

Government of Karnataka



**Curriculum Framework for Undergraduate Programme in
Colleges and Universities of Karnataka State.**

5th Semester Model Syllabus for B.Sc. in BOTANY

Submitted to:

Vice Chairman

Karnataka State Higher Education Council
30, Prasanna Kumar Block, Bengaluru City University
Campus, Bengaluru, Karnataka– 560009

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Government of Karnataka

Model Curriculum of B.Sc. in BOTANY
5th Semester

Karnataka State Higher Education Council

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Listing of Courses from V and VI Semesters for the Undergraduate Program in BOTANY

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Exam/ Evaluation Pattern (Marks)		
					Theory	Practical		IA	Exam	Total
BOTANY AS SINGLE MAJOR IN THIRD YEAR										
V	DSC	BOT C9-T	Plant Morphology and Taxonomy	4	4		2	40	60	100
		BOT C10-P	Plant Morphology and Taxonomy	2		4	3	25	25	50
		BOT C11-T	Genetics and Plant Breeding	3	3		2	40	60	100
		BOT C12-P	Genetics and Plant Breeding	2		4	3	25	25	50
		BOT C13-T	Cell Biology	3	3		2	40	60	100
		BOT C14-P	Cell Biology	2		4	3	25	25	50
	DSE	BOT E1-T (Anyone to be chosen)	A. Algal and Fungal Biotechnology B. Bio fertilisers C. Biofuels	3	3		2	40	60	100
	Vocational	BOT V1-T (Anyone to be chosen)	A. Landscaping and gardening B. Mushroom Cultivation Technology C. Community Forestry	3	3		2	40	60	100
VI	DSC	BOT C15-T	Plant Physiology and Biochemistry	4	4		2	40	60	100
		BOT C16-P	Plant Physiology and Biochemistry	2		4	3	25	25	50
		BOT C17-T	Bioinformatics and computational biology	3	3		2	40	60	100
		BOT C18-P	Bioinformatics and computational biology	2		4	3	25	25	50
		BOT C19-T	Plant Biotechnology	3	3		2	40	60	100
		BOT C20-P	Plant Biotechnology	2		4	3	25	25	50
	DSE	BOT E2-T (Anyone to be chosen)	A. Herbal Drug Technology B. Techniques in Plant Biology C. Floriculture	3	3		2	40	60	100
	Vocational	BOT V2-T (Anyone to be chosen)	A. Plant Quarantine B. Plant Diversity and Human Welfare C.	3	3		2	40	60	100

BOTANY AND ANOTHER SUBJECT AS DOUBLE MAJORS IN THIRD YEAR

V	DSC	BOT C9-T	Plant Morphology and Taxonomy	4	4		2	40	60	100
		BOT C10-P	Plant Morphology and Taxonomy	2		4	3	25	25	50
		BOT C11-T	Genetics and Plant Breeding	4	4		2	40	60	100
		BOT C12-P	Genetics and Plant Breeding	2		4	3	25	25	50
VI	DSC	BOT C13-T	Cell Biology	4	4		2	40	60	100
		BOT C14-P	Cell Biology	2		4	3	25	25	50
		BOT C15-T	Plant Physiology and Biochemistry	4	4		2	40	60	100
		BOT C16-P	Plant Physiology and Biochemistry	2		4	3	25	25	50

Open Electives for non-BOTANY Students are also to designed and contents drafted for the first three semesters with multiple options.

Prof. B. Thimme Gowda, KSHEC.

Note:

1. If any Elective or Vocational course involves theory-cum-practical (2+1 credit), then IA to Exam Marks will be in the ratio of 50:50. The practical part is to be evaluated as part of IA. Semester end examination is only in theory component and questions from practical part, if any.
2. C11, C12, C13 and C14- paper model syllabus given below is designed for single major therefore C11& C13 consists of 3 credits and C12, C14 contains the related practical syllabus respectively. University BoS who choose double major will have to include 4 credit syllabus (one extra unit) for C11 and C13 papers along with the practical experiments in their respective practical papers (C12, C14)



Government of Karnataka

BOTANY Curriculum

Plant Morphology and Taxonomy (Theory)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Plant Morphology and Taxonomy (Theory)		
Course Code:	DSC – BOT-C9 - T	No. of Credits	04
Contact hours	60 Hours	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- CO1. Understanding the main features in Angiosperm evolution
- CO2. Ability to identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification of flowering plants.
- CO3. Interpret the rules of ICN in botanical nomenclature.
- CO4. Classify Plant Systematic and recognize the importance of herbarium and Virtual Herbarium, Evaluate the Important herbaria and botanical gardens.
- CO5. Recognition of locally available angiosperm families and plants and economically important plants. Appreciation of human activities in conservation of useful plants from the past to the present.

Contents	60 Hrs
Unit 1:	15 hrs
<p>Morphology of Root, Stem and Leaf. Their modifications for various functions. Inflorescence – types. Structure and variations of flower. Fruits–types. Floral diagram and floral formula.</p> <p>Introduction to Taxonomy: History, objectives, scope and relevance of Taxonomy</p> <p>Systems of classification: Artificial, Natural and Phylogenetic; brief account of Linnaeus', Bentham & Hooker's, Engler and Prantl's system and APG IV System (2016).-Merits and demerits of classification.</p> <p>Taxonomic literatures: Floras, Monograph. Revisions, Journals.</p> <p>Herbaria and Botanical gardens: Important herbaria and botanical gardens of the world and India. Technique of Herbarium Preparation and roles botanical gardens.</p> <p>Virtual herbarium; E-flora; Documentation.</p>	
Unit 2:	15 hrs
<p>Plant identification: Taxonomic dichotomous keys; intended (yolked) and bracketed keys. (brief account only).</p> <p>Plant descriptions: Common Terminologies used for description of vegetative and reproductive parts of the following families.</p>	

