Punyashlok Ahilyadevi Holkar Solapur University, Solapur



Name of the Faculty: Science & Technology

As per NEP 2020

Syllabus: Botany

Name of the Course: B. Sc. II (Semester III & IV) (Syllabus to be implemented from June 2025)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur Faculty of Science and Technology

B. Sc. II NEP Syllabus Structure for Botany Subject w.e.f. June 2025

Level / Difficulty	Sem.	Faculty		Generic/ Open Elective GE/OE	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS,	Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major	Minor	~~~~					
5.0/200		DSC1-3 (2+1) Plant Anatomy	DSC2-3 (2+1) Economic Botany	GE 3/OE3 (2) Terrace gardening	(DSC 1) Plant anatomy and Plant Metabolism	L2-1 (2)	CC2 (2)		
		DSC1-4 (2+1) Plant Metabolism	DSC2-4 (2+1) Introduction to Plant Protection		VSC2 (2) (DSC 2) Economic Botany & Introduction to plant protection			22	
	IV	DSC1-5 (2+1) Plant Physiology DSC1-6 (2+1) Embryology of Angiosperms	DSC2-5 (2+1) Basic Genetics DSC2-6 (2+1) Food Adulteration	GE4/ OE4 (2) Analytical Techniques in Plant Sciences	VSC3 (2) (DSC1) Plant Physiology and Embryology of Angiosperm VSC4 (2) (DSC2) Basic Genetics & Food adulteration	L2-2 (2)	FP1 / CEP 1 (2)	22	44

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Syllabus for B. Sc. Part-II (Botany)

(Semester-III and IV)

To be implemented from June-2025

Introduction- This is one of the basic subjects of life sciences which provides basic knowledge related to the plants

1) Objectives of the course:

i) To promote the students to the various disciplines of Botany.

ii) To assist the students to understand the Plant anatomy, Plant Physiology, Plant Embryology,

Plant Metabolism, Economic Botany, Plant Protection, Genetics and Food Adulteration.

iii) To enhance the practical knowledge of the students of the subject.

iv) To create research attitudes among the students.

v) To create the awareness about the contribution of Botany to the society.

vi) To impart the knowledge of Botany to student facing the competitive exams.

2) Advantages of the Course:

i) Students after passing B. Sc. with Botany as a principal subject will become eligible for M.Sc. in Botany, Biotechnology, Bioinformatics, Genetics, Forestry, Agrochemicals and Pest management etc.

ii) They can appear for Competitive Examinations like MPSC, UPSC, and Indian forest service's etc. after B. Sc.

iii) They can get jobs in different industries viz. Hybrid seeds industries, Bio-fertilizer industries and Research Institutes etc. B. Sc. III

iv) To update the knowledge of Life science.

v) Students can play important role in environment Protection and biodiversity conservation.

3) Eligibility:

B Sc Part-I pass/ATKT with Botany Subject. (One of the optionals)

4) Duration:

The entire B.Sc. course is of three years (integrated) duration but the B Sc. Part-II is of one year duration with Semester III and IV. When student exit after completion of second year, he get diploma certificate from University.

5) Medium of Instruction: English.

6) Examination pattern:

The students have to appear for theory and practical examination based on DSC -1as major and DSC -2 as minor. Student should complete one GE (Theory) and two VSC (practical) during Semester III and IV. The Details are given on next page.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur B. Sc. II Botany Syllabus Structure (NEP 2020) w.e.f. 2025-26

