MANGALORE UNIVERSITY

(B3-I) Model Programme Structure for Bachelor of Science (Basic/Hons.) Programme with (Subjects with practical)

[Biochemistry, Biotechnology, Botany, Chemistry, Electronics, Geography, Mathematics, Philosophy, Physics, Statistics, Zoology, Psychology, Microbiology, Physical Education, Yogic Science]

Sem.	Discipline Core(DSC) (Credits)	Discipline Elective(DSE) /Open Elective (OE) (Credits)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (Credits)(L+T+P)	Value based (Credits) (L+T+P)	
I	DSC A1(4) A2(2) DSC B1(4) B2(2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)	Env. Studies (3) (3+0+0)	SEC-1: Digital Fluency(2) (2+0+0)	Yoga/ Health & Wellness/ Sports NCC/NSS/R&R(S&G)/ Cultural &Others (2) (0+0+4)	25/26
II	DSC A3(4) A4(2) DSC B3(4) B4(2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	SEC-1: Digital Fluency (2) (2+0+0)	Env. Studies (3) (3+0+0)		26/25
Students exiting the programme after securing 46 credits will be awarded UG Certificate in the relevant Discipline provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits from skill-based courses earned during first year.							
III	DSC A5(4) A6(2) DSC B5(4) B6(2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)	Indian Constitution (3) (3+0+0)	SEC-2:AI/Financial Edu.& Inv. Aw.(2)(2+0+0)	Yoga/ Health & Wellness/ Sports NCC/NSS/R&R(S&G)/ Cultural &Others (2) (0+0+4)	25
IV	DSC A7(4), A8(2) DSC B7(4), B8(2)	Indian Constitution (3)(3+0+0)	L1-4(3), L2-4(3) (4 hrs. each)	OE-3 (3)	SEC-3: Financial Edu. &Inv.Aw /AI(2)(2+0+0)		25
Students exiting the programme after securing 92 credits will be awarded UG Diploma in Discipline A and B provided they secure 4 credits in skill basedVocational courses offer during first –or –second –year summer term.							
V	DSC A9(4) A10(2) A11(4) A12(2);		DSC B9(4), B10(2),B11(4), B12(2)		SEC-4: SEC-4: Cyber Security(2) (2+0+0)/General Aptitude (3) (2+0+2)		26/27
VI	DSC A13(4) A14(2), A15(4), A16(2);		DSC B13(4), B14(2), B15(4),B16(2)		Project work (2)		26
Students exiting the programme after 3 years will be awarded UG Degree in Disciplines A and B as double majors upon securing 136 credits and satisfying the minimum credit requirements under each category of courses prescribed							
B.Sc. (Honours with Research) in Discipline A			**B.Sc. (Honours) in Discipline A**				
VII	DSC A17(4), A18(2), A19(4), A20(2); Res. Methodology-1 (4)	DSE-E1 (3), Vocational-1(3) Res. Proposal formulation (2)*	DSC A17(4), A18(2), A19(4), A20(2); Res. Methodology-1 (4)		DSE-E1(3), Vocational-1(3)		22
VIII	DSC A21(4)	DSE-E2(3), Vocational -2 (3)Research Project (10+2*)	DSC A21(4),A22(2) Internship/Apprenticeship (4)		DSE –E2(3), E3(3) Vocational -2(3), 3(3);		22
Bachelor of Science Degree Honours with or without research, B.Sc.(Honours with Research) or B.Sc. (Honours) in Discipline A upon securing 176 credits and satisfying the minimum credit requirements under each category of courses prescribed.							

Note: Only those students who secure 75% marks or CGPA if 7.5 and above in the first six semesters may choose to undertake research in the fourth year. Honours students not undertaking research have to do 3to 4 Additional courses/Entrepreneurship courses and Internship/Apprenticeship for 12 credits.

MANGALORE UNIVERSITY

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

BOTANY AND ANOTHER SUBJECT AS DOUBLE MAJORS IN THIRD YEAR

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
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.

