dihybrid cross.
- DNA-Double helix structure and replication.
- Genes expression: Transcription and translation, genetic code.

UNIT-III

3. The Diversity of Life(10Hrs.)

- The classification of living things- criteria of classification, Whittaker's system of classification.
- Viruses, structure of viruses.

Book Recommended:

1. Cord Biology – South Western Educational Publications, Texas, 2000

B.Sc. Medical
Scheme of Courses
Semester I-VI
Session 2019-2020

S.No	Class	Code	Subject	Marks		
				Theory/ Practical	Int. Ass.	Total
1.	B.Sc Med. (Sem-I)	Paper- IA	Diversity of Microbes	25	25	100
		Paper- IB	Diversity of Cryptogams	25		
		Practical –I	Based on Paper IA & IB	25		
2.	B.Sc Med. (Sem-II)	Paper-IIA	Cell Biology	25	25	100
		Paper-IIB	Genetics	25		
		Practical –II	Based on Paper IIA & IIB	25		
3.	B.Sc Med. (Sem-III)	Paper-IIIA	Structure, Development, and Reproduction in Flowering Plants - I	25	25	100
		Paper-IIIB	Structure, Development, and Reproduction in Flowering Plants - II	25		
		Practical –III	Based on Paper IIIA & IIIB	25		
4.	B.Sc Med. (Sem-IV)	Paper-IV A	Diversity of Seed Plants and their Systematics – I	25	25	100

		Paper-IV B	Diversity of Seed Plants and their Systematics – II	25		
		Practical –IV	Based on Paper IVA & IVB	25		
5.	B.Sc Med. (Sem-V)	Paper-VA	Plant Physiology	30	20	100
		Paper-VB	Biochemistry and Biotechnology	30		
		Practical –V	Based on Paper VA & VB	20		
6.	B.Sc Med. (Sem-VI)	Paper-VI A	Ecology	30	20	100
		Paper-VI B	Economic Botany	30		
		Practical –VI	Based on Paper VIA & VIB	20		

B.Sc (MEDICAL) SEMESTER–I

BOTANY

Theory Paper IA	**:**	**25 Marks**
Theory Paper IB	**:**	**25 Marks**
Practical I (IA & IB)	**:**	**25 Marks**
Internal Assessment	**:**	**25 Marks**
Total	**:**	**100 Marks**

PAPER–I A: DIVERSITY OF MICROBES

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt any five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT-I

General Characters, Classification of Algae -Taxonomic parameters including those pertaining to photosynthetic pigments, cell wall, food reserves, flagellation *etc*. Economic importance of algae: Uses of algae as food and feed; importance in industry, agriculture, academics, water reservoirs *etc.*

UNIT-II

Important features and life history of:

Chlorophyceae–*Volvox, Oedogonium*, *Coleochaete*,
Xanthophyceae–*Vaucheria*;
Phaeophyceae–*Ectocarpus, Sargassum*;
Rhodophyceae–*Polysiphonia*.

UNIT-III

Viruses, Bacteria and Fungi: General account of viruses and mycoplasma; bacteria–structure, nutrition, reproduction and economic importance; general account cyanobacteria. General characters, classification and economic importance of Fungi.

UNIT-IV

Important features and life history of:

Mastigomycotina–*Pythium, Phytophthora;*
Zygomycotina–*Mucor;*
Ascomycotina–*Saccharomyces, Eurotium, Chaetomium, Peziza;*
Basidiomycotina–*Puccinia, Agaricus;*
Deuteromycotina–*Cercospora, Colletotrichum;*

General account of Lichens.

Suggested Readings:

1. Dubey, R. and Maheshwari, D. (2016). A textbook of Microbiology. S. Chand and company, New Delhi.
2. Alexopoulous, C.J., Mims, C.W. and Blackwell, M. (2002). Introductory Mycology (4th Edition), Wiley - Blackwell, USA.
3. Dube, H.C. (2007). A Textbook of Fungi, Bacteria and Viruses (3rd edition), Scientific Publishers, India
4. Dube, H.C. (2012). An Introduction to Fungi (4th edition), Scientific Publishers., India.
5. James W. Brown. (2014). Principles of Microbial Diversity. ASM press, USA.
6. Ogunseitan, O. (2004). Microbial Diversity: Form and function in Prokaryotes. Wiley Publishers, USA.
7. Sharma, O.P. (2004). Text Book of Thallophytes. McGraw Hill Publishing Co., India.
8. Sharma, P.D. (2004). The Fungi, (2nd Edition) Rastogi Publication, India

B.Sc (MEDICAL) SEMESTER–I

BOTANY

PAPER–I B: DIVERSITY OF CRYPTOGAMS

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT-I

General characters of bryophytes, Amphibians of plants kingdom displaying alternation of generations, Affinities of bryophytes with algae and pteridophytes, Classification.

UNIT-II

Structure and reproduction of:
Hepaticopsida: *Marchantia,*
Anthocerotopsida: *Anthoceros,*
Bryopsida: *Funaria,*
(Developmental stages are excluded).

UNIT-III

General characters of Pteridophyta**,** Life cycle showing alternation of generations, Classification of Pteridophytes, General characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT-IV

Structure and reproduction of *Rhynia, Lycopodium, Selaginella, Equisetum, Pteris, Marsilea.*
(Developmental stages are excluded).

Suggested Readings:

1. Goffinet B. (2008). Bryophyte Biology. Cambridge University Press, UK.

2. Sambamurty, S.S. (2005)**.** A Textbook of Bryophytes, Pteridophytes, Gymnosperms andPaleobotany. I K International Publishing House Pvt Ltd., India

3. Sharma, O.P. (2014). Bryophyta. Mc Graw Hill Education Pvt Ltd., India.

B.Sc (MEDICAL) SEMESTER–I

BOTANY

PRACTICALS–I (BASED ON PAPERS–I A AND I B)

Time: 3 Hrs.
Practical Hours: 4½ Hours/week **Marks: 25**

Suggested Laboratory Exercises

Teachers may select plants/material available in their locality/institution.

1. Gram staining of bacteria.
2. Observation of disease symptoms in hosts infected by fungi, viruses and mycoplasma Section cutting of diseased material and identification of the pathogens as per the theory syllabus.
3. Study of the genera included under algae and fungi.
4. Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta.

Suggested Readings:

Lee, R.E. **(2008).**Phycology, Fourth Edition, Cambridge University Press, USA.

Agrios, G.N. **(1997).**Plant Pathology, 4th edition, Academic Press, U.K.

B.Sc (MEDICAL) SEMESTER–II

BOTANY

Theory Paper II A	**:**	**25 Marks**
Theory Paper II B	**:**	**25 Marks**
Practical I (II A & II B)	**:**	**25 Marks**
Internal Assessment	**:**	**25 Marks**
Total	**:**	**100 Marks**

PAPER–II A: CELL BIOLOGY

Time: 3 Hrs. **Marks: 25**
Theory Lectures: 3 Hours/Week

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT-I

Structure and Function of Nucleus: Ultrastructure; nuclear membrane; nuclear pore models; nucleoplasm; Nuclear matrix; chromatin; nucleolus.

Extranuclear Genome: Presence and function of mitochondrial and plastid DNA; plasmids.

UNIT-II

Structure and Function of Cell Organelles:

Golgi Apparatus,

Endoplasmic Reticulum,

peroxisomes,

Vacuoles.

UNIT-III

Chromosome Organization: Morphology, centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions, variations in chromosome number, aneuploidy, polyploidy, sex chromosomes.

UNIT-IV

The Cell Envelopes: Cell wall - structure and function;
Plasma membrane – Chemical composition, Membrane models and functions; membrane transport.

Suggested Readings:

1. Gupta, P.K. (2013). A Text–book of Cell and Molecular Biology (3rd edition). Rastogi Publications, Meerut, India
2. Johnson, A., Raff, L. and Walter, R. (2008). Molecular Biology of the Cell (5th Edition). Taylor and Francis Group, USA.
3. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments (7th Edition). Wiley Publishers, USA.
4. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.
5. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and Ploegh, H. (2016). Molecular Cell Biology, W.H. Freeman & Co., New York, USA.
6. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.

B.Sc (MEDICAL) SEMESTER–II

BOTANY

PAPER–II B: GENETICS

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT-I

DNA-the Genetic Material: DNA structure; replication; DNA–protein interaction; the nucleosome model, satellite and repetitive DNA.
Genetic Variations: Mutations, spontaneous and induced, transposable genetic elements, DNA damage and repair.

UNIT-II

Cell Division:

Cell cycle;
Mitosis- karyokinesis, cytokinesis, significance of mitosis;
Meiosis- karyokinesis, recombination, crossing over, cytokinesis, significance of meiosis

UNIT-III

Genetic Inheritance: Mendelism: laws of segregation and independent assortment, linkage analysis; allelic and non–allelic interactions.

UNIT-IV

Gene expression: Structure of gene, transfer of genetic informaton; transcription, translation, genetic code, protein synthesis, tRNA, ribosomes, regulation of gene expression in prokaryotes and eukaryotes; proteins, ID, 2D, and 3D structure.

Suggested Readings:

1. Brown, T.A. (2011). Genetics: A Molecular Approach (3rd Edition). BIOS Scientific Publishers, UK.
2. Fletcher, H., Hickey, I. and Winter, P. (2010). Instant Notes on Genetics (3rd edition) Taylor and Francis Group, USA.

3. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (2012). Principles of Genetics (8th Edition). Wiley Sons, USA.
4. Gupta, P.K. (2016). Cell and Molecular Biology, Rastogi Publications, Meerut, India.
5. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
6. Krebs, B. E., Goldstein, E.S. and Kilpatrick, S.T. (2011). Lewins Genes X. Jones and Bartlett Publishers, LLC, UK.
7. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and ploegh, H. (2016). Molecular Cell Biology, W.H. Freeman & Co., New York, USA.
8. Singh, B.D. (2007). Molecular Genetics. Kalyani Publishers, India.
9. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.

B.Sc (MEDICAL) SEMESTER–II

BOTANY

PRACTICAL–II (BASED ON PAPERS–II A AND II B)

Time: 3 Hrs.
Practical Hours: 4½ Hours/week **Marks: 25**

Suggested Laboratory Exercises

Teachers may select plants/material available in their locality/institutions.

1. To study cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra.* Study of cyclosis in *Tradescantia* Staminal Cells.
3. Study of plastids to examine pigment distribution in plants (e.g. *Cassia*, *Lycopersicon* and *Capsicum*).
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
5. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
6. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
7. Preparation of karyotypes from dividing root tip cells and pollen grains.
8. Cytological examination of special types of chromosomes: bar body, lampbrush and polytene chromosomes.
9. Working out the laws of inheritance using seed mixtures.
10. Working out the mode of inheritance of linked genes from test cross and/or F2 data.

Suggested Readings:-

1. Fukui, K. and Nakayama, S. 1996. Plant Chromosomes; Laboratory Methods, CRC Press, Boca Raton, Florida.
2. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology; Structure and Function, Jones and Barllett Publishers, Boston, Massachusetts.
3. Harns, N. and Oparka, K.J. 1994. Plant Cell Biology, A Practical Approach. IRL Press, at Oxford University Press, Oxford, UK.
4. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes; Analysis. Manipulation and Engineering, Harwood Academic Publishers, Australia.
5. Plopper, G. (2016). Principles of Cell Biology. Jones and Barnett Learning, Boston, Massachusetts.

