

ಡಾ. ಮನಮೋಹನ್ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

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No.MSBCU/BoS/Syllabus/Science/ 107 /2026-27

Date: 29.06.2026

NOTIFICATION

Sub: Syllabus for the V & VI Semester Under Graduate Courses in the Faculty of Science -reg

- Ref: 1. Government Order No. ED 166 UNE 2023 Bengaluru dated. 08.05.2024
2. Recommendations of the Boards of Studies in the Faculty of Science
3. Approval of the Academic Council in its meeting held on 08.06.2026
4. Orders of Vice-Chancellor dated.29.06.2026

The Syllabus prepared by the Boards of Studies for the different Subjects of V & VI semester Under Graduate Courses, in the faculty of Science based on the Guidelines and Curriculum Structure issued by the Government under ref(1) have been approved by Academic Council meeting held on 08.06.2026.

Accordingly, the CBCS Syllabus for the V & VI Semester UG Courses of Science Faculty in respect of following subjects are hereby notified for implementation from the academic year 2026-27.

Sl. No.	Subjects
1.	Botany– V & VI Semester
2.	Chemistry– V & VI Semester
3.	Zoology and Genetics– V & VI Semester
4.	BoS in Fashion and Apparel Design i. FAD – V & VI Semester ii. IDD– V & VI Semester
5.	Geography– V & VI Semester
6.	Mathematics– V & VI Semester
7.	Physics – V & VI
8.	BoS in Home Science i) Home Science – V & VI ii)Nutrition & Dietetics – V & VI iii)Clinical Nutrition & Dietetics – V & VI iv)Food Technology – I & II Sem

p.t.o

9.	Criminology and Forensic Science– V & VI
10.	Psychology– V & VI Semester
11.	Electronics – V & VI
12.	Statistics – V & VI
13.	Microbiology– V & VI
14.	Biotechnology– V & VI
15.	Environmental Science– V & VI

The detailed Syllabi for above subjects are notified in the University Website:
www.bcu.ac.in for information of the concerned.


REGISTRAR

Copy to;

1. The Registrar(Evaluation), Dr. Manmohan Singh Bengaluru City University
2. The Dean, Faculty of Science, MSBCU.
3. The Principals of the concerned affiliated Colleges of MSBCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
[As per SEP]

Syllabus for B.Sc.
Botany

2026-27 onwards

**Proceedings of the Meeting of the Board of Studies in Botany (UG), Dr. Manmohan Singh Bengaluru City University (BCU) held on 18. 04. 2026 at 11.30 AM at BCU, Bengaluru
Ref: No. BCU/BOS/SEP/05/2026-27 Dated 06.04.2026**

Minutes of the Meeting: The chairman welcomed the members and placed the agenda for discussion and approval.

AGENDA

- 1) **Preparation of syllabus for B.Sc., Botany (UG) programme (V and VI Semesters) of BCU, Bengaluru: Approved** (The Botany (UG) board has thoroughly discussed the newly synthesized syllabus for B.Sc., Botany (V and VI Semesters) programme of Dr Manmohan Singh Bengaluru City University, Bengaluru for its introduction from the current academic year (2026-27). The board has unanimously approved the syllabus for B.Sc., Botany programme for its introduction for V and VI semester as under).

V Sem	DSCB* -1.5	Theory	Plant Morphology, Plant Taxonomy & Economic Botany	4 Hrs.	3 Credits	80+20
		Practical	Plant Morphology, Plant Taxonomy & Economic Botany	4 Hrs.	2 Credits	40+10
	DSEB -1.4	Elective	Botany & Entrepreneurship	4 Hrs.	3 Credits	40+10
	DCB-1.2	Compulsory Practical	Bioanalytical Techniques	4 Hrs	2 Credits	40+10
VI Sem	DSCB* -1.6	Theory	Biochemistry & Plant Physiology	4 Hrs.	3 Credits	80+20
		Practical	Biochemistry & Plant Physiology	4 Hrs.	2 Credits	40+10
	DSEB - 1.5	Elective	Plant Breeding & Biotechnology	4 Hrs.	3 Credits	40+10
	DCB-1.3	Compulsory Practical	Seed Quality Testing	4 Hrs.	2 Credits	40+10

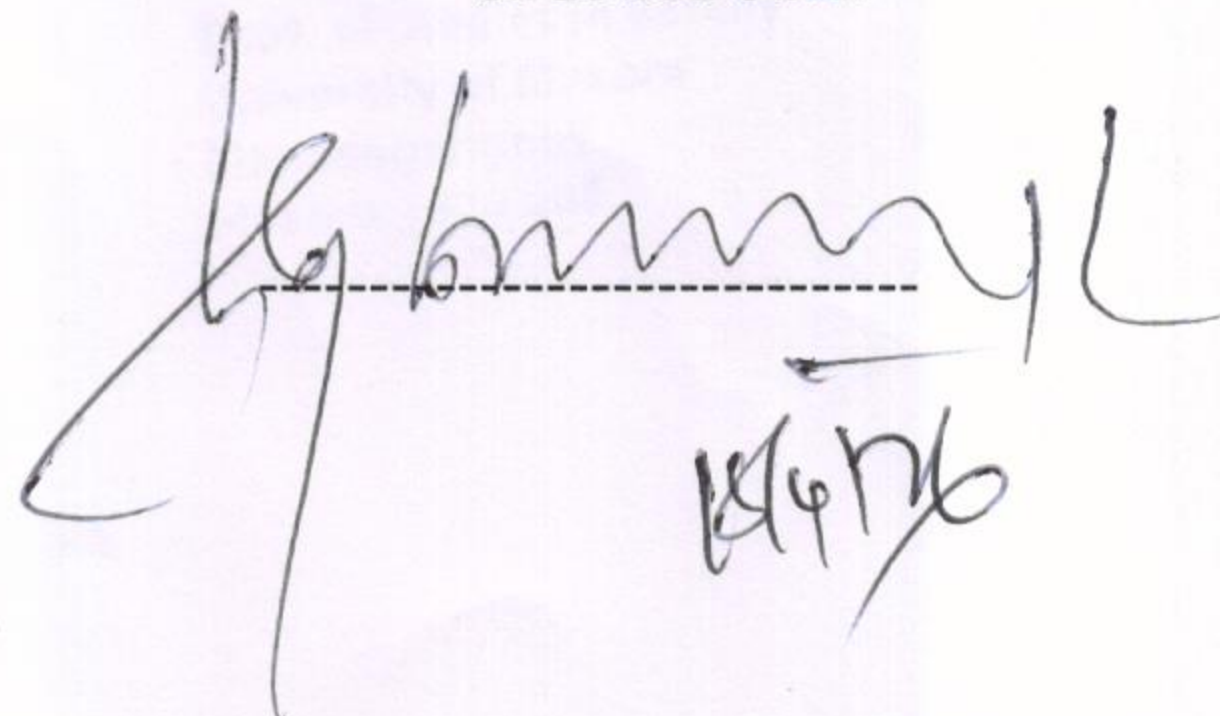
- 1) The board has also unanimously approved the panel of examiners for the academic year 2026-27.
- 2) The board also recommended to constitute the Board of Examiners (BOE) for the academic year 2026-27.