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 isto 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 containsthe 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)

1. 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. Understand the main features in Angiosperm evolution

CO2. Identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification offlowering 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. Recognise locally available angiosperm families, 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**
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. Technique of Herbarium Preparation and role of botanical gardens. **Virtual herbarium;** E-flora; Documentation.	
Unit 2:	**15 hrs**
Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary). Modes of speciation. Problems with species concepts. Rankless system of phylogenetic systematics. **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. **Plant identification**: Taxonomic dichotomous keys; indented (yoked) and bracketed keys. (brief account only).	

Unit 3:	**15 hrs**
Plant descriptions and diagnostic features of Angiosperm families: Common Terminologies used for description of vegetative and reproductive parts of the following plant families: **Brassicaceae, Malvaceae, Anacardiaceae, Fabaceae (with sub- Families), Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae**	
Unit 4:	**15 hrs**
Plant descriptions and diagnostic features of Angiosperm families: **Orchidaceae, Liliaceae, Arecaceae and Poaceae**. **Biometrics, Numerical Taxonomy; Phenetics and Cladistics:** Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences). **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 (*atp*B, rbcL, ITS, trnL) and one nuclear gene (nuclear ribosomal 18s DNA).	

Course Title	**Plant Morphology and Taxonomy (Practical)**	Practical Credits	**02**
Course Code	**DSC – BOT - C10- P**	Contact Hours	**56 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content (4hrs each session)

1. Study of root, stem and leaf structure and modifications.
2. Study of inflorescence types. Studyof flower and its parts.
3. Study of fruits. Floral diagram and floral formula.

4-10. Study of 14 families* with suitable diagrams, technical terms (description, V.S. flower, section of ovary, floral diagram, floral formula and systematic position according to Bentham & Hooker's system of classification).

11-13. 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, Asafoetida, Cumin, Coriander, Coffee, Rubber, Castor, Ginger, Turmeric, Coconut coir, Arecanut, Rice, Wheat, Ragi, Sugarcane, Periwinkle, Sarpagandha, Adusoge.

14. **Field visit**: Local or outside/Botanical Garden/ tribal settlements.

Submission: Record book, Tour report and Herbarium (any 2).

*Dicotyledons –any 12; Monochlamydae- any 1; Monocotyledons- any 2

Pedagogy: Teaching and learning, conducting experiments, field visits

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Test	20
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

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

Formative Assessment for Practical	
Assessment Occasion/type	**Marks**
Attendance	05
Test	10
Submission (Record book, Tour report)	10
Total	**25 Marks**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

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

Part-A

1. Question number 01-12 carries 2 marks each. Answer any 10 questions: 20 marks.

Part-B

2. Question number 13-20 carries 10 Marks each. Answer any 04 questions: 40 marks.

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

Total: 60 Marks Note:

Proportionate weight-age 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. Identify, classify and describe the specimen A & B taxonomically 6 Marks
2. Explain the specimen C using technical terms 4 Marks
3. Write the floral diagram and floral formal of the given specimen D 2 Marks
4. Identification of Specimen/slides E, F,G and H 8 Marks
5. Submission (Journal / Record + two herbarium) 5 Marks

Total 25 marks

General instructions:

Q1. A- Specimen from Dicotyledons, B-Monochlamydae/MonocotyledonsQ2.
Give specimen from the family they studied (C)
Q3. Give specimen from the family they studied (D)
Q4. Specimen /Slides/ materials from Root/Stem/Inflorescence (E), Flower/Fruit (F) and Economic importance (G & H)
Q5. Submission (Journal/ Record + two herbarium)

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

References	
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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, *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi, 1988.

