M.Sc. Botany

Scheme A2: Semester 1st

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A01	Algae & Fungi & Practical	241/BOT/CC101	03	00	02	03	00	01	04	25	50	05	20	**100**
CC-A02	Molecular Biology & Practical	241/BOT/CC102	03	00	02	03	00	01	04	25	50	05	20	**100**
CC-A03	Cell Biology & Practical	241/BOT/CC103	04	00	00	00	00	00	04	30	70	00	00	**100**
Discipline Specific Elective Courses (Select any one course from the following)														
DSE-01	Biostatistics and Data Analysis & Practical OR Genetic Engineering & Practical	241/BOT/DS101	02	00	02	02	00	01	03	15	35	05	20	**75**
Multidisciplinary Course(s)														
MDC-01	One from the Pool	241/BOT/MD101	02	00	02	02	00	01	03	15	35	05	20	**75**
Ability Enhancement Course(s)														
AEC-01	One from the Pool	241/BOT/AE101	02	00	00	02	00	00	02	00	50	00	00	**50**
Value-added Course(s)														
VAC-01	One from the Pool	241/BOT/VA101	02	00	00	02	00	00	02	00	50	00	00	**50**
Total Credits									**22**					**550**

Scheme A2: Semester 2nd

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A04	Plant Taxonomy & Economic Botany & Practical	241/BOT/CC204	04	00	00	04	00	00	04	30	70	00	00	**100**
CC-A05	Biochemistry & Biotechniques & Practical	241/BOT/CC205	03	00	02	03	00	01	04	25	50	05	20	**100**
CC-A06	Molecular Cytogenetics & Practical	241/BOT/CC206	03	00	02	03	00	01	04	25	50	05	20	**100**
Discipline Specific Elective Courses (Select any one course from the following)														
DSE-02	Bioinformatics & Practical OR Advanced Plant Physiology & Practical	241/BOT/DS202	02	00	02	02	00	01	03	15	35	05	20	**75**
Multidisciplinary Course(s)														
MDC-02	One from the Pool	241/BOT/MD202	02	00	02	02	00	01	03	15	50	05	20	**75**
Ability Enhancement Course(s)														
AEC-02	One from the Pool	241/BOT/AE202	02	00	00	02	00	00	02	00	50	00	00	**50**
Skill Enhancement Course(s)														
SEC-01	One from the Pool	241/BOT/SEC201	01	00	02	01	00	01	02	05	20	05	20	**50**
Total Credits									**22**					**550**

Note: *internship or field training or project of 4-6 weeks during summer vacation @ 4 credits.*

Scheme A2: Semester 3rd

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A07	Physiology of Plant growth & development& Practical	241/BOT/CC307	03	00	02	03	00	01	04	25	50	05	20	**100**
CC-A08	Biology of Reproduction and Anatomy& Practical	241/BOT/CC308	04	00	00	04	00	00	04	30	70	00	00	**100**
CC-A09	Bryophytes &Pteridophytes& Practical	241/BOT/CC309	03	00	02	03	00	01	04	25	50	05	20	**100**
Discipline Specific Elective Courses (Select any one course from the following)														
DSE-03	Gymnosperms & Ethnobotany & Practical OR Advanced Phycology & Practical	241/BOT/DS203	02	00	02	02	00	01	03	15	35	05	20	**75**
Multidisciplinary Course(s)														
MD-03	One from the Pool	241/BOT/MD203	02	00	02	02	00	01	03	15	35	05	20	**75**
Skill Enhancement Course(s)														
SEC-02	One from the Pool	241/BOT/SEC202	01	00	02	01	00	01	02	00	50	00	00	**50**
Value added Course(s)														
VA-02	One from the Pool	241/BOT/VA202	02	00	00	02	00	00	02	00	50	00	00	**50**
Seminars														
Seminar	Seminar	241/BOT/SEMINAR201	02	00	00	02	00	00	02	00	50	00	00	**50**
Internship/Field Activity#														
INTRSP	Industrial Visit/ Field Work and Report Writing	241/BOT/INTRSP201	00	00	08	00	00	04	04	00	00	15	35	**50**
Total Credits									**28**					**600**

 # Four credits of internship earned by a student during summer internship after 2nd semester will be counted in 3rd semester of a student who pursue 2 year PG Programme without taking exit option.