Finally, the chairman thanked the members of the board for their co-operation.

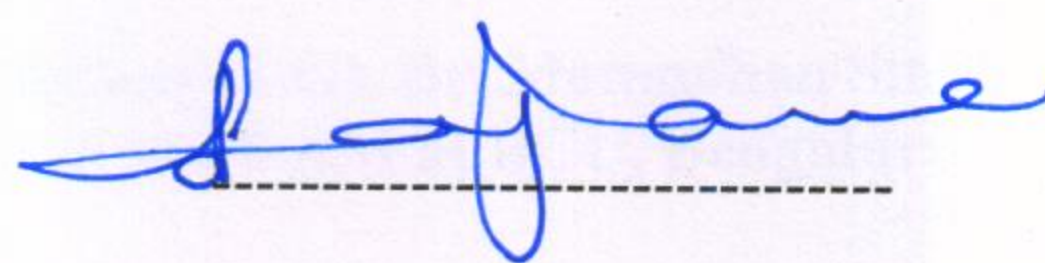
MEMBERS PRESENT

- 1) **Prof. G. R. Janardhana (Chairman)**
Dept. of Studies in Botany
University of Mysore, Mysore, Mysore-06

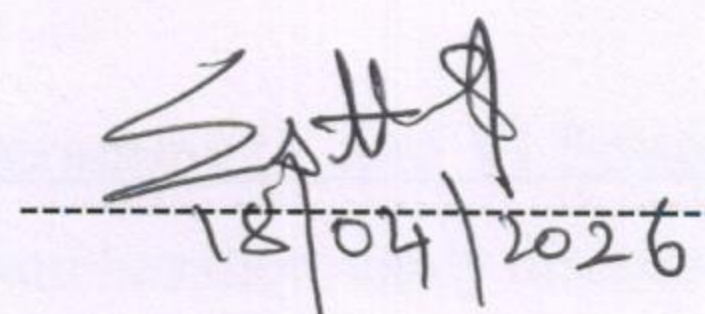
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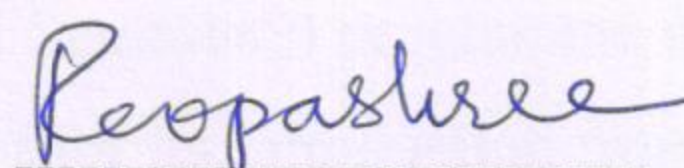


- 2) **Prof. L. Rajanna (Member)**
Senior Professor, Dept. of Botany
Bangalore University, Bangalore-56
- 3) **Mrs. Shobharani (Member)**
Associate Professor, Govt. First Grade College
Yelahanka, Bengaluru-64
- 4) **Mrs. Esther Watson (Member)**
Dept. of Botany, Bishop Cotton College for Women
Bengaluru-27
- 5) **Mrs. Roopashree (Member)**
Dept. of Botany, KLEs Nijalingappa College
Bengaluru-10.
- 6) **Dr. P.B. Mallikarjuna (Member)**
Professor, Govt. First Grade College,
Yelahanka, Bengaluru-64.
- 7) **Dr. C. Suresh Kumar (Member)**
Professor, Dept. of Botany,
Maharanis Cluster University, Bengaluru-01.
- 8) **Dr. C. R. Rekha (Member)**
Professor, Dept. of Botany, Govt. Science College,
Nrupathunga University, Bengaluru-01.
- 9) **Dr. Thoyajaksha (Member)**
Professor, Dept. of Botany
Maharan's Science College, Mysore-05.
- 10) **Dr. N.S. Suresha (Member)**
Dept of Botany,
Govt. Science College, Hassan.