B.Sc (MEDICAL) SEMESTER–III

BOTANY

Theory Paper III A	**:**	**25 Marks**
Theory Paper III B	**:**	**25 Marks**
Practical I (III A &III B)	**:**	**25 Marks**
Internal Assessment	**:**	**25 Marks**
Total	**:**	**100 Marks**

Paper–III A: STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS–I

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT I

The basic body plan of a flowering plant-modular type of growth. Diversity in plant form in annuals, biennials and perennials; trees-largest and longest-lived.

UNIT II

The Shoot System: The shoot apical meristem and its histological organization; meristematic and permanent tissue, formation of internodes, branching pattern; monopodial and sympodial growth; canopy architecture;

UNIT III

Cambium and its functions; formation of secondary xylem; a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; role of woody skeleton; secondary phloem-structure function relationships; periderm. Internal structure of stem: *Helianthus annuus* and *Zea mays*

UNIT IV

Leaf: Origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

Suggested Readings:

1. Beck, C.B. (2010). An Introduction to Plant Structure and Development: Plant anatomy for the Twenty First Century (2nd Edition). Cambridge University Press, UK.
2. Cutler, D. F., Botha, T. and Stevenson, D. M. (2007). Plant Anatomy: An Applied Approach. Blackwell Publishing, Oxford, UK.
3. Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press, California, USA.
4. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
5. Peau, K (1977) Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.
6. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
7. Rudall, P. J. (2007). Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition). Cambridge University Press, UK.
8. Thomas, P. (2000) Trees: Their Natural History, Cambridge University Press, Cambridge.

B.Sc (MEDICAL) SEMESTER–III

BOTANY

Paper–III B: STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS–II
(THEORY)

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT I

The Root System: The root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

UNIT II

Vegetative Reproduction: Various methods of vegetative propagation. Detailed study and types of grafting and budding, economic aspects.

UNIT III

Flower: A modified shoot; structure, development and varieties of flower; functions; structure of anther and pistil; the male and female gametophytes; types of pollination; attractions and reward for pollinators; (sucking and foraging types); pollen-pistil interaction self incompatibility; double fertilization; formation of seed endosperm and embryo; fruit development and maturation.

UNIT IV

Significance of Seed: Suspended animation; ecological adaptation; unit of genetic recombination with reference to reshuffling of genes and replenishment; dispersal strategies.

Note for Teachers:
Wherever required, role of environment and hormones in plant development and reproduction should be emphasized.

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
2. Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
4. Peau, K. (1977). Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.
5. Pegeri, K. and Vander Pijl (1979). The Principles of Pollination Biology, Pergamon Press, Oxford.
6. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.

B.Sc (MEDICAL) SEMESTER–III

BOTANY

Botany Practicals–III (Based on Papers–III A and III B)

Time: 3 Hrs.
Practical Hours: 4½ Hours/week **Practical Marks: 25**

Suggested Laboratory Exercises

1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or Kalanchoe) to the body plan, organography and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden, Study of tree-like habit in cycads, bamboo, banana, traveller's tree (*Revenala madagascariensis*) and Yucca and comparison with true trees as exemplified by conifers and dicotyledons.
3. L.S. Shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and sympodial types of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using free hand razor technique (*Solanum, Boerhavia, Helianthus, Mirabilis, Nyctanthus, Draceana,* Maize) hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of the root. Primary and secondary structure.
8. Examination of a wide range of flowers available in the locality and methods of their pollination.
9. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using *in vitro* pollen germination.
10. Structure of ovule and embryo sac development using serial sections from permanent slides.
11. Nuclear and cellular endosperm. Embryo development in monocots and dicots (using permanent slides/dissections).
12. Simple experiments to show vegetative propagation (leaf cuttings in *Bryophyllum*. *Sansevieria, Begonia*; stem cuttings in rose, *Salix,* money plant, Sugarcane and *Bougainvillea*).
13. Germination of non-dormant and dormant seeds.

Suggested Readings (for laboratory exercises):

1. Bhojwani, S.S. and Bhatnagar, P. (2000). The Embryology of Angiosperms (4th revised and enlarged edition), Vikas Publishing House, New Delhi.
2. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cumminas Publishing Co., Inc., Mehlo Park, California, USA.
3. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1992). Biology of Plants (5th Edition). Worth Publishers, New York.
4. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development (2nd Edition). Cambridge University Press, Cambridge.

B.Sc (MEDICAL) SEMESTER–IV

BOTANY

Theory Paper IVA	**:**	**25 Marks**
Theory Paper IV B	**:**	**25 Marks**
Practical I (IV A & IV B)	**:**	**25 Marks**
Internal Assessment	**:**	**25 Marks**
Total	**:**	**100 Marks**

Paper–IV A: DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS–I

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT I

Characteristics of seed plants, Evolution of the seed habit, Distinguishing features of angiosperms and gymnosperms. General features of gymnosperms and their classification

UNIT II

Evolution and diversity of Gymnosperms including fossil and living gymnosperms, Geological time scale and fossilization. Angiosperms: Origin and evolution, some examples of primitive angiosperms.

UNIT III

Morphology of vegetative and reproductive parts, Anatomy of root, Stem and leaf, Reproduction and life cycle of *Pinus* and *Cycas*

UNIT IV

Morphology of vegetative and reproductive parts, Anatomy of root, Stem and leaf, Reproduction and life cycle of *Epherda* and *Ginkgo*.

Suggested Readings:

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms, New Age Internationl Limited, New Delhi.
2. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
3. Pellant, C. (1994). Fossils, Dragon's World, Great Britain
4. Sporne, K.R. (1965). The Morphology of Gymnosperms, Hutchinson & Co. (Publishers) Ltd., London.
5. Taylor, T. N., Taylor, E. L. and Krings, M. (2008). Paleobotany: The Biology and Evolution of Fossil Plants (2nd Edition). Elsevier Inc. Netherlands.
6. Vashistha, P. C. (2016). Botany for degree students. S.Chand and Company, New Delhi.

B.Sc (MEDICAL) SEMESTER–IV

BOTANY

Paper–IV B: DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS–II (THEORY)

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 25**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of five parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from four units of the whole syllabus out of which candidates will be required to attempt one question from each unit. Each question will carry five marks. Answer to each question should not exceed four pages.

UNIT I

Angiosperm taxonomy; Brief history, Aims and fundamental components (alpha-taxonomy, Omega-taxonomy, Holotaxonomy); Identification keys, Taxonomic literature; Major contribution of cytology, Phytochemistry and taximetrics to taxonomy.

UNIT II

Botanical nomenclature: Taxonomic ranks, Type concept, Principle of priority. Classification of angiosperms; Salient features of the systems proposed by Bentham and Hooker, Engler and Prantl.

UNIT III

Diversity of flowering plants as illustrated by members of the families Ranuculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae.

UNIT IV

Diversity of flowering plants as illustrated by members of the families Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

Suggested Readings:

1. Bendre, A. (2007). Practical Botany, Rastogi Publications, Meerut.
2. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
3. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
4. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.

5. Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
6. Radford, A.E. (1986). Fundamental of Plant Systematics, Harper and Row, New York.
7. Singh, G. (1999). Plant Systematics: Theory and Practice, Oxford and IBH Pvt. Ltd., New Delhi.
8. Sinha, S. (2012). Encyclopedia on Morphology of Angiosperms, Oxford Book Company, Jaipur.
9. Siddiqui, M., Pathak, A. and Dikshit, A. (2016). Taxonomy of Angiosperms: Basic Concepts, Molecular Aspects and Future prospects. Studera Press. Vedam Books, New Delhi.

B.Sc (MEDICAL) SEMESTER–IV

BOTANY

Botany Practicals–IV (Based on Papers–IV A and IV B)

Time: 3 Hrs.
Practical Hours: 4½ Hours/week **Practical Marks: 25**

Suggested Laboratory Exercises

Angiosperms
The following species are suitable for study. This list is only indicative. Teachers may select plants available in their locality.

Teachers may select plants/material available in their locality/institution.

1. Ranunculaceae: *Ranunculus, Delphinium*
2. Brassicaceae: *Brassica, Alyssum, Iberis, Coronopus.*
3. Malvaceae: *Hibiscus, Abutilon.*
4. Rutaceae: *Murraya, Citrus.*
5. Fabaceae: *Faboideae: Lathyrus, Cajanus, Melilotus, Trigonella, Caesalpinioideae: Cassia, Caeslpainia, Mimosoideae: Prosopis, Mimosa, Aeacia.*
6. Apiaceae: *Coriandru, Foeniculum, Anethum.*
7. Acanthaceae: *Adhatoda, Peristrophe.*
8. Apocynaceae: *Vinca, Thevetia, Nerium.*
9. Asclepiadaceae: *Calotropis.*
10. Solanaceae: *Solanum, Withania, Datura.*
11. Euphorbiaceae: *Euphorbia, Phyllanthus.*
12. Lamiaceae: *Ocimum, Salvia.*
13. Chenopodiaceae: *Chenopodium, Beta.*
14. Liliaceae: *Asphodelus, Asparagus.*
15. Poaceae: *Avena, Triticum, Hordeum Poa, Sorghum.*

The Students should be made familiar with the use of identification keys including use of computers in taxonomy.
The teachers should prevent students from collecting plants from the wild and submitting them for the practical examination.
Instead, the student should be asked to prepare field reports.

Gymnosperms

Cycas (i) Habit, armour of leaf bases on the stem (if specimen is not available show photography), very young leaf (circinate vernation) and old foliage leaves, sclae leaf, bulbils, male cone (specimen); Microsporophyll, megasporophyll, mature seed. (ii) Study through permanent slides—normal root (T.S.), stem (T.S.) (if sections are not available show photographs), ovule (L.S.). (iii) Study through hand sections or dissections-coralloid root (T.S.), rachis (T.S.), leaflet (V.S.), microsporophyll (V.S.) pollen grains (W.M.).

Pinus (i)Habit, long and dwarf shoot showing cataphylls and scale leaves, T.S. wood showing growth rings, male cone, 1st year, 2nd year and 3rd year female cones, winged seeds. (ii) Study through permanent slides-root (T.S.), female cone (L.S.) ovule (L.S.), embryo (W.M.) showing polycotyledonous condition. (iii) Study through hand sections or dissections-young stem (T.S.), old stem (wood) (T.L.S. and R.L.S.), needle (T.S. male cone (L.S.), male cone (T.S.), Pollen grains (W.M.).

Ephedra (i) Habit and structure of whole and female cones. (ii) Permanent slides-female cone (L.S.). (iii) Hand sections/dissections-node (L.S.), internode (T.S.), macerated stem to see vessel structure; epidermal peel mount of vegetative parts to study stomata, male cone (T.S. and L.S.), pollen grains.

Ginkgo (i) Habit and structure of whole plant. (ii) Permanent slides-male and female reproductive parts. (iii) pollen grains

Suggested Readings:

1. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.

2. Cronquist, A. (1981). An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

3. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam.

B.Sc (MEDICAL) SEMESTER–V

BOTANY

Theory Paper V A	**:**	**30 Marks**
Theory Paper V B	**:**	**30 Marks**
Practical I (V A & V B)	**:**	**20 Marks**
Internal Assessment	**:**	**20 Marks**
Total	**:**	**100 Marks**

Paper - VA: PLANT PHYSIOLOGY

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 30**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of six parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from equal distribution of the whole syllabus out of which candidates will be required to attempt any four questions. Each question will carry six marks. Answer to each question should not exceed four pages.