Sr.	Paper Code	Course/Title	Nature	Credit	M	arks
NO		Somostor III				
		Semester III			CA	UA
1.	DSC -1 (3)	Major: Plant Anatomy	Theory	2	20	30
2	DSC -1 (4)	Major: Plant Metabolism	Theory	2	20	30
3	DSC 1 (3&4)	Major: Practical's	Practical	1+1	20	30
4	DSC -2 (3)	Minor: Economic Botany	Theory	2	20	30
5	DSC -2 (4)	Minor: Introduction to Plant	Theory	2	20	30
6	DSC 2 (2 p 4)	Minor Proticel's	Drastical	1 + 1	20	20
7	$DSC 2 (3\alpha 4)$	CE: Terração Cardon	Theory	1+1	20	30
/	UE(3)	GE: Terrace Garden	Dreatical	2	20	30
8	VSC I	Plant anatomy and Plant	Practical	Z	20	30
9	VSC 2	Economic Botany & Introduction to plant protection	Practical	2	20	30
10	L2-1	English	Theory	2	20	30
11	CC-2			2	20	30
		Semester III: Total credits wi	th marks	22	220	330
	Total Marks					550
	Semester IV					
1	DSC -1 (5)	Major: Plant Physiology	Theory	2	20	30
2	DSC -1 (6)	Major: Embryology of Angiosperms	Theory	2	20	30
3	DSC-1 (5&6)	Major: Practical's	Practical	1+1	20	30
4	DSC -2 (4)	Minor: Basic Genetics	Theory	2	20	30
5	DSC -2 (5)	Minor: Food Adulteration	Theory	2	20	30
6	DSC-2 (5&6)	Minor: Practical's	Practical	1+1	20	30
7	GE (4)	GE : Analytical Techniques in plant Science	Theory	2	20	30
8	VSC 3	Plant Physiology and Embryology of Angiosperm	Practical	2	20	30
9	VSC 4	Basic Genetics & Food adulteration	Practical	2	20	30
10	L2-1	English	Theory	2	20	30
11	FP	Field Projects	Projects	2	20	30
		Semester IV: Total credits wi	th marks	22	220	330
		Semester III: Total credits wi	th marks	22	220	330
		Total Credits		44	440	660
			Tota	l Marks		1100

7) Assessment of Student:

Continuous Internal Evaluation: Internal evaluation is a continuous evaluation in all types of courses- theory/ practical / Project / Field study. The teacher has flexibility in deciding the components and their weightage in accordance with the University Regulations. Internal evaluation should be very transparent to the students and the components and relative weightage should be announced at the beginning of each learning activity by the concerned teacher.

For theory: Home Assignment / Unit test / Seminar: 20 marks

For Practical: Regular Attendance + Journal Completion + Practical Examination: 20 marks Internal evaluation should be published in the notice board, one week before the closure of each semester.

University Assessment: As per Structure given by University for each paper: 30 Marks

8) Project Evaluation: Internal evaluation of the project in semester IV should start with the beginning of the semester IV and finalize one month before practical examination. 20 marks allotted in internal evaluation.

For the external evaluation the components and weightage of Project/Field Study/ Viva Voce can be discussed and determined finally by the Board of Examiners; the suggested components and their weightage is given below. The project viva should be based on the Project and importance should be given to the Scientific method undertaken in that project.

Sr. No.	Components	Marks
1	Report With All General Parts - Relevance, Objective,	15
	Methodology, Data Analysis, Discussion, Conclusion and	
	Reference etc.	
2	Presentation Skill	05
3	Viva	10

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Botanical Excursion and Practical's

Botanical Excursion: One teacher along with a batch of 20 students be taken for Botanical Excursion to places of Botanical interest. If there are one or more female students in a batch of twenty students, one additional lady teacher is permissible for excursion. T.A. and D.A. for teacher and non-teaching staff participating in excursions should be paid as per university rules. Tour report duly certified by concerned teacher and Head of the Department. Student should submit certified tour report at the time of practical examination.

Practical Course: B.Sc. Part- II Botany practical course is to be covered DSC and VSC to be performed by the students. Each practical is to be supplemented by permanent slides, preserved/fresh specimens, materials, charts, physiological instruments wherever necessary.

Details of Practical Examination:

A) Every candidate must produce a certificate from Head of Department of his / her college, saying that he / she has completed practical course in satisfactory manner as per terms laid down by Academic council on the recommendations of Board of Studies in Botany. The student should record his / her observation and report of each experiment in the journal. The journal is to be signed periodically by teacher in charge and certified by the Head of Department at the end of year. Candidates must produce their certified journal and tour report at the time of practical examination. Candidate is not allowed to appear for the practical examination without a certified journal / loss certificate from Head of Botany Department regarding the same.

B) Practical Examination should be of five hours duration and shall evaluate a candidate in the following respect.