Scheme A2: Semester 4th

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Ability Enhancement Course(s)														
AEC-03	Manuscript Writing**/ Pool	241/BOT/AE403	02	00	00	02	00	00	02	15	35	00	00	**50**
Dissertation/Project Work														
Dissertation	Industrial Training/Research Project/ Dissertation	241/BOT/DISSERTATION401	0	0	40	0	0	20	20	00	00	100	400	**500**
Total Credits									**22**					**550**

BOTANY: SEMESTER-I

CourseType	Course ID	Name of theCourse	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A01	**241/BOT/CC101**	**Algae & Fungi**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. The students will be inspired to become aware and comprehend the broader aspects of Algology.
2. The learning outcome will be aimed towards advanced academic education to broaden the knowledge its Biodiversity, Ecological significance and Economic importance of algae.
3. The students will be inspired to become well versed with the fungal world in terms of recent researches.
4. Economic importance of Fungi with regards to its deleterious and beneficial aspects. Modern economic importance of Lichens. Working knowledge of biological laboratories and research centres in India.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Criteria for algal classification (pigments, reserve food, flagella etc.) and their taxonomic importance. Comparative account of important systems of classification and recent trends. Thallus organization in algae and evolutionary trends. Economic importance of algae as food, feed, uses in industries etc and algal biofertilizers.	12
II	Biodiversity of algae in different habitats (terrestrial, freshwater and marine). Ecological diversity of algae in unusual habitats (thermal, psychrophilic, subaerial, symbioticetc.). Dynamics and consequences of algal blooms and red tides (Freshwater and Marine). Algae as major components of phytoplankton. Morphological features and life cycle patterns of major divisions with suitable examples (Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, and Rhodophyta).	11
III	General characters of fungi: Thallus organization, nutrition and reproduction. Classification of fungi by Ainsworth & Bisby (1983), Alexopoulus et. Al (1996).- phylogeny of fungi-characters used in classification. General account of Myxomycota, mastigomycota, Zygomycota, Ascomycota, Basidiomycota and Mitosporic gungi. Different kinds of spores and their dispersal. Concept of Homothallism, Heterothallism, alternation of generations and parasexualuality.	11
IV	Economic importance of fungi in nutrient cycling, decomposition, humus formation, decay and deterioration of wood & timber. Causal organisms, sysptoms and management of : late and early blight of potato, downy mildew of grapes, green ear disease of Bazra (Sorghum), apple scab, karnal bunt of wheat, rust of wheat, tikka disease of ground nut Lichens: structure, reproduction and economic importance	11
V **Practical**		30

Learning Resources

1. Ahluwalia, A.S. (Ed.). *Phycology: Principles, Processes and Applications.* Daya Publishing House, New Delhi. 2003.
2. Carr, N.G. & Whitton , B.A. (1982): The biology of Cyanobacteria Blackwell Scientific Publ., Oxford, U.K.
3. Dubey, R.C. (2014): Advanced Biotechnology, S Chand & Cmpany Pvt. Ltd., New Delhi.
4. Fatma, T. (2005): Cyanobacterial and Algal Metabolism and Environmental Biotechnology, Narosa Publihers.
5. Fay, P & C van Baalen (1987): The cyanobacteria, Elsevier Science Publishers, B.V. Amsterdam, Netherlands.
6. Gupta, R.K. & Pandey, V.D. (2007): Advaces in Applied Phycology, Daya Publishing House, Daryaganj, New Delhi.
7. Hoek, C. Van Den, Mann, D.G. & Jahns, H.M. (1995): Algae: An Introduction to Phycology, Cambridge University Press, U.K.
8. Kaushik, B.D. (1987): Laboratory methods for Blue-green Algae, Associated Publishing Co., New Delhi.
9. Morris, I. (1980): The Physiological Ecology of Phytoplankton (studies in Ecology, Vol.7), Blackwell Scientific Publ., USA.
10. Prescott, L.M., Harley, J.P. & Klein, D.A. (1996): Microbiology, 3rd edition, Wm. C. Brown Publishers, USA.