UNIT I

Plant-Water Relation: Importance of water to plant life, physical properties of water, (imbibition) diffusion and osmosis, absorption, transport of water and transpiration, physiology of stomata.

UNIT II

Mineral Nutrition: Essential macro-and microelements and their role, mineral uptake, deficiency and toxicity symptoms (hydroponics).

Transport of Organic Substances: Mechanism of phloem transport, source-sink relationship, factors affecting translocation.

UNIT III

Photosynthesis: Significance, historical aspects, photosynthetic pigments, action and absorption spectra and enhancement effects, concept of two photosystems, z-scheme, photophosphorylation, Calvin cycle, photorespiration, C4 pathway, CAM plants.

UNIT IV

Growth and Development: Definitions, phases of growth and development, kinetics of growth, seed dormancy, seed germination and factors of their regulation, plant movements, the concept of photoperiodism, physiology of flowering, florigen concept, biological clocks, physiology of senescence, fruit ripening, plant hormones - auxins, gibberellins, cytokinins, abscissic acid and ethylene, history of their discovery, biosynthesis and mechanism of action, general account of salicylic acid, jasmonates and brassinosteroids, photomophogensis, phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

Suggested Readings:

1. Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell (eds.) 1997. Plant Metabolism (2nd Edition). Longman, Essex, England.
2. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
3. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology (4th Edition). John Wiley and Sons. U.S.A.
4. Mandavia, C., Patel, S. V., Mandavia, M. K., Golakiya, B. A. and Chovatia, V. P. (2009). Glimpses in Plant Physiology. International Book Distributing Co., Lucknow, India.
5. Mohr, H. and Schopfer, P. 1995. Plant Physiology. Springer-Verlag, Berlin, Germany.
6. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th Edition). Wadsworth Publishing Co., California, USA.
7. Taiz, L. and Zeiger, E. (2010). Plant Physiology (5th Edition). Sinauer Associates Inc. USA..
8. Buchanan, B.B., Gruissem, W. and Jones,R.L.(2002). Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland.

B.Sc (MEDICAL) SEMESTER–V

BOTANY

PAPER–VB: BIOCHEMISTRY AND BIOTECHNOLOGY

Time: 3 Hrs.

Theory Lectures: 3 Hours/Week **Max. Marks: 30**

Instructions for the Paper Setters:

There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of six parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from equal distribution of the whole syllabus out of which candidates will be required to attempt any four questions. Each question will carry six marks. Answer to each question should not exceed four pages.

UNIT I

Basics of Enzymology: Discovery and nomenclature, characteristics of enzymes, concept of holoenzyme, apoenzyme, coenzymes and cofactors regulation of enzyme activity, mechanism of action.

UNIT II

Respiration : ATP-the biological energy currency, aerobic and anaerobic respiration, Kreb's cycle, electron transport mechanism (chemi-osmotic theory), redox potential, oxidative phosphorylation, pentose phosphate pathway.

UNIT III

Nitrogen and Lipid Metabolism: Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation, structure and function of lipids, fatty acid biosynthesis, β-oxidation, saturated and unsaturated fatty acids, storage and mobilization of fatty acids.

UNIT IV

Genetic Engineering: Tools and techniques of recombinant DNA technology, cloning vectors, genomic and cDNA library, transposable elements, techniques of gene mapping.

Biotechnology: Functional definition, basic aspects of plant tissue culture, cellular totipotency, differentiation and morphogenesis, biology of *Agrobacterium*, vectors for gene delivery and marker genes, salient achievements in crop biotechnology.

Suggested Readings:

1. Bhojwani, S.S. (1990). Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
2. Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell (eds.) (1997). Plant Metabolism (2nd Edition). Longman, Essex, England.
3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. Lea, P.J. and Leegood, R.C. (1999). Plant Biochemistry and Molecular Biology. John Wiley & Sons, Chelichester, England.
6. Old, R.W. and Primrose, S.B. (1989). Principles of Gene Manipulation, Blackwell Scientific Publishers, Oxford, UK.
7. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics (5^{th} Edition). John Wiley and Sons Inc., U.S.A.
8. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
9. Vasil, I.K. and Thorpe, T.A. (1994). Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

B.Sc (MEDICAL) SEMESTER–V

BOTANY

Botany Practicals – V (Based on Papers- VA and VB)

Practical Hours: 4½ Hours/week **Practical Marks: 20**

Suggested Laboratory Exercises:

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effects of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
5. Separation of chloroplast pigments by solvent method.
6. Determining the osmotic potential of vacuolar sap by plasmolytic method.
7. Determining the water potential of any tuber.
8. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
9. Bioassay of auxin, cytokimin, GA, ABA and ethylene using appropriate plant material.
10. Demonstration of the technique of micropropagation by using different explants, e.g. axillary buds, shoot meristems.
11. Demonstration of the technique of anther pollen culture.
12. Demonstrate the ascent of sap using a dye.
13. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.
14. Demonstrate the transpiration pull by mercury method.
15. Demonstration of osmosis by potato osmoscope.
16. Comparison of loss of water from two surfaces of leaf by CoCl2 method/four leaf method.
17. Demonstration of imbibition by plaster of paris method.
18. Demonstration that $0_2$is evolved during photosynthesis.
19. Separation of pigments by paper chromatography/TLC method.
20. Demonstration of phototropism movements.
21. Demonstration the measurements of growth by arc auxanometer.
22. Preparation of nutrient medium.
23. Sterilization of glassware and plant material.
24. Preparation of explant for aseptic manipulation.
25. Requirements for setting up the tissue culture laboratory.

Suggested Readings (For Laboratory Exercises)

1. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
3. Dixon, R.A. (Ed.) 1987. Plant Cell Culture: A Practical Approach, IRL Press, Oxford.
4. Kochhar, S. L. and Gujral, S. K. (2012). Comprehensive Practical Plant Physiology. Macmillan Publishers India Ltd., Delhi.
5. Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory annual. Springer-Verlag. Berlin.
6. Plummer, D.T. (1996). An Introduction to Practical Biochemistry (3rd Edition). Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
7. Roberts, J. and Tuckar, G.A. (Eds.) 2000. Plant Hormone Protocols. Human Press, New Jersey, USA.
8. Scott, R.P.W. 1995. Techniques and Practices of Chromotography. Marcel Dekker, Inc., New York.
9. Smith, R.H. 2000. Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.
10. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.

B.Sc (MEDICAL) SEMESTER–VI

BOTANY

Theory Paper VI A	**:**	**30 Marks**
Theory Paper VI B	**:**	**30 Marks**
Practical I (VI A & VI B)	**:**	**20 Marks**
Internal Assessment	**:**	**20 Marks**
Total	**:**	**100 Marks**

Paper- VIA: ECOLOGY
(THEORY)

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 30**

Instructions for the Paper Setters:

There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of six parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from equal distribution of the whole syllabus out of which candidates will be required to attempt any four questions. Each question will carry six marks. Answer to each question should not exceed four pages.

UNIT I

Plants and Environment: Atmosphere (gaseous compositions), water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

UNIT II

Population Ecology: Growth curves, ecotypes, ecads.

Community Ecology: Community characteristics, absolute and relative frequency, density and dominance, basal area and importance value index (IVI), Whittaker's classification of biodiversity, indices of alpha, beta and gamma diversity, life forms, biological spectrum, ecological succession.

UNIT III

Ecosystem: Structure, abiotic and biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen and phosphorus.

UNIT IV

Biogeographical Regions of India

Vegetation types of India: Forests and grasslands

Landscape Ecology: Definition & concept, effect of patch size and shape on biodiversity, dynamics of land use.

Suggested Readings

1. Kocchar, S.L. (1998). Economic Botany in Tropics, 2nd edition, Macmillan India Ltd., New Delhi.
2. Kumar, H.D. (2011). Modern Concepts of Ecology. Vikas Publishing House, New Delhi.
3. Mackenzie, A. et al., 1999. Instant Notes in Ecology. Viva Book Pvt. Ltd., New Delhi.
4. Odum, E.P. and Barrett, G.W. (2012). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi.
5. Sambarmurthy, A.V.S.S. and Subramanyam, N.S. (1989). A Textbook of Economic Botany, Wily Eastern Ltd., New Delhi.
6. Sharma, O.P. (1996). Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
7. Sharma, P.D. (2013). Environmental Biology. Rastogi Publications, Meerut.
8. Simpson, B.B. and Conner-Ogozaly, M. (1986). Economic Botany-Plants in Our World. McGraw Hill, New York.

B.Sc (MEDICAL) SEMESTER–VI

BOTANY

Paper- VIB: ECONOMIC BOTANY
(THEORY)

Time: 3 Hrs.
Theory Lectures: 3 Hours/Week **Max. Marks: 30**

Instructions for the Paper Setters:
There will be a total of nine questions and candidates will attempt five questions. Question No. 1 will be compulsory and will consist of six parts with equal distribution from the whole syllabus. Answer to each part should not exceed 3-4 lines. Each part will carry one mark (multiple choice/one-word answer type questions not to be set). The remaining eight questions will be set from equal distribution of the whole syllabus out of which candidates will be required to attempt any four questions. Each question will carry six marks. Answer to each question should not exceed four pages.

UNIT I

Food Plants:*Oryza sativa* (Rice), *Triticum aestivum* (Wheat), *Zea mays* (Maize), *Solanum tuberosum* (Potato), *Saccharum officinarum* (Sugarcane).
Fibres:*Gossypium hirsutum* (Cotton) and *Chorchorus capsularis* (Jute).

UNIT II

Vegetable Oils: *Arachis hypogea* (Groundnut), *Brassica campestris* (Mustard) and *Cocos nucifera* (Coconut).
Spices : General account of *Piper nigrum* (Black pepper), *Eugenia caryophyllum* (Cloves), *Cinnamomum verum* (Cinnamomum), *Elettaria cardamomum* (cardamom), *Zingiber officinalis* (Ginger), *Curcuma longa* (Turmeric), *Coriandrum sativum* (Coriander), *Foeniculum vulgaris* (Fennel) and *Mentha arvensis* (Mint).

UNIT III

Medicinal Plants: General account of *Terminalia chebula* (Harar), *Terminalia belerica* (Bahera), *Azadirachta indica* (Neem), *Phyllanthus emblica* (Amla), Aconitum,*Napellus* (Aconite), *Rauwolfia serpentina* (Sarpagandha), *Atropa belladonna* (Belladonna), *Datura stramonium* (Datura), *Withania somniferum* (Ashwagandha)and *Papaver somniferum* (Poppy).

UNIT IV

Wood: General account of sources of firewood, timber and bamboos.
Beverages:*Camellia sinensis* (Tea) and *Coffea arabica* (Coffee).
Rubber: Morphology of *Hevea brasiliensis* (Rubber), Processing and Uses.

Suggested Readings:

1. Council of Scientific & Industrial Research (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.
2. Das, K. (2010). Medicinal plants- Their importance in Pharmaceutical Sciences, Kalyani Publishers, New Delhi.
3. Kocchar, S.L. (2000). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
4. Prinentel, D. and Hall, C.W. (Eds.) (1989). Food and Natural Resources. Academic Press, London, New York.
5. Reddy, K. et al. (2007). Advances in Medicinal plants, Universities Press, Hyderabad.
6. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
7. Swaminathan, M.S. and Kocchar, S.L. (Eds) (1989). Plants and Society. Macmillan Publications Ltd., London.
8. Verma, V. (2009). Textbook of Economic Botany, ANE Books, New Delhi.