<p>Study of the diagnostic features of Angiosperm families (Any 15 from the listed): Annonaceae, Brassicaceae, Malvaceae, Rutaceae, Anacardiaceae, Fabaceae (with sub Families), Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae / Zingiberaceae, Liliaceae / Commelinaceae, Arcaceae and Cyperaceae / Poaceae.</p> <p>Plant Taxonomic Evidences: from palynology embryology, cytology, phytochemistry and molecular data. Field inventory.</p>	
Unit 3:	15 hrs
<p>Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary). Modes of speciation. Problems with species concepts. Rank less system of phylogenetic systematics</p> <p>Botanical Nomenclature: Principles and rules (ICN); Latest code –brief account, Brief account of Ranks of taxa, Type concept (Typification), Rule of priority, Author citation., valid publication, rejection of names, principle of priority and its limitations; Names of hybrids/cultivated species.</p>	
Unit 4:	15 hrs
<p>Biometrics, Numerical Taxonomy; Phenetics and Cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).</p> <p>Phylogenetic Systematics: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly, clades, synapomorphy, symplesiomorphy, apomorphy, lineage sorting, serial homology etc).</p> <p>Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).</p> <p>Molecular taxonomy: Respect to DNA sequences of chloroplast genes (<i>atpB</i>, <i>rbcL</i>, ITS, <i>trnL</i> etc) and one nuclear gene (nuclear ribosomal 18s DNA).</p>	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Program Name	B.Sc. in BOTANY		Semester	V
Course Title	Plant Morphology and Taxonomy (Practical)		Practical Credits	02
Course Code	DSC – BOT - C10 - P		Contact Hours	4 Hours per week
Formative Assessment	25 Marks	Summative Assessment	25 Marks	
Practical Content				
<p>1. Study of root, stem and leaf structure and modifications. Study of inflorescence types. Study of flower and its parts, Study of fruits. Floral diagram and floral formula.</p> <p>2. Study of families mentioned in theory with at least two examples for each family and make suitable diagrams, describe them in technical terms (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification) and identify up to species using the flora. 26 hrs</p> <p>2. Construction of plant phylogenetic trees using various loci (<i>atpB</i>, <i>rbcL</i>, ITS, <i>trnL</i> etc) with various phylogenetic methods (Neighbour Joining, Maximum Likelihood etc). 06 hrs</p> <p>3. Identify plants/plant products of economic importance belonging to the families mentioned in the syllabus; with binomial, family and morphology of useful parts. Cotton, Mango, Red gram, Green gram, Horse gram, Black gram, Bengal gram, Indigo, Brinjal, Tomato, Chilly, Tamarind, Bitter gourd, <i>Luffa</i>, <i>Asfoetida</i>, Cumin, Coriander, Coffee, Rubber, Tapioca, Ricinus, Ginger, Turmeric, Coir, Arecanut, Rice, Wheat, Ragi, Sugarcane <i>Annona muricata</i> <i>Catharanthus roses</i>, <i>Rauwolfia serpentina</i>, <i>Justicia adhatoda</i>, <i>Vitex nigundo</i> and <i>Leucas aspera</i> 16 hrs</p> <p>4. Field visit: Local or outside area/ Botanical garden/ tribal settlements minimum 3 to 5 days.</p> <p>5. Submission: Record book, Tour report and Herbarium (Preparation of 10 properly identified herbarium specimens; mounting of a properly dried and pressed specimen of any common plants from your locality with herbarium label).</p>				

Pedagogy: Teaching and learning, conducting experiments, field visits.

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05
Test	05
Field visit (3 to 5 days)	05
Submission (Record book, Tour report and Herbarium)	10
Total	25 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

2. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(distribution of marks): 25 marks for the Semester end examination

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|--|---------|
| 1. Identify, classify and describe the specimen A & B taxonomically | 6 Marks |
| 2. Identify the given specimen C with the help of Key using Flora | 4 Marks |
| 3. Write the floral diagram and floral formula of the given specimen D | 2 Marks |
| 4. Identification of Specimen/slides E, F and G | 6 Marks |
| 5. Viva Voce | 2 Marks |
| 6. Submission (Journal / Record +Study Tour Report) | 5 Marks |

Total 25 marks

General instructions:

- Q1. Give specimen from Dicotyledons (A) and Monocotyledons (B)
- Q2. Give specimen from family they studied (C)
- Q3. Give specimen from family they studied (D)
- Q4. Specimen /Slides/ materials from Root/Stem/ Leaf/ Inflorescence (E), Flower/Fruit (F) and Economic importance (G)
- Q5. Viva
- Q6. Submission (Journal/ Record + Study Tour Report)

Note: Same Scheme may be used for IA (Formative Assessment) examination

References	
1	Baker. H.G. 1970. <i>Plant and Civilization</i> , Wadsworth Publishing Company.
2	Colton C.M. 1997. <i>Ethnobotany – Principles and applications</i> . John Wiley and sons –Chichester
3	Cotton, C.M. 1996. <i>Ethnobotany – Principles and Applications</i> . Wiley and Sons
4	Datta S C, <i>Systematic Botany</i> , 4th Ed, Wiley Estern Ltd., New Delhi, 1988.
5	Eames A. J. - <i>Morphology of Angiosperms</i> - Mc Graw Hill, New York.
6	Hall, B.G. (2011). <i>Phylogenetic Trees Made Easy: A How-To Manual</i> . Sinauer Associates, Inc. USA
7	Heywood - <i>Plant taxonomy</i> - Edward Arnold London.
8	Jeffrey C .J. and A. Churchil - <i>An introduction to taxonomy</i> – London.
9	Jeffrey, C. (1982). <i>An Introduction to Plant Taxonomy</i> . Cambridge University Press, Cambridge
10	Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., Donogue, M.J., 2002. <i>Plant Systematics: A Phylogenetic approach</i> , 2nd edition. Sinauer Associates, Inc., USA.
11	Lawrence - <i>Taxonomy of Vascular Plants</i> - Oxford & I B H, New Delhi.
12	Manilal, K.S. and M.S. Muktesh Kumar 1998. <i>A Handbook on Taxonomy Training</i> . DST, New Delhi.
13	Manilal, K.S. and A.K. Pandey, 1996. <i>Taxonomy and Plant Conservation</i> . C.B.S. Publishers & Distributors, New Delhi.
14	Manilal, K.S. 2003. <i>Van Rheedee's Hortus Malabaricus. English Edition</i> , with Annotations and Modern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
15	Naik V.N., <i>Taxonomy of Angiosperms</i> , 1991. Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
16	Pandey, S. N, and S.P. Misra (2008)- <i>Taxonomy of Angiosperms</i> - Ane Books India, New Delhi.
17	Radford A B, W C Dickison, J M Massey & C R Bell, <i>Vascular Plant Systematics</i> , 1974, Harper & Row Publishers, New York.
18	Singh G.2012. <i>Plant systematics: Theory and Practice</i> . Oxford and IBH, Pvt. Ltd., New Delhi.
19	Singh V. & Jain - <i>Taxonomy of Angiosperms</i> - Rastogi Publications, Meerut.
20	Sivarajan V. V - <i>Introduction to Principles of taxonomy</i> - Oxford & I B H New Delhi.
21	Any local/state/regional flora published by BSI or any other agency.

Genetics and Plant Breeding (Theory)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Genetics and Plant Breeding (Theory)		
Course Code:	DSC – BOT-C11 - T	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:.

CO1. Understanding the basics of genetics and plant breeding

CO2. Ability to identify, calculate and describe crossing over, allelic generations and frequencies of recombination.

CO3. Interpret the results of mating and pollinations.

CO4. Classify Plant pollination methods

CO5. Recognition of modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation.

Contents	45 Hrs
Unit 1:	12hrs
Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance. Extrachromosomal Inheritance Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast.	
Unit 2:	12hrs
Linkage, crossing over and chromosome mapping. Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numerical based on gene mapping; Sex Linkage. Variation in chromosome number and structure: Gene mutations Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms. Fine structure of gene (Population and Evolutionary Genetics, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.	
Unit 3:	21 hrs
Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. Methods of crop improvement Introduction: Centers of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self-pollination, cross pollination and vegetative Propagation in plants; Hybridization: For self, cross and vegetative propagation in plants – Procedure, advantages and limitations.	

<p>Quantitative inheritance Concept, mechanism, examples of inheritance of Kernel colour in wheat, Monogenic vs polygenic Inheritance. Inbreeding depression and heterosis History, genetic basis of inbreeding depression and heterosis; Applications. Crop improvement and breeding Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.</p>	
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Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Genetics and Plant Breeding (Practical)	Practical Credits	02
Course Code	DSC – BOT – C12 - P	Contact Hours	4 Hours per week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			
<p>Practical: Plant breeding:</p> <ol style="list-style-type: none"> 1. Reproductive of biology, self and cross pollinated plants; Vegetative reproduction 2. Hybridization: Emasculation, bagging, pollination and production of hybrids and pollen fertility 3. Origin, distribution and centres of diversity of crop plants: Wheat, Sorghum, Rice, Chilly Sugarcane, Cotton, Potato, coffee, Sunflower and groundnut <p>Practical: Genetics</p> <ol style="list-style-type: none"> 1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square. 2. Chromosome mapping using point test cross data. Pedigree analysis for dominant and recessive autosomal and sex-linked traits. 3. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 4. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes. 5. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. 			