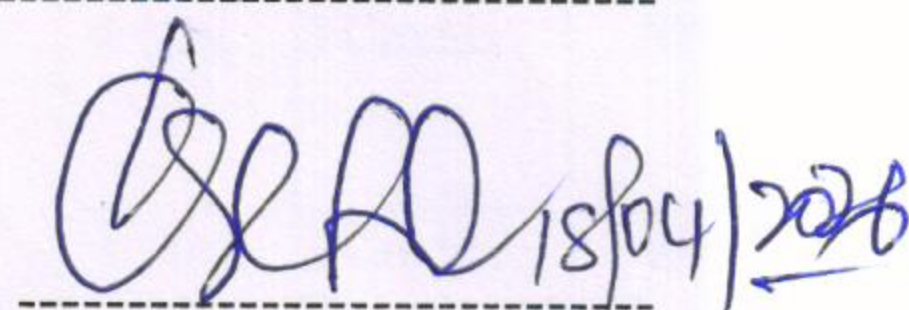


ABSENT


18/04/2026

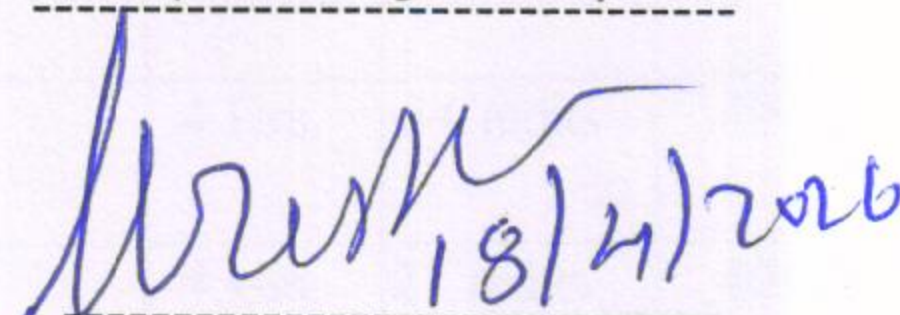


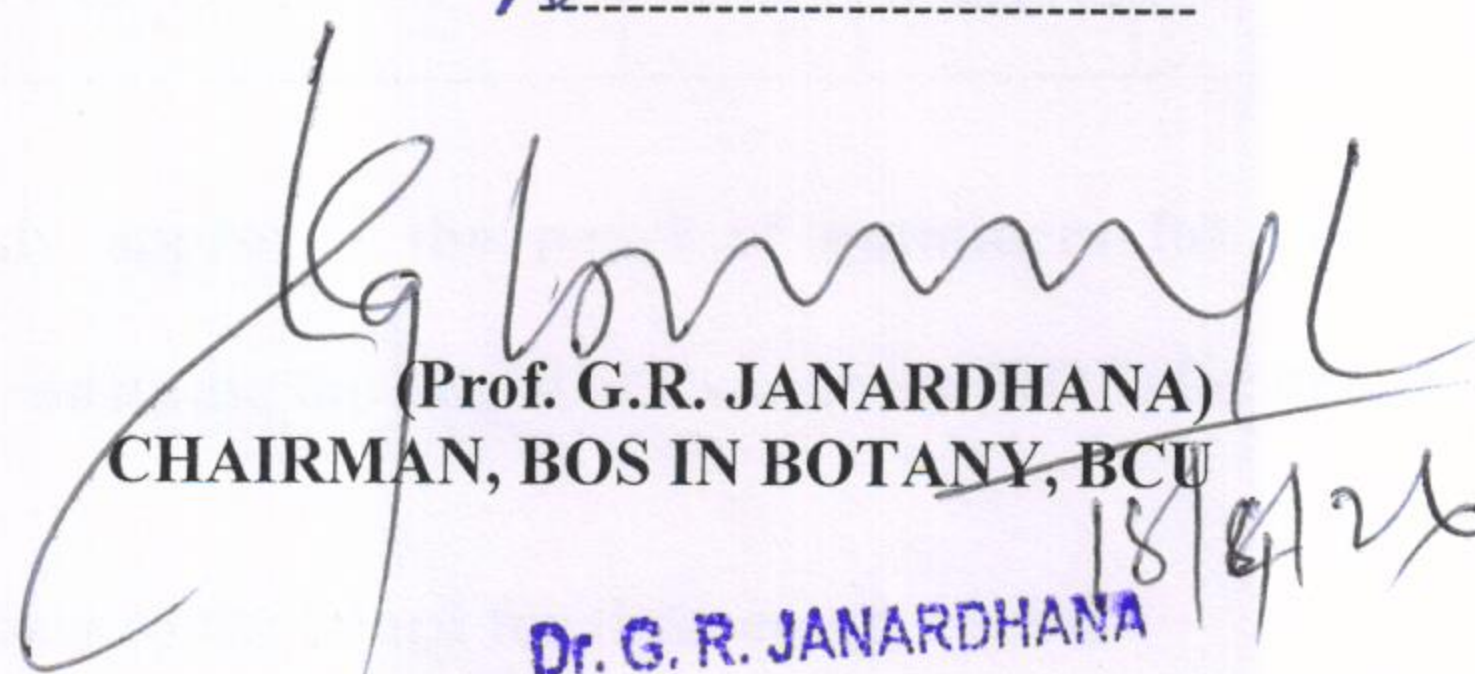
ABSENT


18/04/2026


18/4/26

ABSENT


18/4/2026


18/4/26

(Prof. G.R. JANARDHANA)
CHAIRMAN, BOS IN BOTANY, BCU

Dr. G. R. JANARDHANA
Professor
Dept. of Studies in Botany
University of Mysore
Manasagangothri
Mysore - 570 008

Syllabus for B.Sc., Botany (UG) (2026-27)

Sem	Course Code	Practical/ Theory	TITLE OF THE COURSES	Hrs./ Week L:T:P	Credits	Max Marks
I	DSCB* -1.1	Theory	Microbial Diversity, Mycology and Phycology	4 Hrs.	3	80+20
		Practical	Microbial Diversity, Mycology and Phycology	4 Hrs.	2	40+10
II	DSCB* -1.2	Theory	Bryophytes, Pteridophytes, Paleobotany and Plant Anatomy	4 Hrs.	3	80+20
		Practical	Bryophytes, Pteridophytes, Paleobotany and Plant Anatomy	4 Hrs.	2	40+10
III	DSCB -1.3	Theory	Gymnosperms And Embryology of Angiosperms	4 Hrs.	3	80+20
		Practical	Gymnosperms And Embryology of Angiosperms	4 Hrs.	2	40+10
	DSEB** -1.1	Elective	Mushroom Cultivation Technology	4 Hrs.	3	40+10
	DSEB-1.2	Elective	Plant Propagation	4 Hrs.	3	40+10
IV	DSCB* -1.4	Theory	Cytology Genetics and Molecular Biology	4 Hrs.	3	80+20
		Practical	Cytology, Genetics and Molecular Biology	4 Hrs.	2	40+10
	DCB***-1.1	Compulsory Practical	Nursery, Gardening & Landscaping	4 Hrs.	2	40+10
	DSEB - 1.3	Elective	Medicinal Plants	4 Hrs.	3	40+10
V	DSCB - 1.5	Theory	Plant Morphology, Plant Taxonomy and Economic Botany	4 Hrs.	3	80+20
		Practical	Plant Morphology, Plant Taxonomy & Economic Botany	4 Hrs.	2	40+10
	DSEB - 1.4	Theory	Botany and Entrepreneurship	4 Hrs.	3	40+10
	DCB**-1.2	Compulsory Practical	Bioanalytical Techniques	4 Hrs.	2	40+10
VI	DSCB - 1.6	Theory	Biochemistry & Plant Physiology	4 Hrs.	3	80+20
		Practical	Biochemistry & Plant Physiology	4 Hrs.	2	40+10
	DSEB - 1.5	Theory	Plant Breeding & Biotechnology	4 Hrs.	3	40+10
	DCB - 1.3	Compulsory Practical	Seed Quality Testing	4 Hrs.	2	40+10

DSCB* Discipline Core Course Botany; **DSEB**** Discipline Elective Botany;
DCB*** Discipline Compulsory Course Botany; EC-Open Elective Course.

V SEMESTER
DSCB-1.5: PLANT MORPHOLOGY, PLANT TAXONOMY &
ECONOMIC BOTANY

PROGRAMME	B.Sc., BOTANY	SEMESTER	V
Course Title	Plant Morphology, Plant Taxonomy and Economic Botany		
Course Code		No. of Credits	03
Contact Hours	60 Hours	Duration of Exam	03 Hours
Formative Assessment	20 Marks	Summative Assessment	80 Marks

Course Objectives: The course provides an overview of plant morphology in understanding plants phenotypic characters and its role in plant identification nomenclature and classification. It also provides rules and principles of plant classification. The course also includes economic importance of plants in our day-to-day life and their commercial applications.