B.Sc (MEDICAL) SEMESTER–VI

BOTANY

Botany Practicals–VI (Based on Papers- VIA and VIB)

Practical Hours: 4½ Hours/week **Practical Marks: 20**

Suggested Laboratory Exercises

1. To determine minimum number of quadrats required for reliable estimate of species diversity in grasslands through species area curves.
2. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's Standard Frequency Diagram.
3. To estimate Importance Value Index for grassland species on the basis of relative frequency, relative density and relative dominance in protected and grazed grassland.
4. To measure the vegetation cover of grassland through point frame method.
5. To measure the above ground plant biomass in a grassland.
6. To study the morphological anatomical features of hydrophytes (*Hydrilla, Eichhornia*) Xerophytes (*Nerium, Calotropis*).
7. To determine diversity indices (species richness, Simpson, Shannon-Weaver) in grazed and protected grassland.
8. To estimate bulk density and porosity of grassland and woodland soils.
9. To determine moisture content and water holding capacity of grassland and woodland soil.
10. To study the vegetation structure through profile diagram.
11. To estimate transparency, pH and temperature of different water bodies.
12. To measure dissolved oxygen content in polluted and unpolluted water samples.
13. To estimate salinity of different water samples.
14. To determine the percentage leaf area injury of different leaf samples collected around polluted sites.
15. To estimate dust-holding capacity of the leaves of different plant species.
16. **Food Plants:** Study of the morphology, structure and simple microchemical tests of the foods storing tissues rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (excepting sugarcane).
17. **Fibres:** Study of cotton flowers, sectioning of the cotton ovules/developing seeds to trace the origin and development of cotton fibers. Microscopic study of cotton and test for cellulose. Sectioning and staining of jute stem to show the location and development of fibers. Microscopic structure. Tests for lignocelluloses.
18. **Vegetable Oils:** Study of hand sections of groundnut, mustard and coconut and staining of oil droplets by Sudan III and Sudan Black.
19. **Field Visits:** To study sources of firewood (10 plants)/timber yielding trees (10 trees)/bamboos, list to be prepared mentioning special features, collection of plant based articles of common use.
20. **Spices:** Examine black pepper, cloves, cinnamon (hand sections) and opened buds of cardamom and describe them briefly.

21. Preparations of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy: Write their botanical and common names of parts used and diseases/disorders for which they are prescribed.
22. **Beverages:** Hand section of boiled coffee beans and tea leaves to study the characteristic structural features.
23. Visit to *in situ* conservation site/Botanical Garden.

Suggested Readings (for laboratory exercises)

1. Council of Scientific & Industrial Research. (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.
2. Kocchar, S.L. (2000). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
3. Krebs, C.J. (1989). Ecological Methodology. Harper and Row, New York, USA.
4. Ludwig, J.A.and Reynolds, J.F. (1988). Statistical Ecology, Wiley, New York.
5. Moore, P.W. and Chapman, S.B. (1986). Methods in Plant Ecology, Blackwell Scientific Publications.
6. Prinentel, D. and Hall, C.W. (Eds.) (1989). Food and Natural Resources. Academic Press, London, New York.
7. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
8. Swaminathan, M.S. and Kocchar, S.L. (Eds.) (1989). Plants and Society. Macmillan Publications Ltd., London.

B.A./B.Sc. (Biotech., Food Sci., Comp. Sci., Eco., FD., IT., Med., Non Med.)/B.Sc. (Hons.-Physics, Chemistry, Maths)/B.B.A./B.C.A./B.Com./B.Com. (Hons.)/BJMC/BA Social Sciences/BA (Hons.) Punjabi, BA (Hons.) English

SEMESTER–III

ESL–221: ENVIRONMENTAL STUDIES–I (COMPULSORY)

Time: 3 Hrs. **Max. Marks: 50**
Theory Lectures: 1½ Hours/ Week

Section–A: (20 Marks): It will consist of twelve questions. Candidates will be required to attempt ten questions, each question carrying two marks. Answer to any of the questions should not exceed one page.
Section–B: (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying five marks. Answer to any of the questions should not exceed two & half pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed five pages.

1. The Multidisciplinary Nature of Environmental Studies:

- Definition, scope & its importance.
- Need for public awareness.

2. Natural Resources:

- Natural resources and associated problems:

a) Forest Resources: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
b) Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food Resources: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
e) Energy Resources: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
f) Land Recourses: Land as a resource, land degradation, soil erosion and desertification.
Role of an individual in conservation of natural resources.
Equitable use of resources for sustainable lifestyles.

3. Ecosystem:

Concept of an ecosystem.
Structure and function of an ecosystem.
Producers, consumers and decomposers.
Energy flow in the ecosystem.
Ecological succession.
Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystems:
a. Forest ecosystem

b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

4. Social Issues and Environment:

From unsustainable to sustainable development.
Urban problems related to energy.
Water conservation, rain water harvesting, watershed management.
Resettlement and rehabilitation of people; its problems and concerns. Case studies.
Environmental ethics: Issues and possible solutions.
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
Wasteland reclamation.
Consumerism and waste products.
Environmental Protection Act:

- Air (prevention and Control of Pollution) Act.
- Water (prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.

Issues involved in enforcement of environmental legislation.
Public awareness.

5. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS; Emblem, flag, motto, song, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

B.A./B.Sc. (Biotech., Food Sci., Comp. Sci., Eco., FD., IT., Med., Non Med.)/B.Sc. (Hons.-Physics, Chemistry, Maths)/B.B.A./B.C.A./B.Com./B.Com. (Hons.)/BJMC/BA Social Sciences/BA (Hons.) Punjabi, BA (Hons.) English

SEMESTER–IV

ESL–222: ENVIRONMENTAL STUDIES–II (COMPULSORY)

Time: 3 Hrs. **Max. Marks: 50**
Theory Lectures: 1½ Hours/ Week

Section–A: (20 Marks): It will consist of twelve questions. Candidates will be required to attempt ten questions, each question carrying two marks. Answer to any of the questions should not exceed one page.
Section–B: (15 Marks): It will consist of five short answer type questions. Candidates will be required to attempt three questions, each question carrying five marks. Answer to any of the questions should not exceed two & half pages.
Section–C: (15 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed five pages.

1. Biodiversity and its Conservation:

- Definition: Genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option
- values.
- Biodiversity of global, National and local levels.
- India as mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

2. Environmental Pollution:

-Definition, causes, effects and control measures of:
a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards
h) Electronic Waste
□□Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.
□□Role of an individual in prevention of pollution.
□□Pollution case studies.
□□Disaster Management: Floods, Earthquake, Cyclone and Landslides.

3. Human Population and the Environment

- Population growth, variation among nations.
- Population explosion-Family welfare programme.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS.
- Women and child welfare.
- Role of information technology in environment and human health.
- Case studies.
- Road Safety Rules & Regulations**:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs.
- Accident & First Aid**:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance.

4. National Service Scheme:

- **Entrepreneurship Development:** Definition & Meaning; Qualities of good entrepreneur; Steps/ ways in opening an enterprise; Role of financial and support service Institutions.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self-defense training.

5. Field Visits:

- Visit to a local area to document environmental assets– river/forest/grassland/hill/mountain.
- Visit to a local polluted site–Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems–pond, river, hill slopes etc.
- Contribution of the student to NSS/any other social cause for service of society.

Note: In this section the students will be required to visit and write on the environment of an area/ ecosystem/vi1lage industry/disaster/mine/dam/agriculture field/waste management/hospital etc. with its salient features, limitations, their implications and suggestion for improvement.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

BACHELOR OF PHYSIOTHERAPY (PART-II)

Environmental Studies (Compulsory)

Theory Lectures: 50 Hours **Max. Marks: 100**
Time: 3 Hour

Section–A (45 Marks): It will consist of eighteen questions. Candidates will be required to attempt any fifteen questions, each question carrying three marks. Answer to any of the questions should not exceed two pages.
Section–B (30 Marks): It will consist of ten qestions. Candidates will be required to attempt six questions, each question carrying five marks. Answer to any of the questions should not exceed three pages.
Section–C (25 Marks): It will consist of two questions. Candidate will be required to attempt one question only. Answer to the question should not exceed five pages.

1. **The multidisciplinary nature of environmental studies:** Definition, scope & its importance, Need for public awareness.

2. **Natural resources:** Natural resources and associated problems.
   a) Forest resources: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
   b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
   c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   d) Food resources: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
   e) Energy resources: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
   f) Land recourses: Land as a resource, land degradation, soil erosion and desertification.
   g) Role of an individual in conservation of natural resources, Equitable use of resources for
   sustainable lifestyles.

3. **Ecosystem:**

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

4. Biodiversity and its Conservation:

Definition: Genetic, species and ecosystem diversity, Biogeographical classification of India.

Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values. Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.

Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts Endangered and endemic species of India.

Conservation of Biodiversity:*In situ* and *Ex-situ* conservation of biodiversity

5. Environmental Pollution:

Definition, Causes, effects and control measures of:

a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies Disaster Management: Floods, Earthquake, Cyclone and Landslides

6. Social Issues and Environment:

- From unsustainable to sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies
- Environmental ethics: Issues and possible solutions.
- Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Protection Act
- Air (prevention and Control of Pollution) Act
- Water (prevention and Control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

7. Human population and the environment

- Population growth, variation among nations
- Population explosion-Family welfare programme

- Environment and human health
- Human rights
- Value education
- HIV / AIDS
- Women and child welfare
- Role of information technology in environment :and human health
- Case studies
- Road Safety Rules & Regulations: Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
- Accident & First Aid: First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

8. National Service Scheme

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS; Emblem, flag, motto, song, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.
- **Entrepreneurship Development:** Definition & Meaning; Qualities of good entrepreneur; Steps/ ways in opening an enterprise; Role of financial and support service Institutions.
- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self-defense training.

9. Field Visits:

- Visit to a local area to document environmental assets–river / forest / grassland / hill / mountain.
- Visit to a local polluted site–Urban / Rural / Industrial / Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems–pond, river, hill slopes, etc.
- Contribution of the student to NSS/any other social cause for service of society.

Note: In this section the students will be required to visit and write on the environment of an area/ ecosystem/vi1lage industry/disaster/mine/dam/agriculture field/waste management/hospital etc. with its salient features, limitations, their implications and suggestion for improvement.

References/Books:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Down to Earth, Centre for Science and Environment, New Delhi.
4. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
5. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
6. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
7. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
8. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
9. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar
10. Kanta, S., 2012. Essentials of Environmental Studies, ABS Publications, Jalandhar.