BOTANY: SEMESTER-I								
CourseType	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A02	**241/BOT/CC102**	**Molecular Biology**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. The youth will know DNA replication and DNA repair mechanisms
2. Students will come to know about the process of protein sorting and its mechanisms
3. Students will get the knowledge about the genes and the proteins associated with Cancer i.e. oncogenes and tumor suppressor proteins.
4. The students will gain the knowledge about molecular markers and its application.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	DNA Replication: Mechanism of DNA replication in Prokaryotic and eukaryotic cells. Enzymes and accessory proteins involved in DNA replication and DNA repair. Transcription: Prokaryotic & Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Transcriptional and post-transcriptional gene silencing, Modifications in RNA: 5'- Cap formation, Transcription termination, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear exportof mRNA & its stability.	12
II	Translation: Prokaryotic and eukaryotic translation, Regulation of translation, co- and post translational modifications of proteins. Protein Localization: Synthesis of secretory and membrane protein & their import into nucleus, mitochondria, and peroxisomes, Receptor mediated endocytosis, Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins	11
III	Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head & their desigining strategies, hairpin and other ribozymes. Applications of Antisense and ribozyme technologies. Homologous Recombination: Holliday junction, gene targeting, gene disruption, and' Cre/Lox recombination, RecA and other recombinases Molecular Mapping of Genome: Genetic and physical maps & their applications.	11
IV	Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, Molecular markers & their applications viz., forensic, disease prognosis, genetic counseling, Pedigree, animal trafficking and poaching; Germplasm maintenance, taxonomy and bio-diversity Genome Sequencing: Genomesizes, organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing, sequence information for identification of defective genes.	11

V **Practical**	1. Isolation of Genomic DNA. 2. Isolation of RNA. 3. Quantitative analysis of DNA. 4. Restriction digestion of DNA. 5. Ligation of DNA fragments. 6. Molecular weight analysis using agarose gel electrophoresis. 7. Isolation of plasmid DNA. 8. Western blotting. 9. Southern blotting. 10. Preparation of competent cell.	30

Learning Resources

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitzand A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA. 3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
3. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
4. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers(Ed.), VCH Publishers, Inc., New York.
5. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis,
6. Cold Spring Harbor Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York. 8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

BOTANY: SEMESTER-I								
CourseType	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A03	**241/BOT/CC103**	**Cell Biology**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. This core course will make students able to understand how the cell functions as a unit oflife.
2. Through this course, students will be able to appreciate the importance of various cellfunction and structures in the evolution of multicellular organisms.
3. The studies will make the students reveal elegance, dynamics and economy in the living celland a gratifying unity in the principles by which a cell functions.
4. The students will know about the basic cellular and molecular approaches for cancerdevelopment and treatment.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Biomembranes: Molecular composition and arrangement, functional consequences, membrane transportation; diffusion, active transport and pumps, uniports, symports and antiports,Donnan equilibrium;ion movements and cell function:, Maintenance of cellular pH; Receptor mediated endocytosis, The Extra Cellular Matrix Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata Ca^{++} dependent and Ca^{++} independent Homophilic cell-cell adhesion	12
II	Cytoskeleton and cell movement: Structure and organization of actin filaments, Actin, myosin and cellular movements, Structure and dynamic organizations of microtubules, Intermediate filaments, Cilia and flagella, Cell matrix adhesion, Integrins, Collagen, Non-collagen components, Protein sorting and transport, Protein uptake into the ER, Membrane proteins and Golgi sorting, Mechanism of vesicular transport, Lysosomes, Molecular mechanism of secretory pathway	11
III	Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, The events of M phase, Meiosis and fertilization, Genome organization, Chromosomal organization of genes and noncoding DNA, Mobile DNA, Pathways of intracellular signal transduction, Signaling networks	11
IV	Cell death and cell renewal: Apoptosis, Stem cells and the maintenance of adult tissues, Embryonic stem cells and therapeutic cloning, Biology of Cancer, Oncogenes, Tumor suppressor genes, Molecular approaches to cancer treatment, Biology of Ageing	11
V Practical	1. Preparation of mitotic and meiotic chromosomes. 2. Calculation of morphometric data and preparations of idiogram. 3. Determination of chiasma frequency and terminalization coefficient. 4. Preparation of polytene chromosomes and mapping. 5. Study of permanent slides of different types of cancer and their stages	30

Learning Resources

1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific AmericanBook, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.