5	Eames A. J. - *Morphology of Angiosperms* - Mc Graw Hill, New York.
6	Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates, Inc. USA
7	Heywood - *Plant taxonomy* - Edward Arnold London.
8	Jeffrey C .J. and A. Churchil - *An introduction to taxonomy* – London.
9	Jeffrey, C. (1982). An Introduction to *Plant Taxonomy*. Cambridge University Press, Cambridge
10	Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., Donogue, M.J., 2002. *Plant Systematics: A Phylogenetic approach,* 2nd edition. Sinauer Associates, Inc., USA.
11	Lawrence - *Taxonomy of Vascular Plants* - Oxford & I B H, New Delhi.
12	Manilal, K.S. and M.S. Muktesh Kumar 1998. *A Handbook on Taxonomy Training*. DST, New Delhi.
13	Manilal, K.S. and A.K. Pandey, 1996. *Taxonomy and Plant Conservation*. C.B.S. Publishers & Distributors, New Delhi.
14	Manilal, K.S. 2003. *Van Rheede'sHortusMalabaricus. English Edition*, with Annotations andModern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
15	Naik V.N., *Taxonomy of Angiosperms*, 1991. Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
16	Pandey, S. N, and S.P. Misra (2008)-*Taxonomy of Angiosperms*- Ane Books India, New Delhi.
17	Radford A B, W C Dickison, J M Massey & C R Bell, *Vascular Plant Systematics*, 1974,Harper & Row Publishers, New York.
18	Singh G.2012. *Plant systematics: Theory and Practice*. Oxford and IBH, Pvt. Ltd., New Delhi.
19	Singh V. & Jain - *Taxonomy of Angiosperms* - Rastogi Publications, Meerut.
20	Sivarajan V. V - *Introduction to Principles of taxonomy* - Oxford &I B H New Delhi.
21	Any local/state/regional flora published by BSI or any other agency.
22	Morphology of Angiosperms – John Merie Coulter and Charles, MJP Publishers, 03-03-2023
23	Taxonomy of Angiospers – S.N. Pandey, Ane Books Pvt. Ltd. 2019-10-05

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	**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.Understand the basics of genetics and plant breeding

CO2.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.Recognise modes of inheritance of traits/phenotypes and Phenotype-genotype correlation.

Contents	**60Hrs**
Unit 1:	**15hrs**
Mendelian genetics and its extension: History; Principles of inheritance: law of segregation, law of independent assortment. Test cross and back cross, Autosomes and sex chromosomes; Probability and pedigree analysis. Incomplete dominance (*Mirabilis*) and Codominance (Rhododendron); Multiple alleles (self-sterility in tobacco), Lethal alleles (Snapdragon), Epistasis- 9:7, 9:3:4, 12:3:1, 15:1. Brief account on Pleiotropy, Penetrance and Expressivity. Polygenic inheritance (kernel color in wheat)	
Unit 2:	**15hrs**
Extra chromosomal inheritance, Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast. **Linkage and crossing over** – types, Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence. **Mechanisms of sex determination in Plants** – *Melandrium*, *Coccinia indica* and *Maize.* **Variation in chromosome number**: Aneuploidy and its types, Euploidy and its types. Polyploidy in plants: Auto and allopolyploids- natural and artificial with examples, significance of polyploidy.	

Unit 3:	15hrs
Chromosomal Aberrations: Types and cytological consequences of Deletion, Duplication, Inversion and translocation. **Structure of Gene**: Cistron, recon and muton concept. Prokaryotic and eukaryotic genes. Genetic code and its properties **Gene mutations**, Types of mutations- Spontaneous, Induced; Molecular basis of Mutations (base substitutions and frameshift mutations); Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Role of Transposons in mutation. **Population and Evolutionary Genetics:** Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, genetic drift.	
Unit 4:	**15hrs**
Plant Breeding: Introduction and objectives, Scope Important achievements and undesirable consequences of plant breeding. **Methods of crop improvement:** Introduction, Acclimatization; Selection methods: Mass line, Pure line, Clonal. **Vegetative Propagation in plants**: Layering and Grafting **Male sterility**-Types, production and significance in plant breeding. **Hybridization**: Methods, Types, Advantages and Limitations. Role of mutations in Plant breeding, Role of biotechnology in crop improvement- Transgenic plants.	