B.Sc. BIOTECHNOLOGY
Semester I-IV
Scheme of Course
Session 2019-2020

S.No	Class	Code	Subject	Marks		
				Theory/ Practical	Int. Ass.	Total
1.	B.Sc Biotech. (Sem-I)	BT-2	Botany - A	30	10	40
		Practical	Botany–A	15	05	20
2.	B.Sc Biotech. (Sem-II)	BT-2	Botany - B	30	10	40
		Practical	Botany - B	15	05	20
3.	B.Sc Biotech. (Sem-IV)	BT-2	Botany - C	30	10	40
		Practical	Botany–C	15	05	20

B.Sc (BIOTECHNOLOGY) SEMESTER–I

BT-2 (Botany – A)

Time: 3 Hours **Max. Marks: 40**
Credit Hrs.: 3/Week **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A (8 Marks): Very short answer type 8 questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B (12 Marks): This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C (10 Marks): This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Unit – I

Apical Meristem: Tunica corpus and Histogen theories, reproductive apex and development offlower.
Secondary growth in stem and root of *Helianthus*.
Study of anomalous structure in *Boerhavia, Nyctanthes, Mirabilis and Dracena.*

Unit – II

Structure and development of anther and male gametophyte
Structure and development of ovule and female gametophyte; different types of ovules and embryo sacs

Unit – III

Pollination and fertilization; structure, development and function of endosperm and embryo (dicot and monocot), polyembryony, Self-pollination, cross pollination, male sterility, self incompatibility.

Unit – IV

Terminology pertaining to floral description, taxonomic importance of floral parts of the following families: Solanaceae: *Solanum*, *Petunia*, Liliaceae: *Asphodelus/Asparagus* Rutaceae: *Citrus, Murraya*

B.Sc (BIOTECHNOLOGY) SEMESTER–I

Botany– (Practical)

BT-2 (Botany – A)

Time: 3 Hours **Max. Marks: 20**
Credit Hrs.: 4/Week **Practical : 15; Int. Ass.: 05**

Note. The question paper will be set by the examiner based on the syllabus

Plant Anatomy:

Anatomical studies of normal and abnormal secondary growth in general as mentioned insyllabus.

Embryology:

Study of the permanent slides pertaining to micro and megasporogenesis and female gametophytes and endosperms.

Taxonomy:

a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.

b) Identification and short morphological economic note on the specimens included in Units IV & V of the theory paper A.

c) Each student is required to submit a family wise herbarium consisting of atleast 20 properly pressed and mounted plants.

B.Sc (BIOTECHNOLOGY) SEMESTER–II

BT-2 (Botany – B)

Time: 3 Hours **Max. Marks: 40**
Credit Hrs.: 3/Week **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A (8 Marks): Very short answer type 8 questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B (12 Marks): This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C (10 Marks): This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

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Unit - I

Systems of classification: Artificial, Natural and Phylogenetic; Salient features of Bentham & Hooker's, Hutchinson and Engler & Prantl's system of classification, (Details of Bentham & Hooker's system only). Angiosperms, Gymnosperms, Bryophytes and Lichens- their general characteristics.

Unit – II

General characteristics (excluding economic importance) of following families of angiosperms; giving examples of few important genera:
Ranunculaceae:*Ranunculus,Delphinium*
Brassicaceae: *Brassica*
Apiaceae (Umbelliferae): *Coriander*
Asteraceae (Compositae): *Helianthus, Sonchus, Ageratum*
Lamiaceae (Labiatae): *Ocimum/Salvia*

Unit – III

General characteristics (excluding economic importance) of following families of angiosperms; giving examples of few important genera:
Fabaceae: *Lathyrus, Cassia* and *Acacia* ; Orchidaceae: *Zeuxine*; Poaceae (Graminae): *Triticum*
Criteria for primitive and advanced nature of families and flower. Evolutionary status of Ranunculaceae, Compositae, Orchidaceae.

Unit – IV

Introduction to seed biology, differences between seed and grain. Classification of seed-breeder, foundation, certified and truthfully labeled seeds (TFLs). Brief introduction to methods of seed production, seed testing (seed germination and seed viability test) and seed certification.

B.Sc (BIOTECHNOLOGY) SEMESTER–II

Botany– (Practical)

BT-2 (Botany – B)

Time: 3 Hours **Max. Marks: 20**
Credit Hrs.: 4/Week **Practical : 15; Int. Ass.: 05**

Note. The question paper will be set by the examiner based on the syllabus

a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.

b) Identification and short morphological economic note on the specimens included in Units III, IV & V of the theory paper B.

Each student is required to submit a family wise herbarium consisting of at least 20 properly pressed and mounted plants.

B.Sc (BIOTECHNOLOGY) SEMESTER–IV

BT-2 (Botany – C)

Time: 3 Hours **Max. Marks: 40**
Credit Hrs.: 3/Week **Theory: 30; Int. Ass.: 10**

Note for the paper setters/examiners:

Each question paper will consist of three sections as follows:

Section-A (8 Marks): Very short answer type 8 questions are to be set, two from each unit, the maximum length of answer can be about 1/3 of a page. All questions are compulsory. Each question will carry one mark, total weightage being 8 marks.

Section-B (12 Marks): This section will comprise of 8 questions, two from each unit. 4 questions to be attempted and maximum length of answer can be upto two pages. Each question will carry 3 marks, total weightage being 12 marks.

Section-C (10 Marks): This section will comprise of four essay type questions, one from each unit. Two questions to be attempted. Maximum length of answer can be upto 5 pages. Each question will carry 5 marks, total weightage being 10 marks.

Unit-I

Water relations, osmosis, transpiration, water potential, its components, physiological & molecular adaptations in plants with respect to cold, heat, drought and salt stress.

Unit-II

Heat shock proteins, dehydrins, late embryogenesis abundant proteins, role of different osmolytes in stress tolerance.

Unit-III

Plant Pathology & epidemiology: Definition, classification, mode of transmission & control measures of plant diseases. Disease resistance host pathogen interaction. Phytoalexins, PR proteins.

Unit-IV

A detailed account of the following plant diseases with respect to causal agents, symptoms, epidemology, disease cycle & their control measures. Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, False smut of rice, Bacterial blight of rice, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi, Bunchy top of banana, Downy mildew of Bajra.

B.Sc (BIOTECHNOLOGY) SEMESTER–IV

Botany– (Practical)

BT-2 (Botany – C)

Time: 3 Hours **Max. Marks: 20**
Credit Hrs.: 4/Week **Practical: 15; Int. Ass.: 05**

Note. The question paper will be set by the examiner based on the syllabus.

1. Estimation of relative water content of leaf.

2. Measurement of osmotic potential of different tissues by Chardokov method.

3. Study of Plant pathogens

   (a) Symptoms of the diseases

   (b) Morbid anatomy of the plants infected with following diseases.

   Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, False smut of rice, Bacterial blight of rice, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi, Bunchy top of banana, Downy mildew of bajra.

Books:

1. Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company

2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates

3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications

4. Pandey, B.P. (2001) Plant Pathology, S Chand

5. M.J. Carlile, S.C. Watkinson & G.W. Gooday (2001), The Fungi 2nd Ed., Academic Press.

6. G.N. Agrios (1997), Plant Pathology 4th Ed., Academic Press.

7. R.S. Mehrotra (1980) Plant Pathology Tata McGraw Hill New Delhi.

B.Sc. (Hons.) Botany
Semester I
Scheme of Course
Session 2019-2020

S No.	Code (Course No.)	Subject (Course Title)	Core/Generic/ Lab	Periods/ Week	Marks		
					Theory/ practical	Int. Ass.	Total
1	BHB 101	Algae and Microbiology	Core	6	37	13	50
2	BHB 102	Non-Chordates I	Generic	6	37	13	50
3	BHB 103	Optics	Generic	6	37	13	50
4	BHB 104	Maths I	Generic	6	37	13	50
5	BHB 105	Punjabi / Basic Punjabi I	Ability Enhancement	6	37	13	50
6	BHB 106	Communicative English I	Ability Enhancement	6	37	13	50
7	BHB 107	Lab I : Algae and Microbiology	Lab	6	37	13	50
8	BHB 108	Lab II: Non-Chordates I	Lab	6	37	13	50
9	BHB 109	Lab III Optics	Lab	3	19	06	25

B.Sc. (Hons.) Botany
Semester II
Scheme of Course
Session 2019-2020

S No.	Code (Course No.)	Subject (Course Title)	Core/Generic/ Lab	Periods/ Week	Marks		
					Theory/ practical	Int. Ass.	Total
1	BHB 201	Fungi and Plant Pathology	Core	6	37	13	50
2	BHB 202	Non-Chordates II	Generic	6	37	13	50
3	BHB 203	Modern Physics	Generic	6	37	13	50
4	BHB 204	Maths II	Generic	6	37	13	50
5	BHB 205	Punjabi / Basic Punjabi II	Ability Enhancement	6	37	13	50
6	BHB 206	Communicative English II	Ability Enhancement	6	37	13	50
7	BHB 207	Lab I: Fungi and Plant Pathology	Lab	6	37	13	50
8	BHB 208	Lab II: Non-Chordates II	Lab	6	37	13	50
9	BHB 209	Lab III : Modern Physics	Lab	3	19	06	25

B.Sc. (Hons.) Botany SEMESTER–I

BHB 101: Algae and Microbiology

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

1. Algae: General characteristics, habit and habitat, thallus organization, cell structure, photosynthetic pigments, nutrition, food reserves and flagellation *etc.*
2. Classification of Algae: History and modern trends in classification of algae. Economic importance of algae.

UNIT-II

3. Cyanophyta: General characters, distribution, thallus organization, nutrition, cell structure, cell differentiation, distinction between heterocyst and vegetative cell, reproduction and classification. Morphology and life cycle of *Oscillatoria* and *Nostoc*
4. Salient features, cell structure, thallus organization and reproduction of following divisions:

Chlorophyta: *Chlamydomonas,Volvox,Oedogonium.*
Charophyta: *Chara*
Rhodophyta: *Batrachospermum*
Bacillariophyta: *Pinnularia*
Xanthophyta:*Vaucheria.*
Phaeophyta:*Ectocarpus, Sargassum*

UNIT-III

5. Viruses: Discovery, definition, nature, characteristic features; general structure and classification. Plant viruses, animal viruses, bacterial viruses (Bacteriophages)
6. Transmission of viruses: Transmission of viruses with reference to TMV and bacteriophage (lytic and lysogenic cycle).

UNIT-IV

7. Bacteria and Mycoplasma: Discovery, general characteristics; types-archaebacteria, eubacteria, cell structure; reproduction and recombination (conjugation, transformation and transduction) in bacteria. A general account on Mycoplasmas.

8. Economic importance of bacteria: Economic importance of bacteria with special reference to their role in agriculture and industry.

Suggested Reading

1. Bold, H.C. and Wyne, M.J. *Introduction to the Algae, Structure and Reproduction,* Prentice Hall, New Delhi, 1978.
2. Fritsch, F.E. *The Structure and Reproduction of Algae* (Vols. I & II), Vikas Publishing House Pvt.Ltd., New Delhi, 1979.
3. Kumar, H.D. *Introductory Phycology*, East West Press, New Delhi, 1999.
4. Lee, R.E. *Phycology,* Cambridge University Press, Cambridge, 2008.
5. Van Den Hock, C., Mann, D.G. and Jahns, H.M. *Algae : An Introduction to Phycology*, Cambridge University Press, Cambridge, 1995.
6. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
7. Bos, L. Introduction of Plant Virology, Longman, N.Y., 1978.
8. Mathews, R.E.F. Plant Viriology. Academic Press, N.Y., 1981.
   Schliegel, H.S. General Microbiology. Cambridge University Press, Cambridge, 1995.
9. Smith, K.M. A Text Book of Plant Virus Diseases, Longman, Edinburgh, 1972.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 107: Lab I: Algae and Microbiology

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Practicals

1. Study of vegetative and reproductive structures of following genera:
   Oscillatoria,
   Nostoc,
   Chlamydomonas,
   Volvox,
   Oedogonium.
   Chara,
   Batrachospermum,
   Pinnularia,
   Vaucheria,
   Ectocarpus,
   Sargassum

2. Study of detailed structure of TMV and T-Phage
3. Study of different types (shape, single/colony, flagellation*etc.*) of bacteria
4. Gram staining of bacteria.

Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi

B.Sc. (Hons.) Botany SEMESTER–I

BHB 102: Non-Chordates-I

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

- Protozoa : Type study
  - *Amoeba proteus*
  - *Paramecium*

UNIT-II

- Porifera : Type study
  - *Sycon*
- Coelenterata : Type study
  - *Obelia*

UNIT-III

- Platyhelminthes : Type study
  - *Fasciola hepatica*
  - *Taenia solium*
- Parasitic adaptations in Helminthes

UNIT-IV

- Aschelminthes :Type study
  - *Ascaris*
- Annelida*:* Type study
  - *Pheretima posthuma*

Books Recommended

1. Barnes, R.D., Invertebrate Zoology, Saunders W.B., Co.,Philadelphia, 1980
2. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004
3. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
4. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 108: Lab 2: Non-Chordates-I

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

I. Classification up to orders and study of the specimens mentioned against each phylum with ecological note and economic importance if any

Protozoa: *Amoeba, Euglena, Trypanosoma, Noctiluca, Eimeria, Monocystis, Paramecium, Opalina, Vorticella, Balantidium, Nyctotherus*

Porifera: *Sycon, Grantia, Spongilla, Euplectella, Hyalonema,*

Coelenterata: *Porpita, Velella, Physalia, Aurelia, Metridium, Tubipora, Zooanthus, Madrepora, Favia, Fungia, Obelia* (colony, medusa and polyp), *Sertularia, Tubipora, Plumularia, Bougainvillea.*

Platyhelminthes: *Planaria, Fasciola, Taenia, Dugesia, Echinococcus*

Aschelminthes: *Ascaris* (male and female), *Trichinella, Ancylostoma*

Annelida: *Pheretima, Lumbricus, Nereis, Heteronereis, Aphrodite, Amphitrite, Arenicola, Hirudinaria*

II Study of Permanent slides

Porifera: Spicules, T.S. *Sycon*

Coelenterata: *Hydra* (W.M.), T.S. through the regionsof testis and ovary

Platyhelminthes: Miracidium, Sporocyst, Redia, Cercaria larvae of *Fasciola*, Scolex, mature and gravid proglottids of *Taenia*

Aschelminthes: *Ascaris* (T.S. male and female)

Annelida: Earthworm (T.S. typhlosolar and gizzard region), spermathecae, setae and septal nephridium

III Temporary mounts: Spicules of *Sycon*

IV Culture Preparation: *Paramecium*

V Study of systems through charts/models

Pheretima posthuma: Digestive, Reproductive and Nervous system

VI Students must be taken out to study biodiversity among invertebrates

Guidelines to conduct Practical Examination:-

1.	Identify and classify the specimens upto order. Write a note on their habit, habitat,special features and economic importance if any.	15
2.	Identify the slides and give at least two reasons for their identification.	9
3.	Identify the organ systems of *Pheretima posthuma* by using models.	4
4.	Preparation of Temporary mount	4
5.	Assignment	3
6.	Viva-voce & Practical file.	5

*Minor changes can be done as per the availability of materials.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 103: Optics

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

Ray Optics: Reflection of light, Refraction of light, Total internal reflection and its applications, Lenses, Lens maker's formula, Refraction and dispersion through a prism, Scattering of light, Microscope and its magnifying power.

UNIT-II

Interference: Young's experiment, Coherent Source, Phase and path differences, Theory of interference fringes, Fresnel's biprism, Thickness of thin transparent sheet, Interference in thin film due to reflected and transmitted light, Colour of thin film, Newton's rings and their applications, Michelson interferometer, Febry-Perot Interferometer, Anti reflection coatings.

UNIT-III

Diffraction: Introduction, Fraunhoffer diffraction at a single slit and its discussion, Fraunhoffer diffraction at double slit, Missing orders in a double slit, Diffraction of N slits and its discussion, Diffraction grating, dispersive power, Rayleigh criterion for resolving power, Resolving power of a diffraction grating.

UNIT-IV

Polarization: Transverse nature of light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, Production and detection of polarized light, Optical activity, Specific rotation. Half shade polarimeter.

Reference Books:

1. A Text Book of Optics: N. Subramanayam, B. Lal and M. N. Avadhanulu.
2. Optics: Ajoy Ghatak. Tata Mc Graw Hill Publishing Company Limited.
3. Fundamentals of Optics: Jenkins and White.
4. A Text Book of Optics: T. S. Bhatia, V. K. Sharma, S. Vikas & Company.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 109: Lab III: Optics

Time: 3 Hours **Max. Marks: 25**
Practical: 3Periods/Week **Practical: 19; Int. Ass.: 06**

1. To find the angle of prism by rotating telescope.
2. To find the refractive index of the glass prism using a spectrometer.
3. To find the refractive index of a transparent liquid using a hollow glass prism and spectrometer for given wavelength.
4. To study the variation of refractive index with wavelength of spectral line of mercury source and hence find the values of Cauchy's constant.
5. To measure the wavelength of sodium light by using Newton's rings apparatus.
6. To determine the wavelength of spectral line of mercury using diffraction grating.
7. To determine the wavelength of sodium light using plane diffraction grating.
8. To determine the resolving power of plane diffraction grating.
9. To measure an accessible distance between two points using a sextant.
10. To measure an inaccessible distance between two points using a sextant.
11. To find the magnification power of a telescope.
12. To find the specific rotation of sugar solution by Laurentz half shade polarimeter

Reference Books:

Practical Physics Vol.II, T.S. Bhatia, Gursharan Kaur, Iqbal Singh, Vishal Publications
Practical Physics, C.L. Arora, S. Chand & Co.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 104: Maths-I

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Section-A

Functions: Domain and Range of a function, Graph of a function, Inverse functions, Exponential and logarithmic functions, periodic functions, Limit of functions, Algebraic computation of limits.

Matrices: Introduction and definition of matrices, types of matrices, matrix addition and scalar multiplication, transpose and inverse of a matrix (only application), solution of system of linear equations using matrices.Cayley Hamilton theorem, eigen values and eigen vectors.

Section-B

Differentiation: Derivability and Derivative, Growth rates, instantaneous rate of change, Derivatives of standard functions, Formulae on derivative of sum, difference, product and quotient of functions, Chain rule.
Derivative of trigonometric functions, exponential and logarithmic functions. Derivative of functions expressed in parametric form. Logarithmic differentiation. Derivative of higher order (upto 2nd order). Maxima and minima of a function of a single variable.

Recommended books:

1. Batschelet, E.(1971) : Introduction to Mathematics for Life Scientist, Springer-Verlog, Berlin.
2. Shanti Naryan and P.K. Mittal(2011) : Differential Calculus, S.Chand and Co. (New Delhi)

Practicals: Commands of MATLAB for calculating different type of operations of Matrices.
Graphsof Trignometric functions, Exponential function, Logarithmic function, Inverse function.

B.Sc. (Hons.) Botany SEMESTER–I

BHB 105: pMjwbI (lwzmI)-I

smW: 3 GMty **kul AMk: 50**

iQaUrI AMk : 37:ieMtrnl AsY~smYNt : 13

not: ieMtrnl AsY~smYNt **50** AMkW dI hY, jo kwlj vloN inrDwirq idSw inrdySW Anuswr ienHW AMkW qoN v`KrI hovygI[ies pypr dy kul AMk **40+10** = **50** hn[

AMk-vMf Aqy prIiKAk leI hdwieqW

1. iksy kivqw dw swr jW ausdw ivSw vsqU (do ivcoN ie`k) **8 AMk**

2. iksy khwxI dw swr, ausdw ivSw vsqU, khwxI klw jW pwqr auswrI (do ivcoN ie`k)**8AMk**

3. pYrHw rcnw : iqMn iviSAW ivcoN iksy ie`k au~qy pYrHw ilKx leI ikhw jwvy[**4 AMk**

4. pYrHw dy ky aus bwry cwr pRSnW dy au¤qr **4 AMk**

5. nMbr 5 au~qy id¤qI ivAwkrx dy AwDwr 'qy vrxnwqmk pRSn **8 AMk**

6. nMbr 6 ivc mwq BwSw dy pihlI BwSw Aqy dUjI BwSw vjoN AiDAwpn, mh`qv Aqy sm`isAwvW bwry cwr pRSn pu¤Cy jwxgy, ijnHW ivco ividAwrQI ny do dw au¤qr dyxw hovygw[

(4¿2)=8 AMk

pwT-kRm Aqy pwT-pusqkW

1. **swihq dy rMg** (sMpw. fw. mihl isMG), Bwg pihlw (kivqw Aqy khwxI), rvI swihq pRkwSn, AMimRqsr[
2. **pYrHw rcnw**
3. **pYrHw pVH ky pRSnW dy au¤qr**[
4. (a) **pMjwbI DunI ivauq :** aucwrn AMg, aucwrn sQwn qy ivDIAW, svr, ivAMjn, sur[
   (A) **BwSw vMngIAW** : BwSw dw tkswlI rUp, BwSw Aqy aup-BwSw dw AMqr, pMjwbI aupBwSwvW dy pCwx-icMnH[
5. **mwq BwSw dw AiDAwpn**
   (a) pihlI BwSw dy qOr au¤qy
   (A) dUjI BwSw dy qOr au¤qy

B.Sc. (Hons.) Botany SEMESTER–I

BHB 105: pMjwbI (mu`FlI pMjwbI))-I

smW: 3 GMty **kul AMk: 50**

iQaUrI AMk : 37 : ieMtrnl AsY~smYNt : 13

1. **pMjwbI Bwsæw qy gurmuKI ilpI**

a) nwmkrx qy sMKyp jwx pCwx : gurmuKI vrxmwlw, A`Kr kRm, svr vwhk (a A e), lgW mwqrW, pYr ivc ibMdI vwly vrx, pYr ivc pYx vwly vrx, ibMdI, it`pI, A`Dk[

A) isKlweI qy AiBAws **15 AMk**

2. **gurmuKI, AwrQogRwPI Aqy aucwrn** : svr, ivAMjn : mu`FlI jwx-pCwx Aqy aucwrx, muhwrnI, lgW mwqrW dI pCwx [**10 AMk**

3. **pMjwbI sæbd joV** : mukqw (do A`KrW vwly sæbd, iqMn A`KrW vwly sæbd), ishwrI vwly sæbd, ibhwrI vwly sæbd, AONkV vwly sæbd, dulYNkV vwly sæbd, lW vwly sæbd, dulwvW vwly sæbd, hoVy vwly sæbd, knOVy vwly sæbd, lgWKr (it`pI, ibMdI, A`Dk) vwly sæbd, Suæ`D-ASu`D[

15 AMk

AMk vMf Aqy prIiKAk leI hdwieqW

1. pihly Bwg ivcoN vrxnwqmk pRsæn pu`Cy jwxgy[ijnHW ivcoN iqMn pRsænW dw au~qr dyxw lwjæmI hY[hr pRsæn dy pMj-pMj AMk hn[

(5+5+5) 15 AMk

2. Bwg dUsrw ivcoN do-do nMbr dy pMj pRsæn pu`Cy jwxgy[swry pRsæn lwjæmI hn[**10 AMk**

3. Bwg qIsrw ivcoN iqMn pRsæn pu`Cy jwxgy[ijnHW dy pMj-pMj AMk hn[**15 AMk**

B.Sc. (Hons.) Botany SEMESTER–I

BHB 106: Communicative English-I

Time: 3 Hours **Max. Marks: 50**

Theory: 6 periods/Week **Theory: 37; Int. Ass.: 13**

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 1 and 2 of the book *MakingConnections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, SecondEdition. They will be required to answer the questions given after each essay.