Pedagogy: Teaching and learning, conducting experiments, field / Lab.visits

Formative Assessment for Practical	
Assessment Occasion/type	Marks
Attendance	05
Test	05
Field visit	05
Submission	10
Total	25Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

3. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(distribution of marks): 25 marks for the Semester end examination

1. Perform the emasculation / pollen viability / fertility of the given sample **A** 5 Marks

2. Calculate the recombinant frequency and state the order of gene from the given data **B** 4 Marks

4. Identification of Specimen/slides/ Photographs **C, D** and **E** 6 Marks

5. Viva Voce 5 Marks

6. Submission (Journal / Record) 5 Marks

Total 25 marks

General instructions:

Q1 Material Cassia// Hibiscus/ etc (A)

Q2. Mapping using one point / two point test cross data (B)

Q3. Down's, Klinefelter's and Turner's syndromes, Translocation Ring, Laggards and Inversion Bridge (C, D and E)

Q5. Viva

Q6. Submission (Journal/ Record)

Note: Same Scheme may be used for IA (Formative Assessment) examination

References	
1	Acquaah, G. (2007). Principles of Plant Genetics & Breeding. New Jersey, U.S.: Blackwell Publishing.
2	Singh, B.D. (2005). Plant Breeding: Principles and Methods, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3	Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding, 2nd edition. New Delhi, Delhi: Oxford – IBH.
4	Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons
5	Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th

	edition. New York, NY: W.H. Freeman and Co.
6	Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings
7	Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992).Biology of Plants. New York, NY: W.H. Freeman and Co.
8	Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
9	Poehlman, J.M. (1987). Breeding Field Crops, 3rd Ed. AVI Publishing Co. Inc., Westport, Connecticut
10	Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi.

Cell Biology (Theory)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Cell Biology (Theory)		
Course Code:	DSC-BOT - C13-T	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:.

CO1. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle

CO2. Contemporary approaches in modern cell and molecular biology.

CO3.To study the organization of cell, cell organelles and biomolecules (i.e protein, carbohydrate, lipid and nucleic acid)

CO4.To gain knowledge on the activities in which the diverse macro molecules and microscopic structures inhabiting the cellular world of life are engaged.

CO5.To understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life.

Contents	45Hrs
Unit 1:	15hrs
Cell wall, distribution, chemical composition, functions and variations in prokaryotic and eukaryotic cells (primary and secondary wall), Glycocalyx, Cell-cell interactions/ Junctions, pit connections. Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases. Programmed Cell Death; Biology and elementary knowledge of development and causes of cancer.	
Unit 2:	15hrs
Structure and functions, active and passive transport, proton pumps associated (Na-K, Calmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis. Structural organization, function, marker enzymes of the above organelles, biogenesis of mitochondria and chloroplasts, brief account of transport in mitochondria and chloroplasts (Tim/Tom; Tic/Toc) and semiautonomous nature of mitochondria and chloroplast	
Unit 3:	15hrs
Nuclear envelope, structure of nuclear pore complex, nuclear lamina, transport across nuclear membrane, Nucleolus, rRNA processing. Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test(Objectivetype)	10
Assignments	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Cell Biology (Practical)	Practical Credits	02
Course Code	DSC-BOT - C14-P	Contact Hours	4 Hours per week
Formative Assessment	25Marks	Summative Assessment	25 Marks
Practical Content			
1. Study of plant cell structure with the help of epidermal peel mount of Onion/ Rhoeo/ Crinum. 2. Study of cell and its organelles with the help of electron micrographs. 3. Measurement of length and breadth of plant cell using micrometry. 4. Study different stages of mitosis and meiosis (Onion/ Rhoeo/ Crinum) 5. Study of Karyotype using camera-lucida / chart. 6. Isolation of cell organelle – Chloroplast.			

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

4. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(distribution of marks): 25 marks for the Semester end examination

CELL BIOLOGY

Time =03 hrs

Marks =25

- Preparation of squash/ smear of material A, identify, Sketch and label the any two stages with reasons 06 marks
- Find out cell length and breadth of the given material using micrometry 05marks

- | | |
|--|----------|
| 3. Identify the slides C & D | 04 marks |
| 4. Viva-voce | 05 marks |
| 5. Submission (Journal/ Record + 5 slides) | 05 marks |
| Total 25 marks | |

General instructions:

- Q1. Give specimen from Onion/ Rhoeo/ Crinum plant (A)
 Q2. Give specimen from Onion/ Rhoeo leaf (B)
 Q3. Give slide from mitosis (C) meiosis (D)
 Q4. Viva-voce
 Q5. Submission (Journal/ Record + 5 slides)

Note: Same Scheme may be used for IA (Formative Assessment) examination

References	
1	Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach, 5th edition. Washington, D.C.: ASM Press & Sunderland, Sinauer Associates, MA
2	Karp, G. (2010). Cell Biology, 6th edition. New Jersey, U.S.A.: John Wiley & Sons.
3	De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4	Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San francisco.
5	Reven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H.Freeman and Company
6	Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2013). Essential cell biology (4th ed.). Garland Publishing.
7	Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992).Biology of Plants. New York, NY: W.H. Freeman and Co.
8	Verma, P. S. (2004). Cell Biology,Genetics, Molecular Biology: Evoloution and Ecology. India: S. Chand Limited.

ELECTIVE PAPERS

(Anyone to be chosen)

- A. Algal and Fungal Biotechnology (Theory)**
- B. Bio-fertilizers (Theory)**
- C. Bio-fuels (Theory)**

A. Algal and Fungal Biotechnology (Theory)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Algal and Fungal Biotechnology (Theory)		
Course Code:	BOT E1-A	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:.

CO1. To provide knowledge on the structure and reproduction of certain selected algal and fungi
 CO2. To introduce students to basics of algal biotechnology and economic importance of both groups.
 CO3. To understand the role of fungi in our society and how fungi can be used for more applied aspects
 CO4. To gain knowledge on the industrial applications of fungi

Contents	45Hrs
Unit 1:	15hrs
Introduction to algal biotechnology: Resource potential of algae; commercial utility of algae. Algae as a source of food and feed; Algae as a source of pigments, fine chemicals, fuel and bio-fertilizers. Role of algae in the environment, agriculture, biotechnology and industry. Algal biotechnology: single cell proteins (SCP): Spirulina as single cell protein-production and harvesting of algal biomass – factors affecting biomass production.	
Unit 2:	15hrs
Cyanobacterial inoculants (BGA): Isolation, preparation of starter culture, mass cultivation, field applications and crop response. Economic importance of algae: commercial products of algae: Agar Agar, Alginates, Carrageenin, diatomite, mucilage, minerals and elements - Algae in medicine.	
Unit 3:	15hrs
Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Mycorrhiza); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Fungi as source of medicines (Antibiotics).	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

5. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
2	Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
3	Kumar, H.D. (1999). Introductory Phycology, 2nd edition. New Delhi, Delhi: Affiliated East-West Press.
4	Raven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company
5	Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. New Delhi, Delhi: Aravali International.
6	Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition
7	Barsanti, Laura and Paolo Gualtieri 2005 Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.