Course Title	**Genetics and Plant Breeding (Practical)**	Practical Credits	**02**
Course Code	**DSC – BOT – C12 - P**	Contact Hours	**56 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content (4hrs each session)

1. Vegetative reproduction methods- Cutting, Layering
2. Grafting and its methods.
3. Hybridization: Emasculation, bagging, pollination and production of hybrids
4. Estimation of percentage of Pollen viability/Pollen fertility.
5. Mendel's laws through seed ratios (monohybrid, dihybrid, test cross and back cross)
6. Laboratory exercises in probability and chi-square.
7. Chromosome mapping using point test cross data.
8. Genetic problems: Incomplete dominance and Polygenic inheritance.
9. Genetic problems: Gene interactions (9:7, 9:3:4)
10. Genetic problems: Gene interactions (12:3:1, 15:1)
11. Determination of linkage and cross-over analysis (through two/three point test cross data)
12. Study of aneuploidy: Trisomy in Datura using photographs.
13. Chromosomal aberrations: Translocation Ring, Laggards and Inversion Bridge using photographs.
14. Visit to nursery/Plant breeding stations/KVKs.

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Test	20
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

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**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

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

Part-A

1. Question number 1-12 carries 2 marks each. Answer any 12 questions: 20 marks

Part-B

2. Question number 13-20 carries 10 Marks each. Answer any 04 questions: 40 marks

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

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 pollen viability/fertility of the given sample **A** 6 Marks
2. Solve the given genetic problems **B and C** 8 Marks
3. Identification of Specimen/slides/Photographs **C, D** and **E** 6 Marks
4. Submission (Journal / Record) 5 Marks

Total 25 marks

General instructions:

Q1 Material Cassia/Vinca/Ipomia/Hibiscus (A)Q2
Genetic problems (B & C)

Q3. Layering/Grafting/Emasculation/bagging –C; Trisomy in Datura, linkage and cross-over, Translocation Ring, Laggards and InversionBridge (D and E)

Q4. Submission (Journal/ Record)

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

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1	Acquaah, G. (2007). Principles of Plant Genetics &Breeding.NewJearsey, 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.
11	Fundamentals of Genetics – 6th edition 2022- B.D. Singh
12	Fundamentals of Genetics & Molecular Biology – Dr. Vishnu Shankar Sinha.

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	**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. Understand of Cell metabolism, chemical composition, physiochemical and functional organization of organelle

CO2. Learn the contemporary approaches in modern cell and molecular biology.

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

CO4. Gain knowledge on the activities in which the diverse macro molecules and microscopicstructures inhabiting the cellular world of life are engaged.

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

Contents	**60Hrs**
Unit 1:	**15hrs**
Cell as a unit of structure and function, Characteristics of prokaryotic and eukaryotic cells, Cell wall - distribution, chemical composition, functions, and variations in prokaryotic and eukaryotic cells (primary and secondary wall), Glycocalyx, Cell-cell interactions/Junctions. Cell membrane-Structure and functions, active and passive transport, protonpumps associated (Na-K, Ca-calmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis. Structure, function and biogenesis of mitochondria and chloroplast, An account of transport in mitochondria and chloroplasts (Tim/Tom; Tic/Toc) and semiautonomous nature of mitochondria and chloroplast. Brief account on different types of plastids.	