Course Outcome: After the successful completion of the course, the student will be able to: Identify, classify and describe a plant in scientific terms, based on dichotomous keys. Also, he would be able to use the rules of ICN for botanical nomenclature. He would identify the locally available angiosperm plants and economically important plants for sustainable utility. Also appreciates the economic importance of plants.

UNIT I	Plant Morphology: Study of root, stem, leaf and their modifications. Types of inflorescence and fruits. Structure of flower, floral diagram and formula. Plant Taxonomy: History, aim and scope of plant classification. Systems of classification: Artificial, Natural and Phylogenetic. Salient features of Linnaeus, Bentham & Hooker, Engler & Prantl and APG IV (2016) systems- merits and demerits. Taxonomic literatures: Floras, Monographs and Journals. Herbarium and Botanical Gardens: Herbarium techniques, Important herbaria in India and world. A brief account of Digital herbaria (FRLHT, JC Herbarium). Botanical gardens and its importance - Lalbagh, Acharya Jagdish Chandra Bose and Kew Botanical Garden.	15 Hrs.
UNIT II	Plant Taxonomy: Taxonomic Evidences: Anatomy, Palynology, Embryology, Chromosomes and Chemotaxonomy. Taxonomic Hierarchy: Concept of taxa (family, genus, species), taxonomic categories, Species concepts (biological, morphological, evolutionary). Botanical Nomenclature: Principles and rules (ICN); Latest code –brief account, Principles, Type method, Publication of names - Effective and valid. Rejection of names, Author citation, Principle of priority and its limitations, Nomenclature of hybrid/cultivated species. Dichotomous keys- indented (yolked) and bracketed keys.	15 Hrs

UNIT III	Plant Identification: Study of the diagnostic features of following families with plants of economic Importance: Dicotyledoneae Families: Archichlamydeae- Magnoliaceae, Annonaceae, Brassicaceae, Rutaceae, Fabaceae, Rosaceae & Euphorbiaceae. Metachlamydeae - Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Acanthaceae & Lamiaceae. Monocotyledoneae Families: Arecaceae, Musaceae, Orchidaceae, Commelinaceae and Poaceae (Based on Engler and Prantl's System of classification).	15 Hrs
UNIT IV	Economic Botany: Cereals: Millets and Pulses: Jowar, Ragi, Wheat, Rice; Pulses: Red Gram, Black gram and Bengal gram. Oils and Fat yielding plants: Groundnut, Coconut and Sunflower. Beverages: Tea and Coffee; Textile Fibre yielding crops: Cotton and Coir; Spices: Cardamom, Clove, and Cinnamon; Timber yielding plants: Teak and Rosewood; Narcotic: Tobacco, Opium and Cannabis. Medicinal plants: <i>Rauwolfia serpentina</i> , <i>Catharanthus roseus</i> , <i>Tylophora asthmatica</i> , <i>Cinchona officinalis</i> , <i>Withania somnifera</i> , <i>Tinospora cordifolia</i> , <i>Ocimum tenuifolium</i> , <i>Phyllanthus emblica</i> , <i>Hemidesmus indicus</i> , <i>Marsdenia sylvestre</i> , <i>Allium sativum</i> , <i>Aloe vera</i> , <i>Curcuma longa</i> and <i>Zingiber officinale</i> .	15 Hrs

**QUESTION PAPER PATTERN FOR THEORY EXAMINATION
DSCB-1.5: PLANT MORPHOLOGY, PLANT TAXONOMY &
ECONOMIC BOTANY**

Credits: 03

80 Marks

Marks for each question	No. of Questions		Total Marks
	To be answered	Out of	
Part A. 2 Marks Very short answers	10	12	20
Part B. 5 Marks Short notes	6	8	30
Part C. 10 Marks Essay types	3	5	30
TOTAL			80 Marks

Theory Formative Assessment (Internal Assessment)	Marks
Attendance	05 Marks
Assignment	05 Marks
Tests	10 Marks
TOTAL	20 Marks

SEMESTER V
DSCB 1.5: PLANT MORPHOLOGY, PLANT TAXONOMY & ECONOMIC BOTANY (PRACTICAL)

Program Name	B.Sc. in BOTANY	Semester	V
Course Title	Plant Morphology, Plant Taxonomy & Economic Botany (Practical)	Practical Credits	2
Course Code		Contact Hours/week	4
Formative Assessment	10 Marks	Summative Assessment	40 Marks
Practical Content/ Experiments			
1. Study of root, stem and leaf modifications. 2. Study of inflorescence and fruits. 3. Study of flower, floral diagrams and floral formula. 4. Study of families according to Engler and Prantl System (6 Practical) 5. Economic Botany (2 Practical) 6. Field visit: Local or outside area/ Botanical Garden/ tribal settlements (1-3 days). 7. Submissions: Herbarium sheets (5) and economic Botany products (5). 8. Economic Botany: Food plants: Rice, Wheat, Maize, Ragi Fibre plants: Cotton, Jute, Coir Plant Spices: Cardamom, Clove, Cinnamon, Pepper Oil yielding plants: Ground nut, Coconut, Safflower, Sunflower Beverages: Coffee and Tea Sweeteners: Steviosides, Glycyrrhizin, Rebaudioside Natural colourants: Henna, Indigo, Madder, Saffron, Turmeric Flavours: Mint, Oregano, Basil, Parsely, Rosemary Perfumes: Lavender, Jasmine, Rose, Sandal, Lemon grass Insecticides: Neem, Pyrethrin, Nicotine 9. Vist to Botanical Gardens, National Herbarium, Arboretum and Biological Museums.			

SCHEME OF EXAMINATION FOR PRACTICAL
DSCB 1.5 PLANT MORPHOLOGY, PLANT TAXONOMY &
ECONOMIC BOTANY (PRACTICAL)

Time: 3 Hrs

Marks:40

Q. No.	Question Paper Pattern	Allotted Marks
1	Identify the given plant to family level A & B (5+5)	10 Marks
2	Describe the given specimen C and write the floral formula and floral diagram D (2x4)	08 Marks
3	Identify by giving reasons E, F, G, H, I and J (6x2)	12 Marks
4	Botanical Tour Report / Viva-Voce	05 Marks
5	Class Record	05 Marks
	TOTAL MARKS	40 Marks

Formative Assessment	Marks
Attendance	05 Marks
Submissions (Herbarium)	05 Marks
TOTAL MARKS	10 Marks

Suggested Readings:

- 1) Johri, B. M. 1984. The embryology of Angiosperms. Springer Verlag.
- 2) Johri, B. M. 1982. The experimental embryology of vascular plants. Springer Verlag NY.
- 3) Swamy, B.G.L. & Krishnamurthy, K. V. 1982. From flower to fruit: The embryology of angiosperms. Tata McGraw Hill Co.
- 4) Eames 1961. Morphology of Angiosperms. McGraw Hill book Co., Inc., NY.
- 5) Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill book Co., Inc., NY
- 6) Maheshwari, P. 1963. Recent advances in the embryology of angiosperms. Edited by the International Society of Plant Morphologists, New Delhi
- 7) Bhojwani, S. S. & Bhatnagar, S. P. 1978. The embryology of Angiosperms. Vikas Publishing, House, New Delhi.
- 9) Sinnot, E. W. 1960. Plant Morphogenesis. Mc Graw- Hill Book Co. Inc. New York, USA.
- 11) Lyndon, R. F. 1990. Plant Development: The Cellular basis. Unwin Hyman, London.