B. Bio-fertilizers (Theory)

ProgramName	B.Sc. in BOTANY	Semester	V
Course Title	Bio-fertilizers (Theory)		
Course Code:	BOT E1-B	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):	
<p>Course Outcomes(COs):Afterthesuccessfulcompletionofthecourse,thestudentwillbeableto:.</p> <p>CO1: Explain isolation and role of various soil bacteria in bio-fertilizer production.</p> <p>CO2: Describe production steps and specific requirements for each bio-fertilizers</p> <p>CO3: Restore the soil fertility by performing the sustainable agriculture practices via organic farming</p> <p>CO4: Apply the knowledge gained to generate opportunities of self-employability.</p>	
Contents	45Hrs
Unit 1:	15hrs
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, and carrier based inoculants, Actinorrhizal symbiosis. Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.	
Unit 2:	15hrs
Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.	
Unit 3:	15hrs
Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks

GENERAL PATTERN OF THEORY QUESTION PAPER
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

6. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	Dubey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi.
2	Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3	John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4	Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5	Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6	Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

C. Bio-fuels (Theory)

Program Name	B.Sc.in BOTANY	Semester	V
Course Title	Bio fuels (Theory)		
Course Code:	BOT E1-C	No. of Credits	03
Contact hours	45Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):	
<p>Course Outcomes (COs):After the successful completion of the course, the student will be able to:.</p> <p>CO1. The student will be aware from a technical point of view of energy plants where biomasses and organic wastes are used.</p> <p>CO2. The student will be capable to apply the acquired knowledge to design biomass energy plants and to evaluate their performances.</p> <p>CO3.The student will became capable to judge the different options available given the nature of the feedstock available (kind of biomass, kind of organic waste) and the technological opportunities to valorize it as bioenergy</p> <p>CO4.The student will be capable to efficiently communicate concerning bio-energy options, processes and plants.</p> <p>CO5. The student will be taught that significant bioenergy process advancements are in progress, and that he/she should keep him/herself updated on the last technological outcomes that face the bio-energy market.</p>	
Contents	45Hrs
Unit 1:	15hrs
Introduction, definition, scope and Importance of Bio-fuel. Institutions related to biofuels in India and worldwide. Public awareness of biofuel. Biofuels scenario -in India and worldwide. History of Biofuel; Advantages and disadvantages of biofuels. Generation of biofuels: first, second, third and fourth generation of biofuels and present status.	
Unit 2:	15hrs
Biofuel feed stocks: Agricultural waste, farm waste, forestry waste, organic wastes from the residential, institutional and industrial waste and its importance.(Biomass-plant, animal and microbial based waste). Algal biofuel. Biodiesel species: <i>Pongamia pinnata</i> , <i>Simarouba gluca</i> , <i>Jatropha curcas</i> , <i>Azardirachta india</i> , <i>Madhuca indica</i> and <i>Callophyllum innophyllum</i> etc.; oil content analysis and characterization.	
Unit 3:	15hrs
Introduction to biodiesel, bioethanol, biogas and biohydrogen; production technology of biofuels, quality analysis of biodiesel, bioethanol and biogas and its comparison with national and international standards. Biofuel sustainability; Biofuel Policy in India and around the worldwide; Biofuel production statistics: production of Biodiesel, bioethanol, biogas in Countrywide	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

7. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	The Biodiesel Handbook (2005). JurgenKrahl, Jon Harlan Van Gerpen.AOCS Press.
2	Bioenergy and Biofuels (2017).OzcanKonur. CRC Press, Taylor &Franci's group.
3	https://mnre.gov.in/biofuels
4	Biomass for renewable energy, fuels, and chemicals. D.L. Klass, Academic Press, http://www.sciencedirect.com/science/book/9780124109506
5	Sistemi a biomasse: progettazione e valutazioneeconomica. E. Bocci, A. Caffarelli, M. Villarini, A. D'Amato, MaggioliEditore, http://www.maggiolieditore.it/9788838759697- sistemi-a-biomasse-progettazione-e-valutazioneeconomica.html

VOCATIONAL PAPERS

(Anyone to be chosen)

- A. Landscaping and Gardening (Theory)**
- B. Mushroom Cultivation Technology (Theory)**
- C. Community Forestry (Theory)**

A. Landscaping and Gardening (Theory)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Landscaping and Gardening (Theory)		
Course Code:	BOT V1-A	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):	
Course Outcomes (COs): After the successful completion of the course, the student will be able to:.	
CO1. Students would be able to identify the ornamental plants,	
CO2. They will have an understanding of cultivation methods, landscaping and making the flower arrangement.	
CO3.To understand the concept of different types of gardening practices	
CO4. Apply the basic principles and components of gardening	
CO5. Learn to design various types of formal and informal gardens	
CO6. Establish and maintain special types of gardens for outdoor and indoor landscaping	
Contents	45Hrs
Unit1:	15hrs
Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. Landscaping Places of Public Importance: Landscaping highways and Educational institutions. Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Specialized Gardens: Aquatic garden, Rock garden, Kitchen garden, Herb Garden, Butterfly garden, Botanical garden, English garden, Terrace garden	
Unit2:	15hrs
Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping. Urban forestry; policies and practices. Soil and its characteristics, Potting Mixtures, Essential soil elements, Mineral nutrition and Garden implements.	
Unit3:	15hrs
Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables. Propagation Methods: Seeds (Germination, Viability, Dormancy, Storage, Transplantation), Grafting, Cutting, Layering, Division, Budding, Scaling, Scoping, Microgreens. Introduction and methodology of hydroponics.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

8. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	Nambisan KMP (1992) Design elements of Landscape gardening Oxford and IBH
2	Sudheer K P and Indira V (2007) Post harvest technology of Horticultural crops New India Publication agencies
3	Bose T K., Maiti R G., Duha R S and Das P (1999).Floriculture and LandscapingNaya Prakash
4	Biomass for renewable energy, fuels, and chemicals. D.L. Klass, Academic Press, http://www.sciencedirect.com/science/book/9780124109506
5	Sistemi a biomasse: progettazione e valutazioneeconomica. E. Bocci, A. Caffarelli, M. Villarini, A. D'Amato, MaggioliEditore, http://www.maggiolieditore.it/9788838759697- sistemi-a-biomasse-progettazione-e-valutazioneeconomica.html

B. Mushroom Cultivation Technology (Theory)

Program Name	B.Sc.in BOTANY	Semester	V
Course Title	Mushroom Cultivation Technology (Theory)		
Course Code:	BOT V1-B	No. of Credits	03
Contact hours	45Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):	
Course Outcomes (COs): After the successful completion of the course, the student will be able to:.	
CO1: Identify edible types of mushroom	
CO2: Gain the knowledge of cultivation of different types of edible mushrooms and spawn production	
CO3: Manage the diseases and pests of mushrooms	
CO4: Learn a means of self-employment and income generation	
Contents	45Hrs
Unit1:	15hrs
Mushrooms -Taxonomical rank-History and Scope of mushroom cultivation-Edible and Poisonous Mushrooms-Vegetative characters. Button mushroom (<i>Agaricus bisporus</i>), Milky mushroom (<i>Calocybe indica</i>), Oyster mushroom (<i>Pleurotuss ajorcaju</i>) and paddy straw mushroom (<i>Volvariella volvacea</i>).	
Unit2:	15hrs
Structure and construction of mushroom house, Sterilization of substrates, Spawn production - culture media preparation- production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation, Spawning spawn running, harvesting. Cultivation of oyster and paddy straw mushroom Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies.	
Unit3:	15hrs
Nutritional and medicinal values of mushrooms, (Medicine mushroom, Shiitake, Ganoderma, Cremini Enoki species) Therapeutic aspects- antitumor effect Preservation of mushrooms - freezing, drying, canning, quality assurance and entrepreneurship, Value added products of mushrooms.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

9. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	Marimuthu, T. et al. (1991). Oster Mushroom, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore
2	Nita Bhal. (2000), Hand book on Mushrooms, 2 nd ed. vol. 1 and 2 Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
3	Pandey R.K, S. K Ghosh, (1996). A Hand Book on Mushroom Cultivation, Emkey Publications
4	Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology, Agrobios, Jodhpur
5	Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation, Mittal Publication, New Delhi.
6	Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi
7	V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams EBooks Pvt Ltd., New Delhi (2000)

C. Community Forestry (Theory)

Program Name	B.Sc.in BOTANY	Semester	V
Course Title	Community Forestry (Theory)		
Course Code:	BOT V1-C	No. of Credits	03
Contact hours	45Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:
 CO1. To understand socio-economic, cultural and ecological relationship between forests and people.
 CO2. Students acquaint with the role of people in forest management through analysis of need dependence and traditional interactions between forests and society.
 CO3. Demonstrate ability to identify major forest ecosystems and describe their changes over time, with and without human influence/management.
 CO4. Demonstrate knowledge of inter-temporal management and planning at the forest and landscape levels, and the ability to develop alternative management scenarios for forest lands for an array of objectives including forest products, environmental services, social amenities cultural and other resource values.

Contents	45Hrs
Unit 1:	15hrs
Forests and its importance, forest societies, interactions between forests and people, importance of forests in traditional farming systems, livestock economy and forests, social and cultural factors of forest management, man in ecosystem in relation to eco-philosophy. Afforestation programmes and forest conflicts, wildlife and human conflicts, important forest movements like Chippko /Appiko Movement, Gender dimension of forest management, tribal economy and forests. Pastoralists and their dependence on forests. Forests and livelihood security of tribals.	
Unit 2:	15hrs
Management of Commons and Common Property Resources (CPRs) and open access resources, forest management and sustainable livelihood strategies, forests and food security, eco-tourism and local development, land use change and forestry. Case studies of Padmashri Salumarada Timmakka and Padmashri Tulasi Gowda.	
Unit 3:	15hrs
Forest rights, customary rights of people, community participation, biodiversity and ethnobotany, Joint Forest Management, global environmental change and land use; dams, forests and resettlement of tribals and non-tribals – case study, poverty alleviation and forests, tourism and forest management, role of NGOs and other CBOs community based organization in forest management.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

10. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

References	
1	Annamalai R. 1999. Participatory Learning Action and Micro-planning for JFM. Dean SFRC, Coimbatore
2	FAO. 1978. Forestry for Local Community Development. FAO Publ.
3	Shah SA. 1988. Forestry for People. ICAR.
4	Tiwari KM. 1988. Social Forestry and Rural Development. International Book Distr
5	Vyas GPD. 1999. Community Forestry. Agrobios.
6	Ref related to Salumarada Timmakka and Tulasi Gowda



Government of Karnataka



**Curriculum Framework for Undergraduate Programme in
Colleges and Universities of Karnataka State.**

6th Semester Model Syllabus for B.Sc. in BOTANY

Submitted to:

Vice Chairman

Karnataka State Higher Education Council
30, Prasanna Kumar Block, Bengaluru City University
Campus, Bengaluru, Karnataka– 560009



Government of Karnataka

Model Curriculum of B.Sc. in BOTANY

6th Semester

Karnataka State Higher Education Council

Composition of Subject Expert Committee Members

SN	Name & Organization
1	Dr. G. R. Naik, Vice Chancellor, Garden City University, Bengaluru
2	Dr. Rajasab, M S Ramaiah University of Applied Science, Bangalore
3	Dr. G. R. Janardhana , Professor, University of Mysore, Mysuru
4	Dr. Kotresh K, Professor, Karnatak University, Dharwad
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13	Dr. Mamatha, Assoc. Professor, GFGC, Vijayanagar, Bengaluru
14	Dr. Jayakara Bhandary, Professor, GFGC, Mangalore.
15	Dr. Latha Devi Karekal, Sharanabasaveshwara college of Science, Kalaburgi.
16.	Smt. Akshatha Chandra G. R., Special Officer, KSHEC- Member Convenor



Government of Karnataka
BOTANY Curriculum

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (THEORY)

Program Name	BSc/ BOTANY	Semester	VI
Course Title	Plant Physiology and Plant Biochemistry (Theory)		
Course Code:	BOT C15-T	No. of Credits	04
Contact hours	60 Hours	Duration of Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- CO1. Importance of water and the mechanism of transport.
- CO2. To understand biosynthesis and breakdown of biomolecules.
- CO3. Role of plant hormones in plant development and about secondary metabolites.
- CO4. Preliminary understanding of the basic functions and metabolism in a plant body.
- CO5. To understand the importance of nutrients in plant metabolism and crop yield.

Contents	60 Hrs
UNIT 1	15 Hrs
<p>Plant water relations: Importance of Water as a solvent, Diffusion, osmosis, imbibition, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential and its components. Mechanism of water absorption, Factors affecting water absorption.</p> <p>Transpiration. Types and process. Mechanism of guard cell movement. K⁺ ion mechanism. Antitranspirants.</p> <p>Mechanism of ascent of sap: Vital and physical force theories.</p> <p>Phloem Transport: Transport of organic solutes. path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis.</p> <p>Mineral nutrition : A brief account on Micro and macro nutrients .</p>	
UNIT 2	15 Hrs
<p>Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.</p> <p>Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.</p> <p>Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.</p>	
UNIT 3	15 Hrs
<p>Definition and classification of plant growth regulators- Hormones. Site of synthesis, biosynthesis pathway and metabolism and influence on plant growth development of individual group of hormone- Auxins, Gibberlins, cytokinins, ABA, ethylene .</p> <p>Synthetic growth regulators- classification, their effect on plant growth and development. practical utility in agriculture and horticulture.</p> <p>Sensory Photobiology: Biological clocks, photoperiodism, function & structure of phytochromes, phototropin & cryptochromes.</p> <p>Senescence, Aging & Cell Death (PCD and Autophagosis).</p> <p>Plant Movements</p>	

UNIT 4	15 Hrs
Carbohydrate metabolism Enzymes - classification, kinetics and mechanism of action. Proteins and amino acids: classification, structure - primary, secondary, tertiary and quaternary	
Vitamins - classification, distribution, structure, production, function. Lipids: classification, structure, function and biosynthesis of fatty acids. Secondary plant products: structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.	

Assessment	Marks
Attendance	10 Marks
Test	10 Marks
Seminar	10 Marks
Assignment	10 Marks
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Pedagogy:

Course Title	Plant Physiology and Biochemistry (Practical)	Practical Credits	2
Course Code	BOT C16-P	Contact Hours	4 Hours
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			
<ol style="list-style-type: none"> 1. Experiment to demonstrate the phenomenon of exosmosis and endosmosis. 2. To determine the osmotic pressure of the cell sap by plasmolytic method. 3. To demonstrate root pressure / transpiration pull in plants. 4. To compare the rate of transpiration from the two surfaces of leaf by cobalt chloride paper method. 5. To demonstrate that oxygen is liberated in the process of photosynthesis. 6. Separation of photosynthetic pigments by paper chromatography and measure their R_f values. 7 Estimation of total chlorophyll content by Arnon method. 7. To isolate and identify the amino acids from a mixture using paper chromatography. 8. To Study of Phototrophism. 9. Quantities test for Starch, Protein, Reducing Sugars and Lipids. 10. Estimation of TAN(Titratable acid Number) from Bryophllum leaves/Aloe Vera .. 			