- 1. Practical should be covering all practical's as per syllabus.
- 2. Making temporary stained preparations and identification.
- 3. Identification and setting of physiological and metabolic experiments.
- 4. Spotting of the specimens as per syllabus.
- 5. Journal, Excursion report, field report or horticulture term paper etc.

Objectives & outcomes of course syllabus of B.Sc. II, NEP 2020 Pattern Semester III

Botany–DSC-1- 3: Major: Plant Anatomy

To get knowledge about meristematic cells, their role & classification • To get knowledge about theories of structural organization in plant ٠ To get knowledge about simple & complex tissue • To get knowledge about Types of Vascular bundles & types of tissue system • To get knowledge about primary structure of root & stem • To get knowledge about secondary structure of root & stem ٠ To get knowledge about anomalous secondary structure of root & stem • To get knowledge about types of wood & its organization **Course Outcome:** The students can understand cell structure of Meristem, role & classification. • The students can understand about structural organization in plants • The students can understand structure, types & functions of simple & complex tissue The students can understand organization of vascular bundle, types of tissue system & • their role

- Students will understand the anatomical features of root & stem
- Students will understand the difference in primary & secondary anatomical features of root & stem
- Students will understand the anomalous secondary structure of stem & their functions
- Students will understand types of wood & its structural organization

Botany–DSC-1-4 Major: Plant Metabolism

Course objective:

Course Objective:

- To get knowledge about different macro & micronutrients & its role for plant growth & development
- To get knowledge about types, classification & mechanism of enzyme action
- To get knowledge about plant growth regulators their discovery, physiological roles
- To get knowledge about importance of nitrogen in plant growth, nitrogen cycle & its types
- To get knowledge about carbohydrate metabolism

Course Outcome:

- Students will get knowledge about different macro & micronutrients & its role or plant growth & development
- Students will understand different enzymes & their mechanism
- Students will get knowledge about types of growth regulators their biosynthesis & physiological roles for plant development
- Students get knowledge about importance of nitrogen, types of nitrogen fixation
- Students get knowledge about types of carbohydrates, its classification & examples

Botany (DSC 2-3) Minor: Economic Botany

Course objective:

1. To learn relationship between plants & humans

2. To learn about evolution, morphology, production & cultivation of plants

3. To learn about economic importance of cereals, legumes, spices, dyes, oil & fiber yielding plants

4. To learn about fundamentals of plant growth

5. To learn about process & products involved in plant cultivation.

Course Outcome:

1. Students will able to get knowledge about plant importance in human life

2. Students will able to understand evolution, techniques of production & cultivation of plants.

3. Students will able to understand economic importance of cereals, legumes, spices, dyes, oil & fiber yielding plants

4. Students will able to understand factors required for plant growth

5. Students will get knowledge about process & products involved in plant cultivation

Botany (DSC 2-4) Minor: Introduction to Plant Protection

Course Objective:

1. To get the knowledge of significance of plant protection, gross morphology,

- 2. To get the knowledge about advanced methods of agricultural practices.
- 3. To get the knowledge of general methods of plant protection
- 4. To get the knowledge about methods of management insect pests.
- 5. To get the knowledge about crop identification, fertilizers, irrigation, intercropping methods

Course Outcome:

- 1. Students will able to understand pest & crop interactions
- 2. Students will apply their knowledge to manage pest in agriculture practices
- 3. Students will understand different methods of plant protection
- 4. Students will get knowledge about importance of fertilizers & intercropping methods

Botany: GE 03 Terrace gardening

Objectives:

- 1. To create awareness about terrace gardening.
- 2. To learn the process of composting of domestic degradable waste.
- 3. To know how to plant and grow from seeds or transplants.
- 4. To obtain safe, pesticide-free, healthy green and fresh fruits or vegetables via terrace gardening.

Outcomes:

- 1. To apply terrace gardening as an alternative method for burning of organic waste
- 2. To gain knowledge in the popular methods used in terrace gardening.
- 3. To understand the benefits of growing our own food.

