



BANGALORE UNIVERSITY

DEPARTMENT OF BOTANY

Jnanabharathi Campus, Bengaluru - 560 056

SYLLABUS FOR B. Sc. BOTANY (UG) V & VI SEMESTER

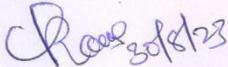
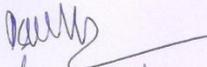
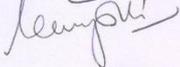
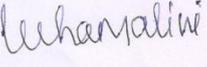
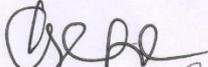
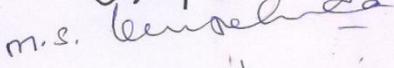
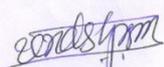
Under Graduate (UG) Programme

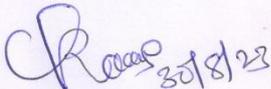
**To be implemented from the academic year
2023-24**

30-08-2023

Proceedings of the Board of studies in Botany (UG) meeting held on 30-08-2023 in the Department of Botany, Bangalore University, Bangalore to discuss and finalize the syllabus of V and VI Sem B.Sc., Botany (NEP) and other issues as per the agenda.

Members Present

		Signature
1. Dr. H. R. Raveesha, Professor & Chairman		
2. Dr. Sharanappa. P	: External Member	
3. Dr. Rajkumar H Garampalli	: External Member	
4. Dr. Usha Malini	: Member	
5. Dr. Suresh Kumar. C	: Member	
6. Dr. Kempegowda. M. S	: Member	
7. Dr. Mamatha. N	: Member	
8. Dr. Venkateshappa. S. M	: Member	


Dr. H. R. Raveesha
Professor & Chairman

Professor & Chairman
Department of Botany,
Bangalore University
Bangalore - 560 056.

B. Sc. Botany Programme outcomes as per NEP 2020

Discipline Core: Botany

Total Credits for the Program: 186

Starting year of implementation: 2021-22

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history. **PO6:** Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career.

BOTANY Curriculum
B. Sc. BOTANY – V Semester

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	2½ 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 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. Conservation of useful plants from the past to the present.			
Contents			60 hrs
Unit I			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, roles of Botanical gardens, technique of herbarium preparation</p> <p>Virtual herbarium: E-flora, Documentation.</p>			
Unit II			15 hrs
<p>Plant identification: Taxonomic dichotomous keys; indented (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: Annonaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae (with sub Families), Apiaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae and Poaceae.</p> <p>Plant Taxonomic Evidences: from palynology embryology, cytology, phytochemistry and molecular data. Field inventory.</p>	
Unit III	15 hrs
<p>Taxonomic Hierarchy: Concept of taxa (family, genus, species), Categories and taxonomic hierarchy, Species concepts (biological, morphological, evolutionary). Modes of speciation.</p> <p>Botanical Nomenclature: Principles and rules (ICN); Latest Botanical code (Shenzen code - 2019), 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 IV	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: DNA sequences of chloroplast genes (rbcL) and one nuclear gene (nuclear ribosomal 18s DNA) (Brief account).</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>	

B. Sc. BOTANY – V Semester
Plant Morphology and Taxonomy (Practical)

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. 04 hrs</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>3. 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)(Demonstration). 06 hrs</p> <p>4. Identify plants/plant products of economic importance belonging to the families mentioned in the syllabus; with binomial, family and morphology of useful parts - Cotton, Red gram, Green gram, Horse gram, Black gram, Bengal gram, Indigo, Brinjal, Tomato, Chilly, Tamarind, Bitter gourd, <i>Luffa</i>, <i>Asafoetida</i>, Cumin, Coriander, Coffee, Rubber, <i>Tapioca</i>, <i>Ricinus</i>, Turmeric, Coir, Arecanut, Rice, Wheat, Ragi, Sugarcane <i>Annona muricata</i> <i>Catharanthus roseus</i>, <i>Rauvolfia serpentina</i>, <i>Justicia adhatoda</i>, <i>Vitex nigundo</i> and <i>Leucas aspera</i>. 16 hrs</p> <p>5. Field visit: Local or outside area/ Botanical garden/ tribal settlements minimum 3 to 5 days.</p> <p>6. 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>				

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	2	1	1	1	2		1	2	1	1	2
CO2	1	1	2	2	1	2		2	2	1	2	1
CO3	3	1	1	2		1	3	1		1	2	1
CO4	2	2		1	2	2			2	1	1	2
CO5		1	1	2	2	3			2	1	2	2

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits.