BOTANY: SEMESTER-I

CourseType	Course Code	Name of theCourse	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
DSE-01 **4 credits**	**241/BOT/DS101**	**Bio-statistical methods and Data Analysis**	**2**	**2**	**15**	**35**	**50**	**3 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. This paper will help in understanding the students about a set of observationsand then designing an experiment.
2. Students will be able to acquire, analyze and understand the significance of data.
3. Students will gain the knowledge about the hypothesis testing.
4. The paper will also help in understanding various Non-parametric tests.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Data Analytics: Introduction, types, characteristics and advantages of data analytics. Descriptive statistical techniques: Central tendency, Dispersion, Skewness and Kurtosis. Correlation and Regression: Simple, Partial and Multiple.	8
II	Probability Theory: Concept and Approaches, Application of Additive and Multiplication Laws, Bay's Theorem, Mathematical Expectations. Probability Distribution: Binomial, Poisson, Normal.	7
III	Hypothesis Testing. Parametric tests: t-test and Analysis of Variance – one way classification,two way classification. Chi-Square test & its application.	7
IV	Non-Parametric Tests: The Runs test of randomness; tests of two-matched samples: Wilkoxson test, Signed Rank- Sum test; Test involving two independent samples: The Mann- Whitney U Test; Tests for K Related samples: The Kruskal Wallis H test, Friedman's test. Overview of Analytic Tools: Excel as analytic tool, SPSS, Data Visualization in Tableau, Elementary idea and Use of R Programming and Python in Analytics, Data Mining, Big Data.	8
V Practical	1. Descriptive statistics: Systemic tabular summarization of data (before analysis), measuresof central tendency, measures of dispersion (using calculators). 2. Tests of significance (Mean, Standard Deviation, proportion. 3. Chi Square Test of Goodness of fit, test of independence of attributes, Analysis of Variance(One way and two ways).	30

Learning Resources

1. Daniel, Wayne W. (2007) Biostatistics: A Foundation for Analysis in Health Sciences 10th Edition, Wiley Series.
2. Pagano, Marcello and Gauvreau, Kimberlee (2000) Principles of Biostatistics, 2nd Edition,CRC Press
3. Chap T. Le, Introductory Biostatistics (2017), Wiley India Pvt Ltd.
4. P.N. Arora and P. K. Malhan, Biostatistics, Himalaya Publishing House
5. B. K. Mahajan, Methods in Biostatistics: For Medical Students and Research Workers,JPB

BOTANY: SEMESTER-I

CourseType	Course Code	Name of theCourse	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
DSE-01	**241/BOT/DS101**	**Genetic Engineering**	**2**	**2**	**15**	**35**	**50**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. The student should be able to design and comprehend experimental strategies for alteration of genes and gene products in variety of organisms.
2. CO2 Students could use various approaches to conduct genetic engineering and their applications in biological research as well as in biotechnology industries.
3. This paper deals with various scopes in genetic engineering along with molecular tools.
4. The students will gain the knowledge about the gene tagging and its role.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Scope in Genetic Engineering. Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation cloning, gene expression. Cloning and patenting of life forms. Molecular Tools and Their Applications, Restriction enzymes, modification enzymes, DNA and RNA markers.	7
II	Nucleic Acid Purification, Yield Analysis, Amplification and its Applications, Gene Cloning Vectors, Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing, cDNA Synthesis and cloning. Alternative Strategies of Gene Cloning. Transgenic and gene knockout technologies. Targeted gene replacement, chromosome engineering	7
III	Microarray, Site-directed Mutagenesis and Protein Engineering. DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays Expression strategies for heterologous genes, Vector engineering and codon optimization, host engineering,in vitro transcription and translation, expression in bacteria expression in bacteria, yeast, insect cells, mammalian cells and in plants.	8
IV	Recombinant proteins: Purification and folding, characterization and stabilization. Phage Display, T-DNA and Transposon Tagging. Gene tagging and its role. Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.	8
V Practical	1. Bacterial culture and antibiotic selection medias. Prepration of competent cells. 2. Isolation of plasmid DNA. 3. Isolation of lambda phage DNA. 4. Quantitation of nucleic acids. 5. Agarose gel electrophoresis and restriction mapping of DNA 6. Construction of restriction map of plasmid DNA. 7. Cloning plasmid/phagemid vectors. 8. Preparation of helper phage and its titration 9. Preparation of single stranded DNA template 10. DNA sequencing 11. Gene expression in E. coli and analysis of gene product 12. PCR and Reporter Gene assay (Gus/CAT/b-GAL) 13. Western Blotting	30