SEMESTER – IV

Botany –DSC-1-5 Plant Physiology

Objective:

- 1 To get knowledge about plant responses to the light Photoperiodism
- 2 To get knowledge about vernalization
- 3 To get knowledge about plant transportation
- 4 To get knowledge about photosynthesis
- 5 To get knowledge about Respiration
- 6 To get knowledge about photorespiration

Outcome:

- 1 Students will get knowledge about Enzymes involved in Photoperiodism & its role in plant development
- 2 Students will get knowledge about enzymes involved, process & importance of vernalization
- 3 Students will get knowledge about translocation, types of transport, source & sink relationship
- 4 Students will get knowledge about light, dark reaction, enzymes involved & its role in plant development
- 5 Students will get knowledge about process of respiration in plants, enzymes involved & their roles
- 6 Students will get knowledge about Mechanism of photorespiration & its significance

Botany –DSC-1-6 Embryology of Angiosperms

Objective:

- 1 To get knowledge about different terms in plant embryology, structure of flower & types
- 2 To study different developmental stages of anther, stigma, types of ovules
- 3 To get knowledge about process & mechanism of pollination & fertilization
- 4 To get knowledge about embryo & endosperm development
- 5 To study Structure & development of dicot & monocot embryo
- 6 To study types of embryos
- 7 To get knowledge about seed & fruit dispersal

Outcome:

- 1 Students will get knowledge about different terms in plant embryology, structure of flower & types
- 2 Students will get knowledge about microsporogenesis, megasporogenesis, development of male, female gamete
- 3 Students will get knowledge about types of pollination, process of fertilization
- 4 Students will get knowledge about stages of endosperm development
- 5 Students will get knowledge about development process of monocot & dicot embryo
- 6 Students will get knowledge about types of embryos in angiosperms
- 7 Students will get knowledge about mechanism of fruit, seed dispersal, agencies & conditions required for seed & fruit dispersal by different agencies

Botany (DSC 2-5) Minor: Basic Genetics

Objective:

- 1 To get the knowledge about the basic genetics and Mendel's Laws
- 2 To get the knowledge about the crosses and gene interaction.
- 3 To get the knowledge about the gene linkage
- 4 To understand the Crossing over mechanism
- 5 To understand the cytological basis of crossing over
- 6 To get the knowledge about introduction of genomes.
- 7 To know about the chloroplast inheritance in plants
- 8 To know about the Mitochondrial inheritance in Yeast and plants.
- **9** To get the knowledge about allele and genotypes
- 10 To get the knowledge about population genetics

Outcome:

- 1. Students will able to apply the knowledge about Basic genetics
- 2. Students willable to understand different types of crosses and gene and its interaction
- 3. Students will understand the basics of gene linkage and different types of gene linkages
- 4. Students will gain the knowledge about concept of crossing over, its mechanism and its significance
- 5. Students will know the cytological basis of crossing over in plants (Maize)
- 6. Students will able to apply the knowledge about chloroplast genome and mitochondrial genome
- 7. Students will able to apply the knowledge about inheritance in chloroplast in *Mirabilis jalapa* and *Zea mays*
- 8. Students will able to apply the knowledge about inheritance in mitochondria in Yeast and Male sterility in plants
- 9. Students will able to apply the knowledge about allele and genotype frequencies, factors affecting them.
- 10. Students will able to apply the knowledge about Hardy Weinberg law, role of natural selection, mutation, genetic drift

Botany (DSC 2-6) Minor: Food Adulteration

Objective:

- 1. To develop basic understanding of food adulteration
- 2. To create awareness about food adulteration practices
- 3. To protect public from poisons & harmful products
- 4. To introduce students to food safety and standardization acts
- 5. To make students skilled in food adulteration testing and analytical instrumentation

Course Outcome:

1. Students will understand the adulteration of common foods and their adverse impact on health

2. Students will be able to get basic skills of detecting adulteration in common foods.

3. Students will extend their knowledge of detecting other kinds of adulteration.

- 4. Students will aware about laws of food adulteration
- 5. Students will able to understand role of several agencies in food adulteration

Botany GE - 04 Analytical Techniques in Plant Sciences

Objectives:

- 1. To develop knowledge about different techniques of microscopy
- 2. To encourage students about understand techniques under plant sciences.
- 3. To get knowledge about gene isolation & purification methods