Unit 2:	**15hrs**
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; Ribosomes, peroxisomes, Lysosomes and Vacuoles. Nuclear envelope, structure of nuclear pore complex, nuclear lamina, transport across nuclear membrane, Nucleolus, Ergastic substances.	
Unit 3:	**15hrs**
Chromosomes: Size and number of chromosomes, Gross and ultra structure, types of chromosomes based on the position of centromere, Heterohromatin, euchromatin, paranemic and plectonemic coils, autosomes and allosomes, karyotype and idiogram, properties and functions of chromosomes. Brief account of supernumerary chromosomes in plants. Phases of eukaryotic cell cycle, Process of mitosis and meiosis; significance, Regulation of cell cycle- checkpoints, role of protein kinases. Concept of Programmed Cell Death. Signal Transduction: Receptors and primary and secondary signal transduction, pathway.	
Unit 4:	**15hrs**
DNA as the carrier of genetic information – Griffith experiment, Avery, McCarty and MacLeod experiment, Hershey - Chase experiment DNA: Chemical composition, types - A, B and Z DNA, structure-Watson & Crick model, Semiconservative replication. RNA: Structure and functions of mRNA, tRNA and rRNA. Gene Expression: Transcription and Translation in prokaryotes, process of Gene splicing. Regulation of gene expression in prokaryotes- Lac operon model. Gene regulation in eukaryotes- transcriptional and post-transcriptional.	

Course Title	**Cell Biology (Practical)**	Practical Credits	**02**
Course Code	**DSC-BOT - C14-P**	Contact Hours	**56 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content (4hrs each session)

1. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo
2. Study of cell and its organelles with the help of electron micrographs/Photographs
3. Measurement of length and breadth of plant cell using micrometry (Using Onion or Rheo leaf cells).
4. To demonstrate the effect of heat on permeability of cell membrane of beet root cells.
5. Study of different concentrations of alcohol on cell membrane permeability
6. Study of ergastic substances - starch (potato), aleurone (wheat grain), calcium oxalate (Pistia), calcium carbonate (Ficus leaf) and oil globules (castor seed).
7. Study of mitosis by squash technique using Onion root tip cells
8. Study of meiosis using Rheo / Onion flower buds
9. Observation of permanent slides of mitosis and meiosis
10. Study of mitotic index from suitable plant material
11. Estimation of total chlorophyll in leaves
12. Demonstration of DNA isolation from plant cells
13. Study of Karyotype using chart.
14. Techniques of preparation of permanent and semi-permanent cytological slides

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Test	20
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

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**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

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

Part-A

1. Question number 01-12 carries 2 marks each. Answer any 10 questions: 20 marks.

Part-B

2. Question number 13-20 carries 10 Marks each. Answer any 04 questions: 40 marks. (Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4)

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

1. Prepare a squash of onion root tip, Identify and explain any one stage with a labelled diagram. 06 marks
2. Find out the cell length and breadth of a given material using Micrometry/Estimation the total amount of chlorophyll (B) 06 marks
3. Identify the slides/ cell organelles C, D, E & F 08 marks
4. Submission (Journal/ Record) 05 marks

Total 25 marks

General instructions:

Q1. Give specimen from Onion root tip (A)
Q2. Give pecimen sample (B)
Q3. Give one slide each from mitosis, meiosis, ergastic substances(C), (D) and (E), one photograph of a cell organelle (F)
Q4. Submission (Journal/ Record)

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 fransisco.
5	Reven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H.Freeman and Company
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8	Verma, P. S. (2004). Cell Biology, Genetics, Molecular Biology: Evoloution and Ecology. India: S. Chand Limited.

9	Molecular biology of the cell by Albert Bruce 6th edition. 2014

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. Ascertain the Importance of water and the mechanism of transport.
CO2. Explain the biosynthesis and breakdown of biomolecules.
CO3. Interpret the role of plant hormones in plant development and about secondary metabolites.
CO4. Perceive the basic functions and metabolism in a plant body.
CO5. Understand the importance of nutrients in plant metabolism and crop yield.