Learning Resources

1. Gene cloning and DNA analysis – An Introduction (2006) 5th edition, T.A Brown, Blackwell publisher.
2. Essential genes (2006), Benzamin Lewin, Pearson education international.
3. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, NewYork.
4. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
5. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
7. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.
8. Molecular Biology of Gene (2008) 6th edition, Watson, Baker,Bell. Gann,Levine and Losick, Pearson education Inc.
9. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
10. Molecular Cloning : A Laboratory Manual (2000), J. sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York
11. DNA Cloning : A Practical Approach (1995) , D.M. Glover and B.D. Hames, IRL Press, Oxford,

BOTANY: SEMESTER-II

CourseType	Course Code	Name of theCourse	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A04 **4 credit**	**241/BOT/CC204**	**Plant Taxonomy and Economic Botany**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. Understand the significance, basic concepts, tools of plant taxonomy
2. Learn about the different systems of classification of angiosperms and relevance of plant taxonomy to other branches.
3. Acquire knowledge about the plant sources of foods, modern and traditional medicines, spices, oil, fibres, dyes, gum and timbers.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	The Species concept, Taxonomic hierarchy, Species, Genus and Family Taxonomic evidence: Morphology, anatomy, palynology. Taxonomic Tools: Herbarium and Floras. Botanical Gardens and herbaria in India; Botanical Survey of India its organization and role.	12
II	Salient Features of the International Code of Nomenclature (ICN). Systems of angiosperm classifications of Benthom and Hooker, Engler and Prantl, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne, Relative merits and demerits of these systems.	11
III	Origin of agriculture: World centers of primary diversity of domesticated plants. 28 Origin, botany, cultivation and uses of cereals (wheat, rice), Sugarcane, Potato Oil yielding plants (groundnut, mustard, sunflower)	11
IV	Botany, origin, uses of important fibres (Cotton, Jute), General account of important spices (Ginger, Turmeric, Cinnamon, Clove, Cardamom, Chilies, Pepper, Fennel, Coriander, Cumin, Asafetida, Nutmeg, Mace, and Saffron), General account of important medicinal plants (Aconite, Cinchona, Belladonna, Digitalis, Glycyrrhiza, Rauvolfia, Papaver, Vasaka, Aloe and Ginseng). A brief account of major Indian Medicinal plants(Amla, Neem, Arjun, Harad, Bahera, Isabgol, Ashwagandha, Bhringraj and Senna) General account of important timber, dye, gums and tannin yielding plants	11
V Practical		30

Learning Resources

1. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row Publishers Inc.
2. Lawrence, G.H.M. 1951. Taxonomy of vascular plants. The Macmillan C., New York.
3. Davis, P.H. and Heywood, V.H. 1965. Principles of Angiosperm Taxonomy. D Van Nostrand Co. , New York.
4. Sivarajan, V.V. 1984. Introduction to Principles of Plant Taxonomy. Oxford IBH Pub. Co., New Delhi.
5. Kochar, S.L. 1981. Economic Botany in the Tropics. Macmillan India Ltd., Delhi.
6. Hill, A.F. 1952. Economic Botany (2nd Ed.) McGraw Hill, New York.
7. Cobley, L.S. and Steele, W.M. 1976. An Introduction to the Botany of Tropical Crops (2nd Ed.) Longmans, London.
8. Simmonds, N.W. 1976. Evolution of Crop Plants Longman, London, New York.
9. SambaMurthy, AVS and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd.,Delhi
10. Judd, W.S.; Campbell. C.S., Kellogg, E.A. and Stevens, P.F. 1999. Plant Systematics A Phylogenetic Approach. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, U.S.A.
11. Schery, R.W. 1972. Plants for Man. Prentice Hall. Englewood Cliffs, N.J. USA
12. Simpson B. B. M. C. Ogorzaly 2001. Economic botany: plants of our world, 3rd ed. McGraw-Hill, New York, New York, USA.
13. Hancock. J. F. 2004. Plant evolution and the origin of crop species. 2nd edition. CABI Publishing, Cambridge, MA USA.
14. Radford, A. E., W. C. Dickison, J. R. Massey, C. R. Bell. 1976. Vascular Plant Systematics Harper and Row, New York..