V SEMESTER
DSEB 1.3: BOTANY AND ENTERPREUERSHIP

PROGRAMME	B.Sc., BOTANY	SEMESTER	V
Course Title	Botany and Entrepreneurship		
Course Code		Number of Credits	03
Contact Hours	60	Duration of Exam	3 Hrs
Formative Assessment Mark	20	Summative Assessment Marks	80

Learning Objectives: The course is aimed to teach students on various entrepreneurship opportunities in Botany such as Horticulture, Forestry, Ayurveda, Food Processing Industry, Seed Industry, Food Packaging, Cottage Industry, and Biological Supplies Industry, Plant Nursery and Gardening, Landscaping and Gardening, Cottage Industry.

Course Outcome: After the completion of the course the students would be provided with all the necessary skills to facilitate them to start their own plant-based business entrepreneurships, start-ups and small-scale industries in self-sustainable manner. The course would provide them the powerful tool to start thinking on small business models for their self-growth and economic independence.

UNIT I	Entrepreneurship in Botany: Entrepreneurship relevance to Botany- Agriculture, Horticulture, Forestry, Ayurveda, Food Processing Industry, Seed Industry, Food Packaging, Cottage Industry, Biological Supplies, Plant Nursery and Gardening, Landscaping and Gardening; Entrepreneurial ecosystem in India-incubation centres, start-up policies, Funding Opportunities-Case studies of successful plant-based enterprises (herbal products, floriculture, Mushroom Cultivation, Tissue Culture Plants, Biofertilizers, Biopesticides, Botanical Pesticides; Essential Skills for Entrepreneurs-Creativity, Innovation, Risk Management and Leadership.	15 Hrs
UNIT II	Floriculture- Flowers and Decorations, Ikebana, Flower pressing and card making, Preservation of plant specimens, Preparation of Decorative Botanical Materials, Bouquet making and floral design; Types of bouquets: round bouquet, hand-tied bouquet, cascading bouquet. Selection of flowers and foliage, handling and preservation of cut flowers. Gardening: Types of gardens: ornamental gardens, kitchen garden, terrace garden, wall garden and balcony gardens. Plants in Gardens, Plant propagation techniques: seed, cutting, layering and grafting. Nursery and Gardening- Establishment and management. Soil preparation and composting methods. Concept of Urban Gardening; vertical and horizontal gardening. Plant selection for space-efficient cultivation.	15Hrs
UNIT III	Hydroponics- Types of hydroponic systems, nutrient solutions and advantages; Terrariums- Types, selection of plants, substrate layers and moisture balance;	15 Hrs

	Aquarium and Aquascaping- Aquatic plants-types, nutrient requirements, lighting and maintenance of planted aquariums. Bonsai - Concept, importance, Principles of design (balance, proportion, harmony, aesthetics), types and styles (formal upright, informal upright, slanting, cascade, semi-cascade), selection of indoor and outdoor species, propagation methods, containers and pot selection, soil mixture and drainage, training and maintenance, seasonal care, environmental requirements, management. Herbal oils and cosmetics: Preparation of herbal oils and plant extracts, natural dyes, herbal cosmetic preparations, essential oil extraction techniques, herbal health care products. Natural Dyes-Types and preparation of natural dyes and applications.	
UNIT IV	Policy and Global Perspectives: National and international policies supporting plant-based entrepreneurship (NSDC, NABARD, DBT, ICAR). WTO, FAO, CTRIPS, UPOV, and their relevance to plant entrepreneurs. Plant variety protection-Conservation of local varieties of plants; geographical indications. Organic farming ventures. Preparing students for start-up incubation, funding proposals, and entrepreneurship competitions. Community entrepreneurship models (Plant Zone/Plant zone shops, Seed villages, Wild/local Seed banks.	15 Hrs

**QUESTION PAPER FOR THEORY EXAMINATION
DSEB-1.3: BOTANY AND ENTERPREUERSHIP**

Hours: 3Hrs

80 Marks

Marks for each question	No. of questions to be		Total Marks
	Answered	Out of	
Part – A (10x2 Marks)	10	12	20
Part -B (6x5 Marks)	6	8	30
Part -C (3x 10 Marks)	3	5	30
TOTAL			80 Marks

Sl. No.	Theory Formative Assessment (Internal Assessment)	Allotted Marks
1	Attendance	05 Marks
2	Assignment	05 Marks
2	Test	10 Marks
3	TOTAL MARKS	20 Marks

Suggested References:

- 1) Elsevier. (2021). *Plant biotechnology and entrepreneurship*. Elsevier Academic Press.
- 2) Springer. (2020). *Entrepreneurship in biotechnology and agriculture*. Springer Nature.
- 3) Balick, M. J., & Cox, P. A. (2020). *Plants, people, and culture: Science of Ethnobotany*. CRC Press.
- 4) Mukherjee, P. K. (2019). *Quality control and evaluation of herbal drugs*. Elsevier.
- 5) ICAR. (2019). *Agri-business management*. Indian Council of Agricultural Research.
- 6) Hartmann, H.T. – Plant Propagation: Principles and Practices
- 7) Kyte, L. – Plants from Test Tubes: An Introduction to Micropropagation
- 8) Singh, R.L. – Principles of Sustainable Agriculture.