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

References
1. Baker. H.G. 1970. Plant and Civilization, Wadsworth Publishing Company.
2. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
3. Cotton, C.M. 1996. Ethnobotany – Principles and Applications. Wiley and Sons
4. Datta S C. 1988. <i>Systematic Botany</i> , 4th Ed, Wiley Estern Ltd., New Delhi.
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6. Hall, B.G. 2011. <i>Phylogenetic Trees Made Easy: A How-To Manual</i> . Sinauer Associates, Inc. USA
7. Heywood, 1999. <i>Plant taxonomy and Biosystematics</i> , Edward Arnold London.
8. Jeffrey C .J. and A. Churchil - <i>An introduction to taxonomy</i> – London.
9. Jeffrey, C. (1982). An Introduction to <i>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, G.H.M. 2012. <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. and Jain, 2015. <i>Taxonomy of Angiosperms</i> - Rastogi Publications, Meerut.
20. Sivarajan V. V. 1991. <i>Introduction to Principles of taxonomy</i> - Oxford &I B H New Delhi.

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2½ 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

Time: 3Hours

Max. Marks: 25

- | | |
|---|---------|
| 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. Draw the floral diagram and write 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 (Record) | 5 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 voce
 Q6. Submission (Journal/ Record + Study Tour Report)

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

B. Sc. BOTANY – V Semester

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	04
Contact hours	60 Hours	Duration of SEA/Exam	2 ½ hours
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.Understanding the basics of genetics and plant breeding</p> <p>CO2.Ability to identify, calculate and describe crossing over, allelic generations and frequencies of recombination.</p> <p>CO3.Interpret the results of mating and pollinations.</p> <p>CO4.Classify Plant pollination methods</p> <p>CO5.Recognition of modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation.</p>	
Contents	60 Hrs
Unit I	15 hrs
<p>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.</p> <p>Extrachromosomal Inheritance, Chloroplast mutation, Variegation in Four o'clock plant, Mitochondrial mutations in yeast.</p>	
Unit II	15 hrs
<p>Linkage, crossing over and chromosome mapping: 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:</p> <p>Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents). Detection of mutations: CLB method, Role of Transposons in mutation, DNA repair mechanisms.</p> <p>Fine structure of gene</p> <p>Population Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law,</p>	

role of natural selection, mutation. Evolutionary Genetics: Genetic drift, Genetic variation and Speciation.	
Unit III	15 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, Centres of origin and domestication of crop plants, plant genetic resources, Acclimatization. Selection methods: Self-pollinating and cross-pollinating plants and types of vegetative propagation in plants.	
Unit IV	15 hrs
Hybridization: self, cross and vegetative propagation in plants – Procedure, advantages and limitations. 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 techniques, role of mutations in crop improvement; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.	

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits, 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>	

B. Sc. BOTANY – V Semester

Genetics and Plant Breeding (Practical)

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 biology, self and cross pollinated plants; vegetative propagation 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. 			

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1		1		2	1		2	1				2
CO2	2	2		2	1			2	2	1		2
CO3	1	2		2	2		2	1				2
CO4			2		2		3					2
CO5	1	2		2	2		1		2	1		2

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits, etc.

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

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.
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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.
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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.

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

Time: 3 Hrs

Max. Marks: 25

- | | |
|---|---------|
| 1. Perform the emasculation / pollen viability / fertility of the given sample A | 5 Marks |
| 2. Solve the given genetic problem B | 4 Marks |
| 3. Identification of Specimen/slides/ Photographs C, D and E | 6 Marks |
| 4. Viva Voce | 5 Marks |
| 5. Submission (Journal / Record) | 5 Marks |

General instructions:

Q1 Material *Cassia/ Hibiscus/ Catharanthus roseus* etc (A)

Q2. Genetic problems (B)

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

Q4. Viva voce

Q5. Submission (Journal/ Record)

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

B. Sc. BOTANY – VI Semester

CELL BIOLOGY (THEORY)

Program Name	B.Sc. in BOTANY	Semester	VI
Course Title	Cell Biology (Theory)		
Course Code:	DSC-BOT - C13-T	No. of Credits	04
Contact hours	60 Hours	Duration of SEA/Exam	2½ hours
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:.. CO1. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle</p> <p>CO2. Contemporary approaches in modern cell and molecular biology.</p> <p>CO3.To study the organization of cell, cell organelles and biomolecules (i.e protein, carbohydrate, lipid and nucleic acid)</p> <p>CO4.To gain knowledge on the activities in which the diverse macro molecules and microscopic structures inhabiting the cellular world of life are engaged.</p> <p>CO5.To understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life.</p>	
Contents	60 Hrs
Unit I	15 hrs
Introduction, discovery, chemical nature, structure and replication of genetic material, genetic code, non-genetic RNA, Biosynthesis of proteins Nucleosome model and Giant chromosomes salivary gland and Lampbrush chromosomes. Regulation of gene action in prokaryotes (Lac and tryptophan-operon). Gene regulation in eukaryotes PCD: Biology and elementary knowledge of development and causes of cancer.	
Unit II	15 hrs
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.	
Unit III	15 hrs
Structure and functions, active and passive transport, proton pumps associated (Na-K, Ca-calmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis. Structural organization, function, marker enzymes of the 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 IV	15 hrs
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, conducting experiments, discussion, interaction, case studies, field visits, 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>	