Outcomes:

- 1. Students will get knowledge about different techniques principles & handling of different instruments.
- 2. Students will get knowledge about different techniques for isolation & purification of genes

Semester III Botany -DSC1-3 (Major) Plant Anatomy (30 Lectures) (Credit 2+1)

Unit 1:	Tissue & Tissue Systems	15 L
	1.1. Meristematic Tissue: Introduction, Characteristics and	(5L)
	Classification of meristems based on position origin function and plain	8 M
	of division, Theories of structural development: Apical cell theory,	
	Histogen theory and Tunica Corpus theory.	
	1.2. Permanent tissue: Structure and function of Simple and complex	(5L)
	tissue Types of Vascular bundles	8 M
	1.3. Tissue System: Epidermal tissue system, Secretory tissue system,	(5L)
	Mechanical tissue system	8 M
Unit 2.	Primary & Secondary structure of plant body	15 L
	2.1 Primary structure of Monocotyledon and Dicotyledon root, stem	(5L)
		8 M
	2.2 Normal secondary growth in Dicotyledon root and stem; Periderm.	(5L)
	Lenticel, Tylosis, Wood types	8 M
	2.3 Anomalous secondary growth in <i>Bignonia</i> and <i>Dracaena</i> stem,	(5L)
	Vascular cambium structure and function	8 M

Practicals (Credits 1)

- 1) Study of shoot and root apex by permanent slides.
- 2) Study of simple and complex tissues with the help of permanent slides.
- 3) Study of primary structure of monocot root, stem.
- 4) Study of Epidermal tissue system.
- 5) Study of Secretary Tissue system.
- 6) Study of Mechanical tissue system.
- 7) Submission any two slides

References:

1. P.C. Vashista. - Plant Anatomy. Pradip Publications, Opposite Sitla mandir, Jalandhar- 144008.

2. B. P. Pandey - Plant Anatomy. S. Chand & Company, LTD. Ram Nagar, New Delhi.110055.

3. A. C. Datta. - Botany For Degree Students. Press-Delhi, Bombay, Madrass

4. Carlquist, S. 1998.- Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of dicotyledonous Wood. Springer – Verlag, Berlin.

5. Culter, E.G. 1969. Part I.- Cells and Tissues. Edward Arnold, London.

6. Culter, E.G. 1971. Part II- Organs.- Plant Anatomy: Experiment and Interpretation. Edward Arnold, London.

7. Esau, K. 1977. - Anatomy of Seed Plants. 2nd edition, John Wifey and Sons, New York.

8. Fahn, A. 1974. - Plant Anatomy. 2nd edition. Pergamon Press, Oxford.

9. Lyndon, R.F. 1990. - Plant Development: The Cellular Basis. Unwin Hyman, London.

10. Mauseth, J.D. 1988.- Plant Anatomy. The Bonjamin /Cummings Publishing Company Inc., Metro Park, California, USA.

11. Nair, M.N.B. 1998. - Wood Anatomy and Major Uses of Wood. Faculty of Forestry, University Putra Malaysia, 43400 Serdang, Selangor D. E., Malaysia.

12. Rahvan, V. 2000.- Developmental Biology of Flowering Plants. Springer- verlag, New York.

13. Raven, P.H., Evert, R. F. and Eichhorn, S.E. 1999. - Biology of Plants. 5th edition. W.H., Freeman and Co., Worth Publishers, New York.

14. Steeves, T.A. and Sussex, I.M. 1989. - Patterns in Plant Development. 2nd edition. Cambridge University, Press, Cambridge.