V SEMESTER
DCB- 1.2: BIOANALYTICAL TECHNIQUES (COMPULSORY PRACTICAL)

PROGRAMME	B.Sc., BOTANY	SEMESTER	V
Course Title	Bioanalytical Techniques		
Course Code		Number of Credits	02
Contact Hours	32 Hrs	Duration of Exam	02 Hrs
Formative Assessment Mark	10	Summative Assessment Marks	40
Learning Objectives: The course is aimed to teach students the practical aspects of seed quality testing to assess the improved seeds for planting purpose. All practical follow ISTA guidelines for seed quality testing for certification purpose. Course Outcome: After the completion of the course, the learners will be able to understand the importance of quality seed testing for certification purposes. The students will be able to test the submitted samples for quality assessment in any seed testing laboratories of public as well as private seed testing laboratories.			
Practical Content/Experiments			
1. Calibration/standardization of bio-analytical instruments used for bioanalytical analysis. 2. Principles and applications of imaging techniques including photomicrography. 3. Preparation of buffers, normal, molar and per cent solutions. 4. Understanding the working principles of spectrophotometry. 5. Understanding the working principles of centrifugation. 6. Separation of fatty acids/lipids by TLC/HPTLC/HPLC. 7. Separation of proteins by PAGE/SDS- PAGE. 8. Agarose gel electrophoresis of DNA/RNA (2DPAGE) 9. Understanding the principles of flow cytometry. 10. Separation of identification of compounds by Gas Chromatography 11. Agar gel diffusion, counter immuno -electrophoresis. 12. Verification of Beer Lambert law with the U.V. spectrophotometer. 13. Demonstration of blotting techniques used in Molecular Biology. 14. Performing PCR for amplification of ITS regions of fungi. 15. Understanding nucleic acid sequencing. 16. Visit to central instrumentation laboratory			

SCHEME OF PRACTICAL EXAMINATION

DCB-1.2: BIOANALYTICAL TECHNIQUES (COMPULSORY PRACTICAL)**Time -03 Hrs****40 Marks**

Q. No.	Question Paper Pattern	Allotted Marks
1	Perform the experiment A	10 Marks
2	Perform the experiment B and C (2x5)	10 Marks
3	Identify by giving reasons C, D, E, F and G (5x2)	10 Marks
4	Viva-Voce	05 Marks
5	Class Record	05 Marks
	TOTAL MARKS	40 Marks

Sl. No.	Formative Assessment (Internal Assessment)	Allotted Marks
1	Attendance	05 Marks
3	Test	05 Marks
4	TOTAL MARKS	10 Marks

Suggested Readings:

- 1) Braithwaite, A. and Smith, F.J. (1996). Chromatographic Methods. 5thedn. Blackie Academic & Professional London.
- 2) Budzikiewicz, H., Djerassi, C. and Williams, D.H. (1968). Mass Spectrometry of Organic Compounds. Holden-Day, San Francisco, CA.
- 3) Harborne, J.B. (1984). Phytochemical Methods. 2nd edn. Chapman and Hall, London.
- 4) Harborne J.B. (1973) Phytochemical methods a guide to modern techniques of plants analysis. Chapman and Hall, London.

SEMESTER-VI
DSCB: 1.6 -BIOCHEMISTRY & PLANT PHYSIOLOGY

Programme	B.Sc., BOTANY	Semester	VI
Course Title	Biochemistry and Plant Physiology		
Course Code		Number of Credits	3
Contact Hours	60	Duration of Exam	3 Hours
Formative Assessment Mark	20	Summative Assessment Marks	80
Course Objectives: Students will understand the basic aspects of biochemistry in relation to plants including products of secondary metabolism. Plant-soil relationships. Mechanism of ascent of Sap, mineral nutrition, plant metabolism including fundamental aspects of photosynthesis and respiration. Students will also understand the importance of plant growth regulators, sensory photobiology, plants movements including stress physiology. Course Outcome: After the completion of the course the students would be able to explain the principles of biochemistry in relation to plants, water relations in plants, plant metabolism, plant growth regulators, photo physiology, plant movements and stress physiology.			
UNIT I	Biochemistry: Carbohydrate metabolism: Cellulose and Starch – structure and function. Enzymes- (Meaning; a brief account of structure and properties) classification (IUB), kinetics (A brief account such as Michelis- Menten) and mechanism of action (Lock- Key and Induced –Fit Theories). Proteins: classification, structure - primary, secondary, tertiary and quaternary; Amino acids - a brief account (types, structure, properties and role). Vitamins - classification, distribution, and function. (Both water and fat soluble). Lipids: classification, structure and function of fatty acids. Secondary plant products: distribution of terpenes, phenolics and nitrogen containing compounds (Alkaloids) and their role in plants (phytoalexins).		15 Hrs
UNIT II	Plant Water Relations: Importance of Water as a solvent; Diffusion, osmosis, imbibition, osmotic potential, turgor pressure, wall pressure, water potential and its components. Mechanism of water absorption, Factors affecting water absorption. Transpiration: Stomatal apparatus and mechanism of stomatal movement (turgid and flaccid states; Starch –Sugar hypothesis, Na-K ion pump theory,). Anti- transpirants. Guttation. Mechanism of Ascent of Sap: Vital and physical force theories. Phloem Transport: Transport of organic solutes. Path of transport, vein loading and unloading. Trans cellular hypothesis and mass flow hypothesis. Mineral nutrition: Micro and macro nutrients; mode of absorption, deficiency symptoms. A brief account of Hydroponics and Aeroponics.		15 Hrs
UNIT III	Plant Metabolism-Photosynthesis: Introduction, Photosynthetic Pigments (Chl a & b, xanthophyll, carotenes – structure and role); Photosystem I and II – (Reaction centers, antenna molecules); Mechanism of Photosynthesis: (The Light Phase): ETS and ATP synthesis, Chemiosmotic coupling hypothesis (Cyclic & Non-cyclic photophosphorylation and photolysis of water); (The Dark phase): C3, C4 and CAM pathways of carbon fixation; Photorespiration		15 Hrs

	(definition and mechanism). Factors affecting photosynthesis- Blackmans law of limiting factors. Respiration: Introduction, Glycolysis, TCA cycle; Oxidative phosphorylation, anaerobic respiration (a general account in plants) Factors affecting respiration. Nitrogen metabolism: (Definition and types) Biological nitrogen fixation (types, biochemistry, mechanism, <i>nif</i> genes in <i>Rhizobium</i>); Nitrate and ammonia assimilation.	
UNIT IV	Plant Growth & Development: Plant growth regulators - Hormones-site of synthesis, and influence on plant growth development of individual group of hormones- Auxins, Gibberellins, Cytokinin, ABA, & ethylene. Synthetic growth regulators - classification, their effect on plant growth and development. Practical utility in agriculture and horticulture. Sensory Photobiology: Biological clocks, Photoperiodism, Structure and functions of phytochrome, phototropin & cryptochrome. & Vernalization. Plant Movements – tropisms and Dormancy (seed & bud)- Factors and methods of breaking dormancy. Senescence and Programmed Cell Death. Stress Physiology: Abiotic stress, salt and water stress.	15 Hrs