BOTANY: SEMESTER-II								
CourseType	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A05 **4 credit**	**241/BOT/CC205**	**Biochemistry & Biotechniques**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. Students will be able to understand the general reactions of various metabolicpathways.
2. It will make the students to understand the structure and classification ofbiomolecules.
3. This paper will provide the basic understanding of various biological techniques.
4. The youth will be able to understand the basics of various techniques
5. It will make the students to understand the applications of these techniques for animalkindness.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Amino acids and peptides-classification, chemical reactions and physical, properties,Sugars - classification and reactions, metabolism of carbohydrate, Heterocyclic compounds-and secondary metabolites in living systems -nucleotides, pigments, isoprenoids, Separation techniques for different biomolecules. Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, body fluids –pH and acid base balance and their importance in clinical biochemistry, muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.	12
II	Lipids- classification, structure and functions Proteins-protein and protein legand interactions, end group analysis, hierarchy in structure, Ramachandran map. Conformational properties of polynucleotides, Polysaccharides - types, secondary and tertiary structural features, analysis- theoretical and experimental; Protein folding – biophysical and cellularaspects, enzymes coenzymes, in born errors of metabolism.	11
III	Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanningand transmission electron microscopes. Centrifuge technique: Principle, types of centrifuge, density gradient centrifuge in isolation of cell, cellorganelles and biomolecules. Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC) and FPLC. Application of chromatographic technique in biology. Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).	11
IV	Spectroscopy: Fluorescence, UV, visible, Infarad, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometery (LC-MS, GC-MS), X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology. Nature and types of radiation, preparation of labelling biological sample, detection and measurement of radiation, GM counter, Scientillation counter. Flow cytometery. Safety measurement in handling radioisotopes, ELISA, RIA and non-radiolabelling.	11

V **Practical**	1. Titration of amino acids 2. Reactions of amino acids, sugars and lipids 3. Isolation of DNA and protein 4. Quantitation of Proteins and Sugars 5. UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra 6. Demonstration of working of different types of microscopes. 7. Demonstration of Chromatography i.e. TLC, HPLC, GC. 8. To demonstrate the separation of proteins with the help of electrophoresis. 9. To study various molecular biology techniques i.e. PCR. 10. To demonstrate the use of spectrophotometer. 11. Purification of protein by column chromatography. 12. Visit of various laboratories in the university, preparation and submission of report.	30

Learning Resources

1. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics.Agrobios, Jodhpur, India.
2. Cooper, T.G. 1977. Tools in Biochemistry. John Wiley, New York, USA.
3. Dryer, R. L. and Lata, G. F. 1989. Experimental Biochemistry. Oxford University Press, NewYork.
4. Hames, B.D.(Ed.).1998. Gel Electrophoresis of Proteins: A Practical Approach, 8th edition.PAS, Oxford University Press, Oxford, UK.
5. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., NewYork.
6. Wilson, K. and Walker, J. 1994. Practical Biochemistry: Principles and Techniques, 4th edition.Cambridge University Press, Cambridge, U
7. A Biologists guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H.Goulding, ELBS Edn.
8. Lehninger AL, Nelson DL & Cox MM (1993) Principles of Biochemistry, 2nd edn. New York: Worth.
9. Stryer L (1995) Biochemistry, 4th edn. New York: WH Freeman.
10. Voet D, Voet JG & Pratt CW (1999) Fundamentals of Biochemistry. New York: Wiley.

