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		30/8/23
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	

30/8/23

Dr. H. R. Raveesha
Professor & Chairman

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

MINUTES OF THE BoS (UG) MEETING

Chairman welcomed the members to the meeting and thereafter the agenda was taken up for discussion

1. Discussed and finalized the NEP syllabus of V and VI semester B.Sc., Botany both (Theory & Practicals) question paper pattern, blue print of question paper, Formative assessment and scheme of valuation for choice based credit system of NEP Programme.

2. Members also discussed the titles of the papers for V & VI Semester disciplines of specific elective papers.

3. The overall N.E.P Module for B.Sc., Botany was discussed, finalized and accepted with modifications wherever necessary.

4. The proposed panel of examiners were recommended for 2023-24 examinations.

5. Recommendations were made for the Constitution of BoE for the academic year 2023-24

6. The Chairperson is authorized to change / incorporate corrections as per the direction of University.

The meeting ended with a vote of thanks by the Chairman.

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

COURSE PATTERN AND SCHEME OF EXAMINATION FOR B.Sc. / B.Sc. (HONS.) AS PER NEP (2023-24 ONWARDS)																		
SUBJECT: BOTANY																		
Sl. No	Semester	Course Code	Title Of The Paper	Teaching Hours	Hours/Week		Examination pattern Max. and Min. Marks/Paper						Duration of exam (hours)		Total marks/ paper	Credits	
							Theory			Practical							
					Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	V	BOT C9 - T	Plant Morphology & Taxonomy	60	4		60	21	40				2 ½		100	4	
		BOT C10 - p	Plant Morphology & Taxonomy	60		4				25	09	25		3	50		2
		BOT C11 - T	Genetics and Plant Breeding	60	4		60	21	40				2 ½		100	4	
		BOT C12 - p	Genetics and Plant Breeding	60		4				25	09	25		3	50		2
			SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	VI	BOT C13 - T	Cell Biology	60	4		60	21	40				2 ½		100	4	
		BOT C14 - p	Cell Biology	60		4				25	09	25		3	50		2
		BOT C15 - T	Plant Physiology and Biochemistry	60	4		60	21	40				2 ½		100	4	
		BOT C16 - p	Plant Physiology and Biochemistry	60		4				25	09	25		3	50		2
			SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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 thecuriosity 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 afterobservation 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 spiritof inquiry.

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

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

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliveron 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 theprofessional 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**
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. **Introduction to Taxonomy**: History, objectives, scope and relevance of Taxonomy **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. **Taxonomic literatures:** Floras, Monograph. Revisions, Journals. **Herbaria and Botanical gardens:** Important herbaria and Botanical gardens of the world and India, roles of Botanical gardens, technique of herbarium preparation **Virtual herbarium:** E-flora, Documentation.	
Unit II	**15 hrs**
Plant identification: Taxonomic dichotomous keys; indented (yolked) and bracketed keys. (Brief account only). **Plant descriptions**: Common terminologies used for description of vegetative and reproductive parts of the following families.	

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. **Plant Taxonomic Evidences:** from palynology embryology, cytology, phytochemistry and molecular data. Field inventory.	
Unit III	**15 hrs**
Taxonomic Hierarchy: Concept of taxa (family, genus, species), Categories and taxonomic hierarchy, Species concepts (biological, morphological, evolutionary). Modes of speciation. **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.	
Unit IV	**15 hrs**
Biometrics, Numerical Taxonomy; Phenetics and Cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences). **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.). **Origin and evolution of angiosperms:** Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). **Molecular taxonomy:** DNA sequences of chloroplast genes (rbcL) and one nuclear gene (nuclear ribosomal 18s DNA) (Brief account).	

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**
Formative Assessment as per guidelines are compulsory	

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

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**

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**

3. Construction of plant phylogenetic trees using various loci (*atp*B, rbcL, ITS, trnL etc) with various phylogenetic methods (Neibour Joining, Maximum Likelihood etc)(Demonstration). **06 hrs**

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, *Luffa*, *Asafoetida*, Cumin, Coriander, Coffee, Rubber, *Tapioca*, *Ricinus*, Turmeric, Coir, Arecanut, Rice, Wheat, Ragi, Sugarcane *Annona muricata Catharanthus roseus*, *Rauvolfia serpentaina, Justicia adhatoda*, *Vitex nigundo* and *Leucas aspera.* **16 hrs**

5. **Field visit**: Local or outside area/ Botanical garden/ tribal settlements minimum 3 to 5 days.

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).

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**
Formative Assessment as per guidelines are compulsory	

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3. Cotton, C.M. 1996. Ethnobotany – Principles and Applications. Wiley and Sons
4. Datta S C. 1988. *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi.
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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):

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.Abilitytoidentify, calculate and describe crossing over, allelic generations and frequencies of recombination.

CO3.Interprettheresults of mating and pollinations.

CO4.ClassifyPlantpollination methods

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

Contents	**60 Hrs**
Unit I	**15 hrs**
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. Extrachromosomal Inheritance, Chloroplast mutation, Variegation in Four o'clock plant, Mitochondrial mutations in yeast.	
Unit II	**15 hrs**
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: **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. Fine structure of gene **Population Genetics:** Allele frequencies, Genotype frequencies, Hardy-Weinberg Law,	

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: S**elf-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**
Formative Assessment as per guidelines are compulsory	

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

Practical: Plant breeding:

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

Practical: Genetics

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**
Formative Assessment as per guidelines are compulsory	

References	
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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):

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	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**
Formative Assessment as per guidelines are compulsory	

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

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.

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**
Formative Assessment as per guidelines are compulsory	

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):

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 I	**15 hrs**
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.	
UNIT II	**15 hrs**
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.	

UNIT III	15 hrs
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 . **Synthetic growth regulators**: Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture. **Sensory Photobiology**: Biological clocks, photoperiodism, function & structure of phytochromes, phototropin & cryptochromes. Senescence and Aging. **Plant Movements:** Spontaneous (Autonomic) and Induced (Paratonic) movements.	
UNIT IV	**15 hrs**
Biomolecules: Classification and functions of Carbohydrates. **Enzymes:** Classification, kinetics and mechanism of action. **Proteins and amino acids**: Classification, structure - primary, secondary, tertiary and quaternary. Classification of Amino acids. **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.	

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
Formative Assessment as per guidelines are compulsory	

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 Phototrophism.
10. Qualitative test for Starch, Protein, Reducing Sugars and Lipids.
11. Estimation of TAN (Titratbale acid Number) from *Bryophllum* leaves/*Aloe vera*. (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**
Formative Assessment as per guidelines are compulsory	

REFERENCES

1. Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc. Wilson, K. and Walker, J. 1994.
2. JainV 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. 2002. Plant Physiology: Fundementals and Applications.Agrobotanical Publishers.
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10. Sinha A K, 2004. Modern Plant Physilogy. 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.