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

11. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Time =03 hrs

Marks =25

- | | |
|---|----------|
| 1. Conduct Major Experiment A | 06 marks |
| 2. Comment on minor Experiments B & C | 06 marks |
| 3. Micro Chemical test D | 03 marks |
| 4. Viva-voce | 05 marks |
| 5. Practical Record + Industrial visit report | 05 marks |

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Practical	
Assessment	Marks
Attendance	10 Marks
Test	10 Marks
Project report / Industrial visit	05 Marks
Total	25 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

REFERENCES

1. Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc. Wilson, K. and Walker, J. 1994
2. Jain V K, 2008. Fundamentals of Plant Physiology. S Chand and Co.
3. Kochhar P L, Krishnamoorthy H N. Plant Physiology. Atmaram and sons, Delhi.
4. Kumar and Purohit. Plant Physiology: Fundamentals and Applications. Agrobotanical Publishers.
5. Malik CP, 2002. Plant Physiology. Kalyani publishers.
6. Mukherjee S, Ghosh AK, 2005. Plant Physiology. New Central Book Agency, Calcutta.
7. Noggle GR, Fritz GJ, Introductory Plant Physiology. Prentice Hall of India.
8. Pandey SN, Sinha BK, 2006. Plant physiology. Vikas Publishing House, New Delhi.
9. Salisbury F B, Ross C W, 1992. Plant Physiology. CBS publishers and Distributors, New Delhi.
10. Sinha A K, 2004. Modern Plant Physiology. Narosa publishing House, New Delhi.
11. Srivastava H S, 2004. Plant physiology and Biochemistry. Rasthogi publications.
12. Verma V, 2007. Text Book of Plant Physiology. Ane Books Pvt. Ltd.

BIOINFORMATICS (THEORY)

Program Name	B.Sc. in BOTANY	Semester	VI
Course Title	Bioinformatics (Theory)		
Course Code:	BOT-C 17-T	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2 Hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Understand the concept of databases and use of different public domain for DNA and proteins sequence retrieval.

CO2. Understand the concept of pairwise alignment of DNA sequences using algorithms.

CO3. Explain the structure of proteins homology modeling approach using SWISS MODEL and SWISS-PDB.

CO4. Reflect upon the role of various models in molecular evolution.

CO5. Analyze the role of (QSAR) techniques in Drug Design.

Contents

45 Hrs

Unit1:

15hrs

Introduction to bioinformatics, Bioinformatics-Definition, History, Scope and Applications. Opportunities in Bioinformatics.

Fundamental of IT: Social and Ethical aspects of IT; Data, information, Knowledge; Introduction to Hardware (CPU, memory, storage, etc.);

Role of IT in Bioinformatics; Introduction to problem solving: algorithms, flow charts; Introduction to networking: Types of networks, world wide web; distributed computing;

Biological databases : Nucleotide databases, Protein databases, Genome databases

Organization of data in NCBI, DDBJ, EBI, PDB, Swiss PROT and retrieval and storage of data in different file formats

Unit2:

15hrs

Sequence alignment: Types – Local Alignment and Global Alignment, Pair wise and Multiple alignments of protein and DNA sequences. Algorithms for used for sequence alignment.

Use of sequence alignment tools: BLAST, Clustal Omega; interpretation of the results to derive biological significance of the queried DNA/protein sequences.

Prediction of structure of proteins by homology modeling approach using SWISSMODEL and SWISS-PDB.

Models of molecular Evolution, Selection of best-fitting models, Methods of Phylogeny reconstruction: Phenetic vs. Cladistic, Neighbor Joining, UPGMA, Maximum Parsimony, Maximum Likelihood, Bayesian Inference,

Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Unit 3:

15hrs

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design.

Structure-based drug designing approaches: - Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps.

Ligand-based drug designing approaches: Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property.

Docking methods to generate new structure; Tools and Molecular docking programs: AutoDock,

Dock, HEX	
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Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Bioinformatics (Practical)	Practical Credits	02
Course Code	BOT C18-P	Contact Hours	48 Hours
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			
<ol style="list-style-type: none"> 1. Retrieval of Nucleic acid and amino acid sequences Data from NCBI 2. Retrieval of Protein structure from PDB 3. Sequence similarity search by BLAST/FASTA and phylogenetic tree construction 4. Multiple sequence alignments by Clustal W and 5. Protein structure visualization, retrieval of structural PDB files from PDB database. 6. Retrieval and Preparation of ligand and Proteins from data banks/libraries and for molecular docking 			

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

12. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

BIOINFORMATICS

Time =03 hrs

Marks =25

1. Molecular docking / Multiple sequence alignments (A) 04 marks
2. Retrieval of Nucleic acid / Amino acid sequences (B) 04 marks
3. Sequence similarity search Or Download structural PDB files from PDB database (C) 04 marks
4. Phylogenetic tree construction and analysis by downloading the data (D) 03 marks
5. Viva-voce 05 marks
6. Practical Record + Lab. visit report 05 marks

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Practical	
Assessment Occasion/type	Marks
Attendance	05
Test	05
Field visit	05
Submission	10
Total	25Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	Arthur M. Lesk. (2003). Introduction to Bioinformatics, Oxford University Press, Indian edition.
2	Des Higgins and Willie Taylor. (2000). Bioinformatics, Sequence, structure and databanks. A practical approach. Oxford University Press, Indian edition, Second impression, New Delhi.
3	Imtiaz Alam Khan. (2005). Elementary bioinformatics. Pharma Book Syndicate, Hyderabad.
4	Krane Dan, E. and Raymer M.L. (2004). Fundamental concepts of Bioinformatics. Pearson education. New Delhi. Second Indian reprint.
5	Rastogi, S.C., Medirattta, N. and Rastogi. P. (2004). Bioinformatics, methods and applications, genomics, proteomics and drug discovery, Prentice hall of India, pvt. Ltd., New Delhi.
6	Baxevanis, A. D. and Ouellettee, B. F. F. (2002). Bioinformatics: A Practical Guide to the analysis of Genes and Proteins. (2nd Ed.), New York, John Wiley & Sons, Inc. Publications.
7	Attwood, T. K. and Parry-Smith, D. J. (2001). Introduction to Bioinformatics Delhi. Pearson Education (Singapore) Ptd. Ltd.

PLANT BIOTECHNOLOGY (THEORY)

Program Name	B.Sc. in BOTANY	Semester	VI
Course Title	Plant Biotechnology (Theory)		
Course Code:	BOT C-19 T	No. of Credits	03
Contact hours	45Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations

CO2. Understand how biotechnology has been used to develop knowledge of complex processes that occur in the plant

CO3. Use basic biotechnological techniques to explore molecular biology of plants

CO4. Understand the processes involved in the planning, conduct and execution of plant biotechnology experiments

CO5. Explain how biotechnology is used for plant improvement and discuss the ethical implications of that use

Contents	45Hrs
Unit 1:	15hrs
Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and cybrids; Cryopreservation; Germplasm Conservation).	
Unit 2:	15hrs
Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC). Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning) Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR;	
Unit 3:	15hrs
Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Micro projectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP). Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Biosafety concerns.	