**QUESTION PAPER PATTERN FOR EXAMINATION
DSCB: 1.6 -BIOCHEMISTRY & PLANT PHYSIOLOGY**

Credits: 03

80 Marks

Marks for each question	No. of Questions		Total Marks
	To be answered	Out of	
Part A. 2 Marks short answers	10	12	20
Part B. 5 Marks short notes	6	8	30
Part C. 10 Marks essay types	3	5	30
TOTAL			80 Marks

Theory Formative Assessment	
Assessment	Marks
Attendance	05
Assignment	05
Tests	10
Total	20 Marks

SEMESTER-VI

DSCB-1.6: BIOCHEMISTRY AND PLANT PHYSIOLOGY (PRACTICAL)

Course Title	Biochemistry and Plant Physiology	Practical Credits	2 Credits
Course Code		Contact Hours	60 Hours
Formative Assessment	10 Marks	Summative Assessment	40 Marks
Learning Objectives: Students would be able to learn and appreciate the skills acquired during sessions and use them in real time experimentation in project/research work			
Practical Content / Experiments			
1. Conduct experiment to demonstrate the phenomenon of exosmosis and endosmosis. 2. Determine the osmotic pressure of the cell sap by plasmolytic method. 3. Demonstrate transpiration pull in plants. 4. Estimation of ascorbic acid in the given sample. 5. Demonstrate that oxygen is liberated in the process of photosynthesis. 6. Separation of photosynthetic pigments by paper chromatography and measure their R_f values. 7. Determination of rate of photosynthesis at different wavelength of light and different concentrations of CO₂. 8. Separate and identify the amino acids from a mixture using paper chromatography. 9. Study of Phototropism. 10. Determination of Seed Viability by tetrazolium chloride method. 11. Qualitative tests for Starch, Protein, Reducing Sugars and Lipids. 12. Estimation of TAN (Titrable Acid Number) from <i>Bryophyllum</i> leaves /<i>Aloe vera</i>. 13. Bioassays on plant hormones – Auxins-, Adventitious root formation test, Gibberellins- breakage of dormancy test with seeds, Cytokinin- Chlorophyll Retention Test (Leaf Disc Test). 14. Determination of Succinate Dehydrogenase (SDH) Activity Using Germinating seeds. 15. Visit to Crop Physiology Labs in Agricultural Universities/ Research Laboratory.			

SCHEME FOR PRACTICAL EXAMINATION

DSCB-1.6: BIOCHEMISTRY AND PLANT PHYSIOLOGY (PRACTICAL)

Hours: 03 Hrs
Marks: 40

Q. No.	Question Paper Pattern	Allotted Marks
1	Perform the major experiment A	12 Marks
2	Perform the minor experiments B and C (2x4)	08 Marks
3	Identify by giving reasons D, E, F, G and H (5x2)	10 Marks
4	Viva-Voce	05 Marks
5	Class Record	05 Marks
	TOTAL MARKS	40 Marks

Formative Assessment	
Assessment	Marks
Attendance	5 Marks
Test	5 Marks
TOTAL	10 Marks

Suggested Readings

- 1) Conn, EE, Stumpf, PK, Bruening, G and Doi, RH (2006), Outlines of Biochemistry, 5th edn, Wiley Publishers
- 2) Wilson, K. and Walker, J. (1994): Fundamentals of Biochemistry, 2nd edn. John Wiley and Sons Inc.
- 3) Jain V K, (2008). Fundamentals of Plant Physiology. S Chand and Co. New Delhi
- 4) Kochhar P L, Krishnamoorthy H N. Plant Physiology. Atmaram and Sons, Delhi.
- 5) Mukherji S, Ghosh AK, (2005). Plant Physiology. New Central Book Agency, Calcutta.
- 6) Salisbury F B, Ross C W, (1992). Plant Physiology. CBS publishers and Distributors, New Delhi.
- 7) Sinha A K, (2004). Modern Plant Physiology. Narosa publishing House, New Delhi.
- 8) Srivastava H S, (2004). Plant Physiology and Biochemistry. Rasthogi publications.
- 9) Verma V, (2007). Text Book of Plant Physiology. Anne Books Pvt. Ltd
- 10) Hopkins WG & Huner NPA, (2009). Introduction to Plant Physiology, 4th Edition, John Wiley
- 11) Taiz L, Zeiger E, Max Moller I & Murphy A (2018) Fundamentals of Plant Physiology, Sinauer Associates
- 12) Hans Walter-Heldt et al. (2011). Plant Biochemistry, Academic Press.
- 13) Audus, L. J. (1972). Plant Growth Substances. Leonard Hill, London.

SEMESTER-VI
DSEB-1.5: PLANT BREEDING AND BIOTECHNOLOGY

Programme	B. Sc.	Semester	VI
Subject	B.Sc., BOTANY		
Course Title	Plant Breeding and Biotechnology		
Course Code		No. of Credits	03
Contact Hours	60 Hours	Duration of examination	03Hrs
Formative assessment Marks	20	Summative Assessment Marks	80

Course Objectives: To understand the principles and scope of plant breeding, different breeding systems and modes of reproduction in crop plants, major achievements and limitations, centres of origin and domestication of crop plants and their significance in plant, various methods of crop improvement, including acclimatization, selection, selection methods used in self-pollinated, cross-pollinated, and vegetatively propagated plants. The course helps to understand the fundamentals of plant tissue culture, including media composition, totipotency, organogenesis, and embryogenesis, advanced tissue culture techniques such as protoplast culture, tools and techniques of recombinant DNA technology, including restriction and applications of biotechnology in agriculture and industry.

Course Outcome: After the completion of the course the students would be able to explain the principles and importance of plant breeding in agriculture, different methods including molecular methods used in crop improvement. The students able to explain the importance of plant tissue culture and its applications in micropropagation of plants. Also, able to understand the development of biotechnology, principles and applications of Biotechnology.