15. Thomas, P. 2000. - Trees: Their Natural History. Cambridge University Press, Cambridge.

16. Chandurkar P. J. Plant Anatomy. Oxford and IBH publication Co. New Delhi 1971

17. Greulach V A and Adams J E Plant- An introduction to Modern Biology. Toppen Co. Ltd, Tokyo,

18. Eams and Mc Daniel. An Introduction to Plant Anatomy. McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan

19. Adriance S Foster. Practical Plant Anatomy. D Van Nostrand Co. INC, Newyork

20. Pijush Roy. Plant Anatomy. New Central Book Agency Ltd, Kolkata

21. Pandey S N and Ajanta Chadha. Plant Anatomy and Embryology. Vikas Publishing House, Pvt, Ltd, New Delhi

Semester III Botany -DSC-1-4 (Major) Plant Metabolism (30 Lectures) (Credit 2+1)

Unit 1:	Mineral nutrition, Enzymes & Plant growth regulators	15 L
	1.1. Mineral nutrition: Introduction of mineral nutrition, Roleand	(5L)
	Deficiency symptoms of Macronutrients (N, P, K) and Micronutrients	8 M
	(Fe, Mn.)	
	1.2. Enzymes : Introduction of enzymes, Nomenclature, Classification,	(4L)
	Properties and mechanism of enzyme action	6 M
	1.3. Plant growth regulators: Introduction, Discovery, types of	(6L)
	growth regulators with its physiological role and practical applications	10 M
	of auxins, gibberellins, cytokinin, ABA, Ethylene and CCC.	
Unit 2.	Plant metabolism	15 L
	2.1. Nitrogen Metabolism: Introduction, Physical and Biological	(8L)
	nitrogen fixation (symbiotic and non-symbiotic), Nitrogen cycle,	13 M
	Mechanism of biological nitrogen fixation, Significance of biological	
	nitrogen fixation	
	2.2 Carbohydrate metabolism: Introduction, Broad classification,	(7L)
	Monosaccharides - Properties and examples	12 M
	(Triose, Tetrose, Pentose and Hexose)	
	Oligosaccharides - Properties and examples (Sucrose, Maltose and	
	Lactose)	
	Polysaccharides - Properties and examples (Starch and Cellulose),	
	Biosynthesis and degradation of sucrose and starch	

Practicals (Credits II)

- 1) Study of role and deficiency symptoms of N, P, K, Fe, Mn.
- 2) Effect of different concentrations of Auxins (IAA) on seed germination (any suitable dicot seeds).
- 3) Effect of different concentrations of Gibberellic acid (GA) on seed germination (any suitable monocot seeds).
- 4) Effect of different concentrations of Ethylene on fruit ripening
- 5) Study of effect of pH on Catalase enzyme activity.
- 6) Study of effect of temperature on Malate dehydrogenase enzyme activity.
- 7) Demonstration of fermentation.

References:

1. Hopkins, W. G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.

2. Moore, T. C. 1989. Biochemistry and Physiology of Plant Hormones. (2nd edition). Springer – Verlag, New York, USA.

3. Salisburry, F.B. and Ross, C. W. 1992. Plant Physiology. (4th edition). Wadsworth Publishing Co., California, USA. 19

4. Taiz, L. and Zeiger, E. 1998. Plant Physiology. (2nd edition) SinauerAssociates, Inc., Publishers, Massachusetts, USA.

5. R.C. Grewal – Plant Physiology. Campus Books International 483/24, Prahiad street Ansari Road, Darya ganj, New Delhi – 110002.

6. V.K. Jain – Fundamentals of Plant Physiology. S. Chand & Company Ltd. Ramnagar, New Delhi – 110055.

7. Salisbury Ross – Plant Physiology. CBS, Publishers & Distributions 485/ Jain Bhawan, Bhole Nath Nagar, Shahdara, New Delhi – 110032.

8. Devlin & Witham – Plant Physiology. CBS Publishers & Distributors 485, Jain Bhavan, Bhole Nath Nagar, Shahdara, New Delhi – 110032.

9. G. Ray Noggle / G. Fritz- Introductory Plant Physiology. Prentice Hall of India Ltd. New Delhi – 110001.

10. V.Verma. Text Book of Plant Physiology. Emkay Publications., B-19, East KrishnaNagar, Delhi-1100051.

11. V.I. Paladin. Plant Physiology. Arihant Publishers. Jaypur, (India)

12. Dr. S. Sundara rajan- Physiology of Transport in Plants. Anmol Publications, Pvt. LTD. New Delhi.110002.

13. D.O.hall & K.K. Rao. Photosyntheis. Edward Arnold, East Street, Baltimore, Mary-land-21202,U.S.A.

14. Bidwell, R.G.S. 1974. Plant Physiology. Macmillan P ub. Co., N.Y.

15.Devlin, R.M. and F.H. Witham. 1983. Plant Physiology. Willard Grant Press. U.S.A.