2. Developing Vocabulary and using it in the Right Context:

The students will be required to master "Word List" and "Correct Usage of Commonly Used Words and Phrases" from the Chapter "Vocabulary" in the book *The Written Word.*

3. Writing Skills

Students will be required to write Paragraph Writing and Letter Writing as in the book *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

Suggested paper pattern:-

1. Practical Question on Paragraph Writing with internal choice as prescribed in *The Written Word* (8 marks)
2. Short answer type questions from Unit 1 and 2 of *Making Connections : A Strategic Approach To Academic Reading* (12 marks)
3. Essay type question with internal choice from Unit 1 and 2 of *Making Connections: A strategic Approach to Academic Reading* (8 marks)
4. A question on Letter Writing from *The Written Word* (6 marks)
5. Theoretical question(s) based on the two chapters from the book *The Written Word* (6 marks)

B.Sc. (Hons.) Botany SEMESTER–II

BHB 201: Fungi & Plant Pathology

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

1. Characteristic features and classification of fungi.
2. Economic importance of fungi.
3. General account of the following groups of fungi with the help of genera mentioned against each group and emphasis on diseases caused.

MYXOMYCOTA : *Physarum*
OOMYCOTA : *Pythium, Phytophthora, Peronosclerospora,Albugo.*

UNIT-II

4. General account of the following groups of fungi with the help of genera mentioned against each group and emphasis on diseases caused.

CHYTRIDIOMYCOTA **:** *Synchytrium*
ZYGOMYCOTA **:** *Rhizopus*
ASCOMYCOTA **:** *Saccharomyces, Erysiphe, Aspergillus, Penicillium, Peziza*

UNIT-III

5. General account of the following groups of fungi with the help of genera mentioned against each group and emphasis on diseases caused.

BASIDIOMYCOTA **:** *Agaricus,Polyporus, Lycoperdon, Puccinia, Ustilago*
MITOSPORIC FUNGI **:** *Cercospora, Pyricularia, Colletotrichum, Alternaria.*

UNIT – IV

6. Principles of Plant pathology: Terms and concepts; General symptoms; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation;Plant defense mechanisms; prevention and control of plant diseases; role of quarantine.

Suggested Readings

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopolous, C.J. Mims, C.W. and Blackwell, M. *Introductory Mycology,* John Wiley and Sons, New York, 1996.
3. Bilgrami, K.S. and Verma, R.N. *Physiology of Fungi,* Vikas Publishing House, New Delhi, 1978.
4. Burnett, J.H. *Fundamentals of Mycology,* Edward Arnold, London, 1976.
5. Carlile, M.J., Watkinson, S.C. and Gooday, G.W. *The Fungi.* Academic Press, New York.
6. Hale, M.E., 1983 *The Biology of Lichens,* Arnold, London, 2001.
7. Ingold, C.T. *Fungal Spores,* Their Liberation and Dispersal, Clarendon Press, Oxford, 1971.
8. Kendrick, B. *The Fifth Kingdom*. Focus Publishing, Newburyport, M.A. U.S.A., 2000.
9. Kirk, P.M., Canon, P.F., Minter, D.W. and Stalpers, J.A. *Dictionary of the Fungi*. 10th Edition,
   CAB International, U.K., 2008.
10. Moore, L. *Fundamentals of the Fungi,* Prentice Hall, New York, 1972.
11. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.
12. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 207: Lab I: Fungi & Plant Pathology

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Practicals

1. To work out the histopathology of the following :
(a) White rust of Crucifers
(b) Late blight of potato
(c) Downy mildew of sorghum/bajra
(d) Die back of pea
(e) Powdery mildew
(f) Wheat rust
(g) Smut diseases of wheat and barley
(h) Red rot of sugarcane
(i) Tikka disease of groundnut
(j) Early blight of tomato/ Potato
(k) Red rot of sugarcane

2. To make permanent preparations :
(a) V.S. of an apothecium – *Peziza* (tissue study).
(b) V.S. Gill of mushroom
3. To make temporary mount: A study of the fungi viz. *Rhizophus,Penicillium, Aspergillus, Cercospora, Alternaria* and *Pyricularia*.
4. General survey (morphology) of other specimens of Myxomycota, Zygomycota, Ascomycota andBasidiomycota.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 202: Non-Chordates-II

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

- Arthropoda: Type study
  - *Periplaneta Americana*
- Onychophora: (General characteristics and evolutionary significance)

UNIT-II

- Mollusca: Type study
  - *Pila*
- Significance of Torsion in Molluscs

UNIT-III

- Echinodermata: Type study
  - *Asterias*
- Study of Echinoderm larvae

UNIT-IV

- Hemichordata: Type study
  - *Balanoglossus*
- Affinities of Hemichordates with non chordates and chordates.

Books Recommended

1. Barnes, A., Invertebrate Zoology, Harcourt Publishers, International Company, 2001.
2. Chaudhry, S., Fundamental Invertebrate Zoology, S. Vikas & Co. Fatehpura, Jalandhar, 2003
3. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004. 2012
4. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut,
5. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors, Delhi, 1992.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 208: Lab 2: Non-Chordates-II

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

I Classification up to order and study of the specimens mentioned against each phylum with ecological note and economic importance if any

Arthropoda: *Palaemon, Lobster, Cancer, Sacculina, Eupagurus, Lepas, Cyclops, Daphnia, Peripatus, Lepisma, Periplaneta, Gryllus, Mantis, Forficula,* Dragonfly, *Cimex, Bombyx, Polistes, Apis, Pediculus, Julus, Scolopendra, Palamnaeus, Aranea, Limulus*

Mollusca: *Mytilus, Pholas, Pecten, Aplysia, Limax, Pila, Sepia, Octopus, Nautilus*

Echinodermata: *Asterias, Ophiothrix, Echinus, Antedon*

II. Study of Permanent slides

Arthropoda Trachea and mouthparts of Cockroach
Mollusca Radula of *Pila*
Echinodermata T.S. of Star-fish arm

III. Study of systems through charts/models

Periplaneta americana: Digestive and Nervous system
Pila: Digestive and Nervous system

Guidelines to conduct Practical Examination:-

1.	Identify and classify the specimens upto order. Write a note on their habit, habitat,special features and economic importance if any.	15
2.	Identify the slides and give at least two reasons for their identification.	9
3.	Identify the organ systems by using models.	4
4.	Preparation of Temporary mount	4
5.	Assignment	3
6.	Viva-voce & Practical file.	5

*Minor changes can be done as per the availability of materials.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 203: Modern Physics

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

UNIT-I

Atomic Structure: Structure of Atom, Rutherford Scattering, Impact parameter, Distance of closest approach, Nucleus and its properties, The Bohr model of atom, Electron orbits, Energy levels and Hydrogen spectra, Bohr's correspondence principle, Atomic excitation, Franck Hertz experiment, Introduction to Lasers, Einsteins coefficients, He-Ne Laser.

UNIT-II

Radioisotopes and their Application: Radioactivity, Radioactive decay laws, Uranium and Carbon dating, α, β and γ decays and their properties, Radioisotopes, their production and separation, Uses of radioisotopes in medicine, agriculture and geology, Radiation doses and their units, Biological effects of radiation.

UNIT-III

Dual Nature of Matter and Radiation: Planck's quantum hypothesis, de Broglie's hypothesis, Electron diffraction experiments of Davisson and Germen, Wave group and particle velocities, Heisenberg's uncertainty principle, Principle of the electron microscope, Diffraction of X-rays from crystals, , Bragg's law of diffraction.

UNIT-IV

Elementary Particles: Classification of elementary particles and their properties, Antiparticles, Conservation laws (qualitative only), Uses of ionization chamber, G.M. Counter, Scintillation counter and Photographic emulsions as detectors, Origin and general characterization of cosmic rays (Primary and Secondary).

Reference Books:

1. Concepts of Modern Physics: A. Beiser.
2. Essentials of Modern Physics: V. Acosta and C. L. Grown
3. Fundamentals of Modern Physics: B. D. Duggal and C. L. Chhabra.

B.Sc. (Hons.) Botany SEMESTER–II
BHB 209: Lab 3: Modern Physics

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

I. The distribution of marks is as follows:
i) One experiment **20 Marks**
ii) Brief Theory **5 Marks**
iii) Viva–Voce **10Marks**
iv) Record (Practical file) **5 Marks**
II. There will be one session of 3 hours duration and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment is allotted to more than three examinee in any group.

1. To study the gas discharge spectrum of hydrogen.
2. To study the absorption spectra of iodine vapours.
3. To determine the ionization potential of mercury.
4. To study the photoelectric effect and determine the value of Planck's constant.
5. Study of variation of light intensity with distance using photovoltaic cell (Inverse Square Law).
6. To draw the plateau of a GM counter and find the operating voltage of GM tube.
7. To find the dead time of GM counter.
8. To study the absorption coefficient beta particles in aluminium using GM counter and find the absorption coefficients.
9. To study the statistical fluctuations and end point energy of beta particles using GM counter.
10. Measurement of reverse saturation current in pn junction diode at various temperatures and find the approximate value of the band gap.
11. To determine the wavelength of He-Ne laser using plane diffraction grating.

Reference Books :
Practical Physics Vol.II, T.S. Bhatia, Gursharan Kaur, Iqbal Singh, Vishal Publications
Practical Physics, C.L. Arora, S. Chand & Co.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 204: Maths-II

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Note for Paper setters/examiners: In Unit-I,Set 6 questions from section A. Students are to attempt any five. Each question carries 2 marks. In Unit-II, Set 6 questions from section B. Students are to attempt any four. Each question carries 3 marks. In Unit –III, Set any 5 questions from section A&B.Students are to attempt any 3.Each question carries 5 marks.

Section -A

Integration: As inverse of differentiation. Indefinite integral of standard forms. Integration by parts. Integration by substitution.
Integration using method of partial fractions (of algebraic rational functions).
Definite integral and application in finding the area under simple curves, especially lines , arcs of circles(in standard form only).
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Section-B

Statistics: Concept of Probability, Random Experiments: outcomes, sample spaces (Set Representation),Additive and Multiplication law of Probability, Independent Events, Conditional probability. Permutations and Combinations, standard deviation and skewness.

Differential Equations: Definition, Solution of differential equations of first order and first degree(Variable separable, homogeneous equations, linear equations and equations reducible to the linear form). Applications of first order differential equations to biology.

Recommended books:

1. Gupta S.P. (2000): Statistical methods. Sultan Chand and Company, New Delhi.
2. Kapoor V.K. and Gupta S.C. (2000): Fundamentals of Mathematical Statistics. Sultan Chand and Company, New Delhi.
3. Bailey, N.T.J.(1995): Statistical Methods in Biology, Cambridge University Press. .
4. Shanti Naryan and P.K. Mittal(2011): Integral Calculus, S.Chand and Co. (New Delhi)

Practicals:
Graphs of simple curves, circles, lines. Experiments on probability theory, random experiments:- outcomes, sample space along with practical examples.