UNIT I	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: Centres of origin and domestication of crop plants, Plant genetic resources; Acclimatization; Selection methods: For self-pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants. Inbreeding depression and heterosis. History, genetic basis of inbreeding depression and heterosis; Applications. Quantitative inheritance; Concept, mechanism, examples of inheritance of Kernel colour in wheat, Monogenic vs polygenic Inheritance.	15 Hrs
UNIT II	Biotechnology: Introduction, Development of Biotechnology, Branches of Biotechnology. Scope and applications of Biotechnology. Plant Biotechnology and its applications. Plant Tissue Culture: Historical perspective; Tissue culture media; (MS), Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation- Germplasm Conservation.	15Hrs

UNIT III	Genetic Engineering: History and current status of G. engineering, Restriction Endonucleases- Recognition sites and applications, Vectors: Prokaryotic, Lambda phage and eukaryotic vectors, Principles of Gene Cloning (Chimeric DNA construction, Bacterial Transformation, Selection of recombinant clones. DNA libraries- construction of genomic and cDNA libraries. Gene transfer- through <i>Agrobacterium</i> . Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics-selectable marker and reporter genes (Luciferase, GUS, GFP). Examples for transgenic plants.	15 Hrs
UNIT IV	Applications of Biotechnology: Agriculture -Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations). Health - edible vaccines; growth regulators, Industrial production of enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Plant Products (High-starch potatoes, Modified oils (omega-3 fatty acids), Biofuel Crops– <i>Jatropha Curcas</i> , <i>Pongamia</i>). Environment: Role of transgenics in bioremediation (Superbug). Biosafety concerns in biotechnology- impact on agriculture, environment and human health.	15 Hrs

QUESTION PAPER FOR THEORY EXAMINATION
DSEB-1.5: PLANT BREEDING AND BIOTECHNOLOGY

Hours: 3Hrs

80 Marks

Marks for each question	No. of questions to be		Total Marks
	Answered	Out of	
PART - A (2 Marks)	10	12	20 Marks
PART - B (5 Marks)	6	8	30 Marks
PART - C (10 Marks)	3	5	30 Marks
TOTAL MARKS			80 Marks

Theory Formative Assessment	Marks
Attendance	05 Marks
Assignment	05 Marks
Test	10 Marks
TOTAL MARKS	20 Marks

Suggested Readings:

- 1) Bhojwani, S.S. and Razdan, M.K., (1996). *Plant Tissue Culture: Theory and Practice*. Elsevier Science Amsterdam. The Netherlands.
- 2) Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. ASM Press, Washington.
- 3) Stewart, C.N. Jr. (2008). *Plant Biotechnology & Genetics: Principles, Techniques and Applications*. John Wiley & Sons Inc. U.S.A.
- 4) Primrose S B and R.M. Twyman. 2006 (7th Edition) *Principles of Gene Manipulation and Genomics*.
- 5) Acquaah, G. (2012). *Principles of plant genetics and breeding* (2nd ed.). Wiley Blackwell.
- 6) Chahal, G. S., & Gosal, S. S. (2002). *Principles and procedures of plant breeding*. Alpha Science International Ltd.
- 7) Chaudhari, H. K. (1984). *Elementary principles of plant breeding* (2nd ed.). Oxford-IBH.
- 8) Chopra, V. L. (2001). *Plant breeding: Theory and practice*. New India Publishing Agency.
- 9) Malik, C. P., & Wani, S. H. (2021). *New plant breeding techniques*. Pointer Publishers.
- 10) Paroda, R. S., & Joshi, A. (1995). *Plant genetic resources: Conservation and management*. Springer.
- 11) Sadhu, M. K. (1996). *Plant propagation*. New Age International Publishers.
- 12) Sharma, J. R. (1994). *Principles and practice of plant breeding*. Tata McGraw-Hill Publishers.
- 13) Shukla, R. S., & Chandel, P. S. (2004). *Cytogenetics, evolution and plant breeding*. S. Chand & Company Pvt. Ltd.
- 14) Singh, B. D. (2019). *Plant breeding: Principles and methods* (11th ed.). Kalyani Publishers.
- 15) Adrian Slater, Nigel W. Scott, Mark R. Fowler, (2008). *Plant Biotechnology: The Genetic Manipulation of Plants*, 2nd edn. Oxford University Press, Oxford.

VI SEMESTER
DCB- 1.3: SEED QUALITY TESTING (COMPULSORY PRACTICAL)

PROGRAMME	B.Sc., BOTANY	SEMESTER	VI
Course Title	Seed Quality Testing		
Course Code		Number of Credits	02
Contact Hours	32	Duration of Exam	02 Hrs
Formative Assessment Mark	10	Summative Assessment Marks	40
Learning Objectives: The course is aimed to teach students the practical aspects of seed quality testing to assess the improved seeds for planting purpose. All practical follow ISTA guidelines for seed quality testing for certification purpose. Course Outcome: After the completion of the course, the learners will be able to understand the importance of quality seed testing for certification purposes. The students will be able to test the submitted samples for quality assessment in any seed testing laboratories of public as well as private seed testing laboratories.			
Practical Content/Experiments			
1. Seed testing laboratory, design, planning equipment required for seed testing 2. Physical purity analysis of given seed samples. 3. Determination seed density of given seed samples. 4. Determination of moisture content (hot air oven method) of the given seed samples. 5. Determination of seed germination for planting purpose. 6. Determination of Vigour Index of the given seed samples. 7. Seed vigour analysis by brick-gravel method. 8. Determination of seed viability by Tetrazolium (TZ) test. 9. Seed health testing by SBM and agar plating method. 10. Identification of common seed-borne fungi and reporting. 11. Accelerated Ageing Test to know the suitability of seeds for sowing purpose. 12. Determination of electrical conductivity of the seed samples. 13. Seed certification tags and their importance. 14. Visit to seed testing laboratory/Seed Production companies.			

SCHEME OF PRACTICAL EXAMINATION
DCB- 1.3: SEED QUALITY TESTING (COMPULSORY PRACTICAL)

Time -03 Hrs

40 Marks

Q. No.	Question Paper Pattern	Marks
1	Perform the experiment A	10 Marks
2	Perform the experiment B and C (2x5)	10 Marks
3	Identify by giving reasons D, E, F, G and H (5x2)	10 Marks
4	Viva-Voce	05 Marks
5	Class Record	05 Marks
	TOTAL MARKS	40 Marks

Formative Assessment (Internal Assessment)	Marks
Attendance	05 Marks
Seed industry visit report	05 Marks
TOTAL	10 Marks

Suggested Readings

- 1) International Seed Testing Association. 2023. International Rules for Seed Testing, International Seed Testing Association, Bassersdorf, Switzerland.
- 2) Copeland, L.O. & McDonald, M.B. 2012. Principles of Seed Science and Technology (4th/5th Ed.) Springer Science & Business Media, New York.
- 3) Agrawal, R.L. 1998. Seed Technology (2nd Ed.) Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- 4) AOSA 2009. Association of Official Seed Analysts) – Seed Vigor Testing Handbook Contribution No. 32, AOSA, USA.
- 5) Food and Agriculture Organization. 1985. Guide to Forest Seed Handling. FAO Forestry Paper No. 20, FO, Rome, Italy.

Sd/-
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