BOTANY: SEMESTER-II								
CourseType	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A06	**241/BOT/CC206**	**Molecular Cytogenetics**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. Students will be able to study the molecular composition of the chromosomes.
2. They will gain the knowledge about mutations and molecular basis of cell cycle andits check points
3. The paper deals with nature and mechanism of genomic imprinting.
4. Students will gain the knowledge about mutations and detection of mutagens.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Biology of Chromosomes: Molecular anatomy of eukaryotic chromosomes;Metaphase chromosomes: Centromere, Kinetochore, Nucleolus organizers and rRNA genes, Telomere: structure and Functions, Heterochromatin and euchromatin, Giant Chromosomes: Polytene Chromosomes, Lampbrush Chromosomes	12
II	Sex Chromosomes: Sex determination and the Y Chromosome, Dosage compensation in *C. elegans*, *Drosophila* and Humans, Nature and mechanism of genomic imprinting, X- inactivation and imprinting, Sex specific imprinting	11
III	Genes in Pedigrees: Mendelian pedigree pattern, Inheritance of mitochondrial diseases, Complications to the basic pedigree patterns, Non-Mendelian traits. Somatic Cell Genetics: Cell fusion and somatic cell hybrids – agents and mechanism of fusion, Heterokaryon – Cell lines and selection systems and chromosome segregation,	11
IV	Gene Mutations : Spontaneous mutations – Base pair substitution and frame shift mutations Induced mutations – Radiation, chemical and environmental, In –vitro site specific mutagenesis. Detection of mutagens – The Ames test and sister chromatid exchanges, Genetics of Cell Cycle: Genetic regulation of cell division in yeast and eukaryotes, Molecular basis of cellular check points.	11
V Practical	1. Making karyological preparations from testicular material of suitable insects by squash and air drying techniques to study the structure and behaviour of chromosomes during mitosis and meiosis. 2. Study of chiasma frequency and terminalisation co-efficient. 3. Study of mitosis from hepatic ceacae of suitable insects or from onion root tips and preparation of karyotype andidiogram. 4. Demonstration of banding techniques (C, G and T). 5. Study of NORs in insect chromosomes. 6. Making preparations from salivary glands of Chironomus larvae / Drosophila larvae tostudy polytene chromosomes. 7. Effect of temperature on polytene chromosomes. 8. Preparation of human buccal smear to study sex chromatin. 9. Nuclear sexing from polymorphonuclear leucocytes. 10. Identification of meiotic and mitotic stages from permanent slides.	30

	11. Gel electrophoresis: Practical demonstration. 12. Isolation of genomic DNA. 13. PCR: Introduction and practical demonstration.	

Learning Resources

1. Atherly, A.C., J.R. Girton and J.F. McDonald. The Science of Genetics. Sauders CollegePublishing, Harcort Brace College Publishers, NY.
2. Brooker, R.J. Genetics : Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics – The Continuity of Life. Brook/ColePublishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley andSons. Inc., NY.
5. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. AnIntroduction to Genetic Analysis. W.H. Freeman and company, NY.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. MolecularBiology of Genes. The Benjamin/Cummings Publishing Company Inc., Tokyo.
9. Tom Strachan & Read, A.P. Human Molecular Genetics 3rd edition, Garland Publishing2004, London.

BOTANY: SEMESTER-II								
CourseType	**Course Code**	**Name of theCourse**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
DSE-02	**241/BOT/DS202**	**Bioinformatics**	**2**	**2**	**15**	**35**	**50**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. The youth will be able to understand the basics of various techniques
2. It will make the students to understand the applications of these techniques for animalkindness

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Computers: An overview of computers, microcomputers, VDUs and printer; What is programming?Algorithms; Languages and packages: Introduction to MS Office, MS Access, introduction to SQL (structured querry language) Handling arrays, procedures. Colour, sound and graphics; Use of standard packages.	7
II	Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Pattern modifiers.Applications of PERL in Bioinformatics: Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA	7
III	Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Preliminary ideas of query and analysis of sequence information. Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch&SmithWaterman algorithms. Analysis of computational complexities andthe relative merits and demerits of eachmethod.Theory of scoring matrices and their use for sequence comparison.	8
IV	Database Search Algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST results. Pattern Recognition Methods in Sequence Analysis: Concept of a sequence pattern, regular expression based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAst. Markov chains and Markov models and their use in gene finding. Concept of HMMS, the Forward backward and the Viterbi algorithm.The Baum Welch algorithm for training a HMM.Use of profile HMM for protein family classification.	8
	1. Retrieve Nucleotide sequences from NCBI serve. 2. Retrieve Protein sequences from PDB. 3. Analysis of sequences Similarity using BLAST/pBLAST/nrBLAST 4. To predict protein secondary structures by using iPred.	