B.Sc. (Hons.) Botany SEMESTER–II

BHB 205: pMjwbl (lwzml)-II

smW : 3 GMty **kul AMk: 50**

iQaUrl AMk : 37: ieMtrnl AsY~smYNt : 13

pwT-kRm Aqy pwT-pusqkW

1. **swihq dy rMg** (sMpw. fw. mihl isMG), Bwg dUjw (vwrqk Aqy ryKw-ic`qr), rvl swihq pRkwSn, AMimRqsr[
2. **Sbd-bxqr Aqy Sbd rcnw** : pirBwSw, muFly sMklp[
3. **Sbd SRyxlAW**
4. **pYrHw rcnw**
5. **pYrHw pVH ky pRSnW dy au¤qr**
6. **muhwvry Aqy AKwx**

AMk-vMf Aqy prIiKAk leI hdwieqW

1. iksy lyK/inbMD dw swr jW ausdw ivSw vsqU (do ivcoN ie`k) **(8 AMk)**
2. ryKw icqr : swr, ivSw-vsqU, S^sIAq dy gux **(8 AMk)**
3. XUint 3-4 nMbr au¤qy id¤qI ivAwkrx dy AwDwr qy vrxnwqmk pRSn **(8 AMk)**
4. pYrHw rcnw : iqMn iviSAW ivcoN iksy ie`k au~qy pYrHw ilKx leI ikhw jwvy [**(4 AMk)**
5. pYrHw dy ky aus bwry cwr pRSnW dy au¤qr **(4 AMk)**
6. nMbr 7 ivc A¤T AKwx Aqy A`T muhwvry pu¤Cy jwxgy, ijnHW ivcoN ividAwrQI ny cwr-cwr f vwkW ivc vrq ky ArQ sp`St krny hoxgy[**(4+4 = 8 AMk)**

not: ieMtrnl AsY~smYNt 10 AMkW dI hY, jo kwlj vloN inrDwirq idSw inrdySW Anuswr ienHW AMkW qoN v`KrI hovygI[ies pypr dy kul AMk 40+10 = 50 hn[

B.Sc. (Hons.) Botany SEMESTER–II

BHB 205: pMjwbI (mu`FlI pMjwbI)-II

smW : 3 GMty **kul AMk: 50**

iQaUrI AMk: 37: ieMtrnl AsY~smYNt : 13

pwT-kRm Aqy pwT-pusqkW

1. **pMjwbI sæbd bxqr** : DwqU, vDyqr (Agyqr, mDyqr, ipCyqr), pMjwbI kosægq sæbd Aqy ivAwkrixk sæbd **15 AMk**
2. **pMjwbI sæbd pRkwr** :
   a) sMXukq sæbd, smwsI sæbd, dojwqI sæbd, dohry/duhrukqI sæbd Aqy imsærq sæbd
   A) isKlweI qy AiBAws **10 AMk**

3. **pMjwbI sæbd rcnw** :
   a) ie`k-vcn bhu-vcn, ilMg-puilMg, bhu-ArQk sæbd, smwn-ArQk sæbd, bhuqy sæbdW leI ie`k sæbd, sæbd joV, ivroDAwrQk sæbd
   A) in`q vrqoN dI pMjwbI sæbdwvlI : Kwx-pIx, swkwdwrI, ru`qW, mhIinAW, igxqI, mOsm, mwrkIt/bwjæwr, vpwr, DMidAW nwl sMbMiDq[**10+5=15 AMk**

AMk vMf Aqy prIiKAk leI hdwieqW

1. Bwg pihlW ivcoN cwr pRsæn puCy jwxgy ijnHW ivcoN iqMn pRsænW dw au~qr dyxw lwjæmI hn[hr pRsæn dy pMj-pMj nMbr hn [**15 AMk**
2. Bwg dUsrw ivcoN do-do nMbr dy pMj pRsæn pu`Cy jwxgy[swry pRsæn lwjæmI hn[**10 AMk**
3. Bwg qIsrw dy (a) Bwg ivcoN do svwl Aqy (A) Bwg ivcoN ie`k svwl puiCAw jwvygw[hr pRsæn dy pMj-pMj AMk hn[**10+5=15 AMk**

not: ieMtrnl AsY~smYNt 10 AMkW dI hY, jo kwlj vloN inrDwirq idSw inrdySW Anuswr ienHW AMkW qoN v`KrI hovygI[ies pypr dy kul AMk 40+10 = 50 hn[

B.Sc. (Hons.) Botany SEMESTER–II
BHB 206: Communicative English-II

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Suggested paper pattern:-

1. Practical Question on Essay Writing with internal choice as prescribed in *The Written Word* (8 marks)
2. Short answer type questions from Unit 3 and 4 of *Making Connections : A Strategic Approach To Academic Reading* (12 marks)
3. Essay type question with internal choice from Unit 3 and 4 of *Making Connections: A strategic Approach to Academic Reading* (8 marks)
4. Question on note making from *The Written Word* (6 marks)
5. Theoretical question(s) based on the two chapters from the book *The Written Word* (6 marks)

Course Contents:

1. Reading and Comprehension Skills:

Students will be required to read and comprehend the essays in Unit 3 and 4 of the book *MakingConnections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, SecondEdition. They will be required to answer the questions given after each essay.

2. Writing Skills

Students will be required to learn Essay writing, Report Writing and Letter Writing as in the book *TheWritten Word* by Vandana R. Singh, Oxford University Press, New Delhi.

B.Sc. (Hons.) Zoology
Scheme of Courses
Semester I-II
Session 2019-2020

Sr. No.	Code (Course No.)	Subject (Course Title)	Core/Generic/ Lab	Periods/ Week	Marks		
					Theory/ practical	Int. Ass.	Total
Semester I							
1	BHZ-102	Cryptogams-I	Generic	6	37	13	50
2	BHZ-108	Cryptogams-I	Lab I	6	37	13	50
Semester II							
3	BHZ-202	Cryptogams-II	Generic	6	37	13	50
4	BHZ-208	Cryptogams-II	Lab II	6	37	13	50

B.Sc. (Hons.) Zoology SEMESTER–I

BHZ-102: Cryptogams-I

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Unit –I

Algae: Habit and habitat, general characters, distribution, classification and economic importance of algae.

Structure, reproduction and life cycle of:

Cyanophyta: *Oscillatoria* and*Nostoc*

Chlorophyta: *Ulothrix* and *Spirogyra*

Unit –II

Structure, reproduction and life cycle of:

Xanthophyta: *Vaucheria*

Phaeophyta: *Ectocarpus* and *Sargassum*

Rhodophyta: *Batrachospermum* and *Polysiphonia*

Unit – III

Fungi: Occurrence and distribution, general characteristics, classification and economic importance of fungi.

General characteristics, structure, reproduction and life cycle of:

Mastigomycotina: *Phytophthora*

Zygomycotina: *Rhizopus*

Ascomycotina: *Peziza, Penicillium*

Unit-IV

General characteristics, structure, reproduction and life cycle of:

Basidiomycotina: *Puccinia, Agaricus*

Deuteromycotina: *Colletotrichum, Alternaria*

General account of Lichens.

Suggested Readings:

1. Sharma, O.P. 1992. Text Book of Thallophytes, McGraw Hill Publishing Co. New Delhi.

2. Thakur, A. K. and S. K. Bassi**.** 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.

3. Alexopolous, J. and W. M. Charles. 1988. Introduction to Mycology. Wiley Eastern, New Delhi.

4. Dube, H.C.1990. An Introduction to Fungi, Vikas Publishing House, Pvt. Ltd. Delhi.

5. Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.

6. Sharma, P.D. 1991. The Fungi, Rastogi and Co, Meerut.

7. Vashishta, B. R. 1990. Botany for Degree Students: Fungi, S. Chand & Company Ltd, New Delhi.

B.Sc. (Hons.) Zoology SEMESTER–I

BHZ-108: Lab I: Cryptogams-I

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

1. To study the morphology of various genera included in algae:

   Oscillatoria and *Nostoc*
   Ulothrix and *Spirogyra*
   Vaucheria
   Ectocarpus
   Batrachospermum and *Sargassum*

2. To study the morphology and reproductive stages of various genera included in fungi:
   Phytophthora
   Rhizopus
   Saccharomyces
   Agaricus
   Peziza

3. To study disease samples along with spores and life cycle in:
   Puccinia
   Colletotrichum
   Alternaria

4. To study the various types of lichens and their reproductive structures (soredia and apothecium):
   Crustose
   Foliose
   Fructicose

5. To study mycorrhizae:
   Ectomycorrhiza
   Endomycorrhiza

B.Sc. (Hons.) Zoology SEMESTER–II

BHZ-202: Cryptogams-II

Time: 3 Hours **Max. Marks: 50**
Theory: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

Instructions for the paper setter:
1) There will be a total of 9 questions of which five are to be attempted.
2) Question 1 will be compulsory and will be of 5 short answer type (One mark each).
3) The remaining 8 questions shall include two questions from each unit. Candidate shall be required to attempt 4 questions, one from each unit. All questions shall have equal marks (8 marks each). Preferably, the question should not be split into any sub-parts. In case of any splitting, it should not have more than two sub-parts.

Unit-I

Bryophytes: General characters, classification and economic importance, bryophytes as amphibians of plant kingdom, adaptive characters for land habitatdisplaying heterologous alternation of generations.

Unit –II

Study of morphology, anatomy, reproductive characters and life cycle of following:

Hepaticopsida: *Marchantia*

Anthocerotopsida: *Anthoceros*

Bryopsida:*Funaria*

Unit- III

Pteridophytes: General characters, classification and economic importance, the first vascular plants, stelar system in pteridophytes, heterospory and seed habit, apogamy and apospory.

Unit - IV

Study of morphology, anatomy, reproductive characters and life cycle of following:

Psilophyta: *Psilotum*

Lycophyta*: Lycopodium*

Sphenophyta: *Equisetum*

Pterophyta:*Pteris*

Suggested Readings:

1. Puri, P. 1980. Bryophyta. Atma Ram and Sons. Delhi
2. Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. Botany for Degree Students:
3. Bryophyta. S. Chand & Company Ltd, New Delhi.
4. Vashishta, B. R., A. K. Sinha and V. P. Singh. 2008. Botany for Degree Students: Algae.
   S. Chand & Company Ltd, New Delhi.
5. Richardson, D.H.S. 1981 The Biology of Mosses. John Wiley and Sons, New York.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IKInternational Publishers.
7. Shaw, A.J. and Goffinet, B. (2000) Bryophyte Biology. Cambridge University Press.
8. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
9. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
10. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot,Allahabad.

B.Sc. (Hons.) Zoology SEMESTER–II

BHZ-208: Lab II: Cryptogams-II

Time: 3 Hours **Max. Marks: 50**
Practical: 6 Periods/Week **Theory: 37; Int. Ass.: 13**

1. Study of morphology, anatomy and reproductive structures of various genera of bryophytes:

   Hepaticopsida: *Marchantia*

   Anthocerotopsida: *Anthoceros*

   Bryopsida:*Funaria*

2. Study of morphology, anatomy and reproductive structures of various genera of Pteridophytes:

   Psilophyta: *Psilotum*

   Lycophyta*: Lycopodium*

   Sphenophyta: *Equisetum*

   Pterophyta:*Pteris*

3. Study of some pteridophytes in their natural habitat.