B. Sc. BOTANY – VI Semester **CELL BIOLOGY (Practical)**

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			
<ol style="list-style-type: none"> 1. Study of plant cell structure with the help of epidermal peel mount of Onion/ <i>Rhoeo</i>/ 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/ <i>Rhoeo</i>/ Crinum) 5. Study of Karyotype using camera-lucida / chart. 6. Isolation of cell organelle – Chloroplast. 			

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1			2	1			3	1				2
CO2	2	1	2		1				3			2
CO3	2		1		2				1			1
CO4			2		2		1					3
CO5									2	1	2	3

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits, etc.

Formative Assessment for Practical	
Assessment Occasion/type	Marks
Attendance	05
Test	05
Assignments	05
Submission (Submission of 5 permanent slides)	10
Total	25Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

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: Evolution and Ecology. India: S. Chand Limited.

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

Max. Marks: 25

1. Preparation of squash/ smear of material A, identify, Sketch and label the any two stages with reasons 06 marks
2. 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

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

B. Sc. BOTANY – VI Semester
PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (THEORY)

Program Name	B.Sc. 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 ½ hours
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. 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.</p>	
Contents	60 hrs
UNIT I	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. Transpiration. Types and process, Mechanism of guard cell movement, K⁺ ion mechanism, Antitranspirants. Mechanism of ascent of sap: Vital and physical force theories. Phloem Transport: Transport of organic solutes. Path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis. Mineral nutrition: Micro and macro nutrients - their importance and deficiency symptoms.</p>	
UNIT II	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. Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Oxidative Pentose Phosphate Pathway. Nitrogen metabolism: Biological nitrogen fixation: Nitrate and ammonia assimilation.</p>	

UNIT III	15 hrs
<p>Plant growth regulators: Definition and classification, site of synthesis, biosynthesis pathway and metabolism and influence on plant growth development - Auxins, Gibberellins, cytokinins, ABA and 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 and Aging.</p> <p>Plant Movements: Spontaneous (Autonomic) and Induced (Paratonic) movements.</p>	
UNIT IV	15 hrs
<p>Biomolecules: Classification and functions of Carbohydrates.</p> <p>Enzymes: Classification, kinetics and mechanism of action.</p> <p>Proteins and amino acids: Classification, structure - primary, secondary, tertiary and quaternary. Classification of Amino acids.</p> <p>Vitamins: Classification, distribution, structure, production, function.</p> <p>Lipids: Classification, structure, function and biosynthesis of fatty acids.</p> <p>Secondary plant products: Structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.</p>	

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits, etc.

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>	

B. Sc. BOTANY – VI Semester
PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (Practical)

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				
1. Experiment to demonstrate the phenomenon of exosmosis and endosmosis. 2. To determine the osmotic pressure of the cell sap by plasmolytic method. (Major) 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 Rf values (Major) 7. Estimation of total chlorophyll content by Arnon method. (Major) 8. To isolate and identify the amino acids from a mixture using paper chromatography. (Major) 9. To Study of Phototropism. 10. Qualitative test for Starch, Protein, Reducing Sugars and Lipids. 11. Estimation of TAN (Titratable acid Number) from <i>Bryophllum</i> leaves/ <i>Aloe vera</i> . (Major)				

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1			1	2			1	1				2
CO2	1		2		1				2			
CO3	2		1		2				3			
CO4			2		2		3					
CO5									2	1	2	2

Pedagogy: Teaching and learning, conducting experiments, discussion, interaction, case studies, field visits, 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.
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5. Malik CP, 2002. Plant Physiology. Kalyani publishers.
6. Mukherjee S, Ghosh AK, 2005. Plant Physiology. New Central Book Agency, Calcutta.
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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.

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2½ 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 Hours

Max. 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 | 05 marks |

General Instructions:

- Q1. Osmotic potential/paper chromatographic separation of pigments (A)
- Q2. CoCl_2 / O_2 evolution/Root pressure/transpiration pull experiments (B & C)
- Q3. Qualitative tests for Starch, Protein, Reducing Sugars and Lipids (D)
- Q4. Viva-voce
- Q5. Practical record

Internship for Graduate Programme (As Per UGC & AICTE)

Course title	Internship Discipline specific
No of contact hours	90
No credits	2
Method of evaluation	Presentations/Report submission/Activity etc.,

- ❖ Internship shall be Discipline Specific of 90 hours (2 credits) with a duration 4-6 weeks.
- ❖ Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- ❖ Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- ❖ The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- ❖ The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.