V Practical	5. Perform phylogenetic analysis using PHYLIP. 6. Perform multiple sequence alignment by using ClustalW. 7. Primer design 8. Computational modeling of genomic, transcriptomic and proteomic	30

Learning Resources

1. Jin Xiong (2006) Essential Bioinformatics. Cambridge publisher
2. ZhumurGhosh and BibekanandMallick (2008) Bionformatics: Principles andApplications. Oxford University Press publisher
3. OrpitaBosu and SimminderKaurThukral(2007).Bioinformatics. Oxford University Presspublisher
4. M.Lesk (2002) Introduction to Bioinformatics. Oxford University Press publisher
5. Fundamental Concepts of Bioinformatics, Dan E. Krane, Michael L. Raymer, Michaeel L. Raymer, Elaine NicponMarieb, 2002, Benjamin/Cummings
6. P. Rastogi and N. Mendiritta (2013) Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revisededition
7. Mount and David W (2004) Bioinformatics: sequence and genome analysis. Cshl Press,2nd edition
8. Harisha S (2007) Fundamentals of Bioinformatics. I K International Publishing HousePvt. Ltd
9. Dan E. Krane (2003) Fundamentals concepts of bioinformatics. Dorling Kindersley (RS);First edition
10. David Edwards and Jason Stajich (2009) Bioinformatics: Tools and Applications.Published by Springer

BOTANY: SEMESTER-II

CourseType	Course Code	Name of theCourse	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
DSE-02	**241/BOT/DS202**	**Advanced Plant Physiology**	**2**	**2**	**15**	**35**	**50**	**3 hrs.**
4 credit		**Practical**	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. The students will be able to understand the physiological and biochemical basis of drought stress and its manifestation in plant productivity.
2. The students will be well acquainted with the mechanisms of salt and temperature stresses.
3. The learners will acquire the indepth knowledge of process of photosynthesis and the translocations of photosynthates from source to sinks.
4. The students will enhance their knowledge regarding mechanism of respiratory cycle in plants and the methods of estimation of respiration.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Water stress: Drought, its definition and quantification, water deficit and plant growth, physiological and biochemical functions, responses injury affected by drought, Adaptive strategies for drought resistance. Osmotic adjustment, osmoprotectants. Water logging/ oxygen deficiency and its effects on plant growth.	8
II	Salt and temperature stress: Unit-II Salt stress; Saline and alkaline soils, salt stress injury, mechanism of salt stress and halophytes. 38 Temperature stress; high temperature stress, heat shock proteins, chilling and frost injury and mechanism of tolerance.	8
III	Photosynthesis: The four major complexes of thylakoids. The path of carbon in photosynthesis (C3, C4 and CAM plants) Rubisco, structure and its association with the mechanism of carboxylation and oxygenation of RUBP. Effect of environmental factors on photosynthetic rates. Translocation of photosynthates and its importance in sink growth.	7
IV	Respiration: Cyanide insensitive respiration: Mechanism and significance. Comparison between normal electron transport chain and alternate oxidase pathway of respiration. Glycolic acid metabolism and photorespiration. Glyoxylate cycle. Respiration in intact plants and tissues.	7
V **Practical**		30

Learning Resources

1. Bonner, J. And Varner, J.E. (1976) Plant Biochemistry, Academic Press, New York and London (Third Edition).
2. Buchanan, B.B., Gruissem, w. And Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
3. Cooper, T.G. (1977). Electrophoresis. In : The Tools of Biochemistry. John Wiley and Sons., New York.
4. Dey, P.M. and Harborne, J.B. (1997), First Indian edition, 2000). Plant Biochemistry. Academic Press, Harcourt Asia Pvt. Ltd.
5. Noggle, G.r. and Fritz, G.J. (1983). Introductory Plant Physiology. Prentice-Hall of India Pvt. Ltd., New Delhi, 2nd edition (Seventh reprint, 1992).
6. Salisbury, F.B. and Ross, G.W. (1992). Plant Physiology. Fourth Edition, Wadsworth Publishing Co. Belmont, California, USA.
7. Sawhney, S.K. and Singh, Randhir. (2000). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
8. Solmos, T. (1977). Cyanide resistant respiration in higher plants. In : Ann. Rev. Pl. Physiol. 28: 279-297.