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Plant Biotechnology (Practical)	Practical Credits	02
Course Code	BOT C-20 P	Contact Hours	45Hours
Formative Assessment	25 Marks	Summative Assessment	25Marks
Practical Content			
1. (a) Preparation of MS medium. (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of Tobacco/Datura/Brassica etc. 2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & 3. Preparation of Artificial/Synthetic seeds. 4. Isolation of protoplasts. 5. Study and description of binary vectors by using photographs. 6. Study of methods of gene transfer through photographs: <i>Agrobacterium</i> -mediated, direct gene transfer by electroporation, microinjection, micro projectile bombardment. 7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs. 8. Isolation of plasmid DNA. 9. Isolation and spectrophotometric quantification of DNA. 10. Separation of DNA using agarose gel electrophoresis and gel documentation. 11. Visit Biotech lab nearby your area.			

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

13. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

PLANT BIOTECHNOLOGY

Time =03 hrs

Marks =25

1. Isolation of plant DNA/ spectrophotometric quantification of DNA (A) 05 marks
 2. Preparation of Artificial/Synthetic Seed/ Inoculation using leaf and nodal explants (B) 04 marks
 3. Comment on Bt cotton, Golden rice, FlavrSavr tomato, microinjection, micro projectile bombardment, Agarose /PAGE electrophoresis, Transilluminator, PCR (C&D) 06 marks
 4. Viva-voce 05 marks
 5. Practical Record + Lab. visit report 05 marks
- 25 Marks**

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Practical	
Assessment Occasion/type	Marks
Attendance	05
Test	05
Lab. visit	05
Submission	10
Total	25 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2	Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3	Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition
4	Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition
5	Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

Discipline Specific Elective Papers

(Anyone to be chosen)

A. Herbal Drug Technology (Theory)

B. Techniques in Plant Biology (Theory)

C. Floriculture (Theory)

A. Herbal Drug Technology (Theory)

Program Name	B.Sc. in BOTANY	Semester	VI
Course Title	Herbal Drug Technology (Theory)		
Course Code:	BOT-E2-A -Th	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):	
<p>Course Outcomes (COs): After the successful completion of the course, the student will be able to:</p> <p>CO1: Explain method for identification and authentication of herbal drugs</p> <p>CO2: Explain methods for selection and processing of herbal drugs as raw materials for herbal drug preparation</p> <p>CO3: Explain methods of good agricultural practices for medicinal plants like organic farming and using biopesticides for pest control</p> <p>CO4: Explain basic principles of traditional medicinal systems with method of preparation and standardization of ayurvedic formulations</p> <p>CO5: Describe benefits of various plants as nutraceuticals in ailments and also the herb-food interaction of various plant drugs</p> <p>CO6: Describe about herbs or natural origin drugs as raw materials for preparation of cosmetics, excipients, conventional herbal formulation and novel dosage forms like phytosomes</p> <p>CO7: Describe rules and regulation for assessment of herbal drugs, patenting of natural products and manufacture of herbal formulations based on traditional medicinal system.</p> <p>CO8: Explain present status and prospects of herbal drug based industry and components for Good Manufacturing Practice for Indian systems of medicine</p>	
Contents	45Hrs
Unit 1:	15hrs
<p>Herbs as raw materials Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material Biodynamic Agriculture Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/ Bioinsecticides. Indian Systems of Medicine a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.</p> <p>Herbal Cosmetics: Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.</p> <p>Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene.</p>	
Unit 2:	15hrs
<p>Nutraceuticals General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Withania, Ashwagandha, Spirulina Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.</p> <p>Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.</p> <p>Herbal formulations : Conventional herbal formulations like syrups, mixtures and tablets and Novel</p>	

dosage forms like phytosomes	
Unit 3:	15hrs
<p>General Introduction to Herbal Industry Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.</p> <p>Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. Patenting and Regulatory requirements of natural products: a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.</p>	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	Textbook of Pharmacognosy by Trease& Evans.
2	Textbook of Pharmacognosy by Tyler, Brady & Robber
3	Pharmacognosy by Kokate, Purohit and Gokhale
4	Essential of Pharmacognosy by Dr.S.H.Ansari
5	Pharmacognosy & Phytochemistry by V.D.Rangari
6	Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7	Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

14. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B. Techniques in Plant Biology (Theory)

Program Name	B.Sc. in BOTANY	Semester	VI
Course Title	Techniques in Plant Biology (Theory)		
Course Code:	BOT E2-B-Th	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:
 CO1. To learn principals and operations of microscopes and application in biology
 CO2. To learn the techniques of separation of biological samples.
 CO3. To understand the techniques of characterization of biomolecules.
 CO4. To learn the techniques and principals of chromatography, spectrophotometry, blotting and molecular biology techniques and their advance versions.

Contents	45Hrs
Unit1:	15hrs
Microtomy and slide preparation: Fixatives and staining technique. Preparation of whole mounts. Bright-field stains and fluorochromes. Metachromatic staining reaction. Histochemical dyes for the localization of starch, proteins, nucleic acid and lipids.	
Spectroscopic techniques- Colorimetry, UV-Visible Absorption Spectrophotometry, Infra-Red Spectrophotometry, Mass Spectrophotometry, NMR Spectrophotometry and GCMS, LCMS.	
Unit2:	15hrs
Chromatographic techniques – Principle, Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography and Gas Chromatography. Gas Liquid Chromatography (GLC), High Performance Thin Layer Chromatography (HPTLC), High Performance Liquid Chromatography (HPLC), Ion-Exchange Chromatography, Affinity Chromatography, Autoradiography.	
Unit3:	15hrs
Characterization and isolation of proteins, nucleic acids and phytochemicals: Centrifugation, Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; FTIR.	
Molecular techniques: Southern, Northern, Western & Slot blots. PCR, DNA sequencing. Electrophoresis: AGE, PAGE, SDS-PAGE,	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Techniques in Plant Biology (Practical)	Practical Credits	02
Course Code	BOT E2-B-P	Contact Hours	45Hours
Formative Assessment	25 Marks	Summative Assessment	25Marks
Practical Content (Based on BOS recommendation)			
<ol style="list-style-type: none"> 1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs. 2. Demonstration of ELISA 3. To separate nitrogenous bases by paper chromatography. 4. Isolation of chloroplasts by differential centrifugation. 5. To separate chloroplast pigments by column chromatography. 6. To estimate protein concentration through Lowry's methods. 7. To separate proteins using PAGE. 8. To separate DNA (marker) using AGE. 9. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, differential staining, fluorescence and FISH). 10. Preparation of permanent slides (double staining) 			

References	
1	Alan peacock H. 1966 Elementary Microtechnique Edward Arnold (Pub) Ltd
2	Reid P.D. and R.F. Pont-Lezica (Eds.). 1992. Tissue Printing: tools for the study of anatomy, histochemistry, and gene expression. Academic Press. New York.
3	Conn H.J. 1991. Biological stains. Ninth Edition. Sigma Chemical Company, St. Louis. USA.
4	Prasad & Prasad 2000 Emkay Replications, Delhi. 8. Puru's M.J. et al 1966 Laboratory Techniques in Botany Butter Worths
5	Patki L.R. 1992 An Introduction to Microtechnique S. Chand & Company, New Delhi.
6	Johnson D.A. 1940 Plant Microtechnique. Mac - Graw Hill, New Delhi.
7	Prasad & Prasad 2000 Emkay Replications, Delhi. 8. Puru's M.J. et al 1966 Laboratory Techniques in Botany Butter Worths
8	Krishnamrthy K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers & Publishers) Pvt. Ltd. Madras.