Contents	**60 Hrs**
UNIT 1	**15 Hrs**
Plant water relations: Mechanism of water absorption, Factors affecting water absorption. **Mechanism of ascent of sap:** Vital and physical force theories. **Transpiration.** Types and process. Mechanism of guard cell movement. K+ ion exchange mechanism. Antitranspirants. Guttation. **Translocation of organic solutes:** Transport of organic solutes. path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis. **Mineral nutrition:** Essential elements: Classification - Macro and Micronutrients. Functions and deficiency symptoms of macro elements- N, P, K and Mg. Functions and deficiency symptoms of Micronutrients-Zn, Mn and B. Hydroponics and its applications. Mechanism of mineral salt absorption: Passive absorption – diffusion, ion exchange. Active absorption- Cytochrome pump theory, Protein Lecithin theory .	
UNIT 2	**15 Hrs**
Enzymes - classification, kinetics and mechanism of action. **Bioenergetics:** Definition, examples for major bioenergetic processes. **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, TCA cycle; Oxidative phosphorylation, Glyoxylate cycle, Oxidative Pentose Phosphate Pathway. Anaerobic respiration – alcoholic and lactic acid fermentation. ATP yield during aerobic and anaerobic respirations. Respiratory quotient.	
UNIT 3	**15 Hrs**

Plant growth regulators: Definition and classification, Role of Auxins, Gibberlins, cytokinins, ABA and ethylene on plant growth and development. Practical utility in agriculture and horticulture, Synthetic growth regulators. **Sensory Photobiology**: Biological clocks, photoperiodism, function & structure of phytochromes, phototropins & cryptochromes. **Plant movements**: Nastic movements – nyctinasty, chemo nasty and seismonasty. Tropic movements –phototropic, hydrotropic, geotropic and thigmotropic. **Dormancy in plants:** Definition and types. Bud dormancy - induction and breaking. Seed dormancy – causes and methods of breaking.	
UNIT 4	**15 Hrs**
Carbohydrate metabolism – Classification of Carbohydrates. Structure of ribose and deoxyribose sugars, glucose, fructose, sucrose, starch and cellulose, Metabolism of sucrose and starch, **Nitrogen metabolism** - Sources of nitrogen, physical and biological nitrogen fixation and mechanism of biological nitrogen fixation- asymboitic and symbiotic, formation of root nodules in Leguminous plants, Nitrate reduction and amino acid synthesis. **Fat metabolism** - General account of fats, synthesis of glycerol, synthesis of fatty acids, and condensation of fatty acid and glycerol, fat degradation, β (Beta) -oxidation, glyoxylate cycle and its significance, plant waxes **Secondary plant products**: structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.	

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

Major Experiments:

1. To determine the osmotic pressure of the cell sap by plasmolytic method.
2. To demonstrate root pressure / transpiration pull in plants.
3. To demonstrate that oxygen is liberated in the process of photosynthesis.
4. Separation of photosynthetic pigments by paper chromatography and measure their Rf values.
5. To isolate and identify the amino acids from a mixture using paper chromatography.
6. Determination of RQ of germinating seeds using Ganong's Respirometer.
7. Qualitative test for Starch, Protein, Reducing Sugars, and Lipids.
8. Estimation of carbohydrates
9. Estimation of proteins
10. Estimation of TAN(Titratable acid Number) from Bryophllum leaves/Aloe Vera ..

Minor experiments:

11. Experiment to demonstrate the phenomenon of exosmosis and endosmosis by potato osmoscope and thistle funnel experiment.
12. Study of Phototropism, hydrotropism and geotropism
13. a) Demonstration of fermentation using Kuhn's fermentation vessel
    b) Measurement of linear growth of a plant using arc auxanometer
14. To compare the rate of transpiration from the two surfaces of leaf by cobalt chloride paper method

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Test	20
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

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**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

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

Part-A

1. Question number 01-12 carries 2 marks each. Answer any 10 questions: 20 marks.

Part-B

2. Question number 13-20 carries 10 Marks each. Answer any 04 questions: 40 marks. (Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4)

Total: 60 Marks

Note: Proportionate weight-age 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. Estimation of proteins/ carbohydrates/TAN 05 marks
5. Practical Record 05 marks

REFERENCES

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3. Kumar and Purohit. Plant Physiology: Fundementals and Applications.Agrobotanical Publishers.
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12. Plant physiology and development by Taiz March 2018, 6th edition
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