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

15. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

C. Floriculture (Theory)

Program Name	B.Sc.in BOTANY	Semester	VI
Course Title	Floriculture (Theory)		
Course Code:	BOT E2-C-Th	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):	
Course Outcomes (COs): After the successful completion of the course, the student will be able to: CO1: Identify and describe the ornamental flowering plants. CO2: Practice the methods of preparing soil and water, cultivation and propagation methods. CO3: Design, prepare and apply appropriate combinations of plants and methods of cultivation for commercial setup. CO4: Adapt to the job role of Floriculturist (employment/ entrepreneurship)	
Contents	45Hrs
Unit1:	15hrs
Introduction to floriculture, tools and equipments. Study of diversity in shape, size, and colour of flowers (including basic botany, nomenclature, common name and general uses). Identification and preparation of an inventory of herbaceous flowering plants, climbers, shrubs, and trees around the campus. Study the various physico-chemical properties of soil.	
Unit2:	15hrs
Methods of preparation of floral beds, soil preparation, greenhouse design and fumigation methods. Methods of seed sowing and raising flowering plants through seeds, bulbs and through vegetative methods in planters, containers and in outdoor environments. Role of light, plant growth regulators and nutrients in blooming and flowering. Bacterial and fungal diseases and pests of ornamental flowers and their management.	
Unit3:	15hrs
Interior decoration methods, flower arrangements (Japanese, Western and Indian). Harvesting, methods to increase the shelf life of flowers, post-harvest care and marketing platforms for the floriculture industry. Field visit to nearby nursery/garden to understand basic aspects of Garden design. Five flowering plants that are grown commercially, their share in the global market, methods used for selling the products and importance of the floriculture industry in job creation.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Floriculture (Practical)	Practical Credits	02
Course Code	BOTE2CP	Contact Hours	45Hours
Formative Assessment	25Marks	Summative Assessment	25Marks
Practical Content (Based on BOS recommendation)			
1. Common garden operations using different implements. Identification & practice Bio-fertilizer. 2. Handling of soils, purpose of nursery bed, potting media, potting etc. 3. Propagation by cutting, budding, greating. 4. Handling of seeds, bulbs, cut flowers, nursery plants, pot plants. 5. Acquaintance with soil types, various manures, fertilizers, Vermi compost, pesticides, growth regulator. 6. Systematic waste disposal keeping environment pollution in view			

References	
1	Randhawa, G.S., Mukhopadhyay, A. (1986). Floriculture in India. New York, NY: Allied Publishers.
2	Larson, R. A. (Ed.). (2012). Introduction to floriculture. Elsevier
3	Pal, S. L. (2019). Role of plant growth regulators in floriculture: An overview. J. Pharmacogn. Phytochem, 8, 789-796.
4	Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5	Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6	Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

16. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

VOCATIONAL PAPERS

(Anyone to be chosen)

- A. Plant Quarantine (Theory)**
- B. Plant Diversity and Human Welfare (Theory)**

A. Plant Quarantine (Theory)

Program Name	B.Sc.in BOTANY	Semester	VI
Course Title	Plant Quarantine (Theory)		
Course Code:	BOT V2- A	No. of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):	
<p>Course Outcomes (COs): After the successful completion of the course, the student will be able to:</p> <p>CO1. Diagnose causes of plant damage, especially by pests, and identify the agent responsible.</p> <p>CO2. Apply an understanding of the practices available to manage insects, diseases and weeds.</p> <p>CO3. Create an integrated management program and explain the benefits and limitations of its components.</p> <p>CO4. Make informed decisions about pest management practices based on appropriate sampling of pest populations and interpreting sampling data.</p> <p>CO5. Defend the value of a holistic approach to pest management.</p>	
Contents	45Hrs
Unit 1:	15hrs
Plant quarantine: Introduction to Plant Quarantine Information System (PQIS) and objective. Imports: Plant Quarantine Order and Amendments, Issuance of the Import Permit, Import inspection and clearance, Procedures of PEQ inspection, Time schedules for clearance, Permits required for import of Germplasm, Transgenic or Genetically Modified Organisms, live insects and microbial cultures, plants and plant products, Requirement of Import of Wood and Timber: Special conditions for import of plant species.	
Unit 2:	15hrs
Exports: Export inspection and certification procedure: Time schedules for clearance, Fees and Charges, Circular issued to Export Certification Authorities. Post-entry Quarantine: Appeal and Revision, Power of Relaxation, issuance of import permit, import inspection, inspection authorities Fees and charges, commodities not requiring Plant Quarantine clearance	
Unit 3:	15hrs
Phytosanitary: Phytosanitary Agreement, national standards for phytosanitary measures, accredit treatment facilities, Quarantine Disinfestation Treatment. The Destructive Insects and Pests Act, 1914 and amendments The Plant Quarantine Order 2003 - Amendments International Plant Protection Convention WTO-SPS Agreement International Standards on Phytosanitary Measures (ISPMs). Biodiversity Act Entrepreneurship opportunities: Testing quality and contaminants (Chemical and biological in organic farming and their products)	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	M.C. Muthaiyan (2009) Principles and Practices of Plant Quarantine, Allied publishers private limited.
2	Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
3	Singh, R.S. 998 Plant Diseases. 7th edition, Oxford & IBH, New Delhi.
4	Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

17. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B. Plant Diversity and Human Welfare (Theory)

Program Name	B.Sc.in BOTANY	Semester	VI
Course Title	Plant Diversity and Human Welfare (Theory)		
Course Code:	BOT V2- B	No.of Credits	03
Contact hours	45 Hours	Duration of SEA/Exam	2hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite (s):	
Course Outcomes (COs): After the successful completion of the course, the student will be able to: CO1. Knowledge related to Plant diversity CO2. Skill related to the Conservation of Biodiversity CO3. Understand methods of conservation of Biodiversity CO4. Learn the role and scope of Plant Diversity for Human Welfare.	
Contents	45Hrs
Unit 1:	15hrs
Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at The ecosystem level, Agro-biodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro-biodiversity, Projected scenario for biodiversity loss,	
Unit 2:	15hrs
Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects. b) Avenue trees. c) Ornamental plants of India. d) Alcoholic beverages through ages. e) Wood and its uses. f) Medicinal and aromatic plants (<i>Aegle marmelos</i> , <i>Adatoda vasica</i> , <i>Azadirachta indica</i> , <i>Aloe barbadensis</i> , <i>Centella asiatica</i> , <i>Emblica officinalis</i> , <i>Moringa oleifera</i> , <i>Nothapodytes nimmoniana</i> , <i>Rauwalfia serpentine</i> , <i>Solanum nigrum</i> , <i>Terminalia chebula</i> , <i>Terminalia ballerica</i> , <i>Zingiber officinale</i>) (<i>Vetiveria zizanoides</i> L, <i>Cymbopogon flexuosus</i> , <i>Ocimum sanctum</i> , <i>Crocus sativus</i>)	
Unit 3:	15hrs
Fruits and nuts: Important fruit crops (05 important locally/seasonally available plants) and their commercial importance. Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution - IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Attendance	10
Test (Objective type)	10
Assignments	10
Seminar	10
Total	40Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	Krishnamurthy, K.V. (2004). An Advanced Textbook of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2	FAO. 1978. Forestry for Local Community Development. FAO Publ.
3	P.Vasanth Kumar 2014. Economic Botany. Sonali Publications New Delhi.
4	Sundar Rajan-2007. College Botany Vol-V, Part 1: Taxonomy and Economic Botany Himalaya Publishing House.
5	Odum E.P. (1971): Fundamentals of Ecology (2nd Edn.,) Saunders & Co., Philadelphia

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

18. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.