16.Hans-Walter Heldt. 1997. Plant Biochemistry and Molecular Biology. Oxford University Press, New York. Usa.

17. Jain, V.K. (2000): Fundamentals Of Plant Physiology ,S.Chand&Co, New Delhi.

18. Pandey, S.N. (1991): Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.

19. Verma, V. (2007): Text Book of Plant Physiology. Ane Books India, New Delhi.

20. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology.4th edition Academic Press, UK

21. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Associates, Saunders land, Massachusetts, USA

22. Helgi OPik, Stephen A. Rolfe, Arthur J. Willis. 2005. The Physiology of Flowering Plants, Cambridge University Press, UK

23. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

24. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd edition. Longman Group, U.K.

25. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.26. Emil Tmog, Mineral Nutrition of Plants. Oxford and IBH Publishing House, Bombay/ New Delhi. 27.S. Sundara rajan- Plants Physiology. Anmol Publications, Pvt. LTD.New Delhi.110002.

Discipline Specific Elective Botany (DSC 2-3) Minor: Economic Botany (Credit 2+1) 30 L

Unit 1:	Introduction to Economic Botany	15 L
	1.1. Origin of Cultivated Plants: Concept of Centers of Origin, their	(3L)
	importance with reference to Vavilov's work.	5 M
	1.2. Crop domestication and loss of genetic diversity ; Evolution of	(3L)
	new crops/varieties, importance of germplasm diversity.	5 M
	1.3. Cereals: Origin, morphology, Production, Cultivation and	(3L)
	Economic importance of Jowar.	5 M
	1.4 Legumes: Origin, morphology, Production, Cultivation and	(3L)
	Nutritive Value of Chick pea.	5 M
	1.5 Sugar Crop: Morphology and processing of sugarcane, products	(3L)
	and byproducts of sugarcane industry& their uses	5 M
Unit 2.	Economic plants	15 L
	2.1. Spices: Origin, morphology, Production, Cultivation and	(8L)
	Economic importance. Listing of important spices, their family and	13 M
	part used Clove	
	2.2 Dyes : Origin, morphology, Production, Cultivation and Economic	(3L)
	importance of Lowsonia (Mehandi), processing & uses	5 M
	2.3 Oils : Origin, morphology, Production, Cultivation and Economic	(3L)
	importance Groundnut	5 M
	2.4 Fiber-yielding plants: Origin, morphology, Production,	(3L)
	Cultivation and Economic importance of Cotton	5 M
	2.5 Drug-yielding plants: Origin, morphology, Production,	(3L)
	Cultivation and Economic importance of Ginger	5 M

Practical's:

- 1. Taxonomic status of food plants and its uses Jowar
- 2. Taxonomic status of Industrial plants and its uses Cotton
- 3. Taxonomic status of drug plants and its uses- Ginger
- 4&5. Agricultural and Industrial uses of plants. Chick pea & ground nut
- 6. Study of economically important plants (Dyes): Lowsonia (Mehandi)
- 7. Determination of sugars percentage by hand- refractometer

Reference:

1. B. P. Pandey (2017) Economic Botany. S. Chand Publication, New Delhi.

2. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.

3. Samba Murty and Subrahmanyam (2011). Text Book of Modern Economic Botany, CBS Publishers and Distributors, New Delhi.

- 4. Hill, Albert F. Economic Botany, Tata Mc Grow Hill Publishing Company, Ltd. New Delhi.
- 5. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer A Publishers, The Netherlands. 5. Singh, Pandey and Jain (2017).
- 6. Economic Botany, Rastogi Publication, Meerut. 6. B. Baruah (2017).
- 7. Economic Botany, Kalyani Publishers, New Delhi.
- 8. Chrispeels, & M.J., Sadava, D.E. (1994). Plants. Genes and Agriculture. Jones & Bartlett-Publishers.

9. Berg L, (2008). Introductory Botany: Plants, People, and the Environment. Thomson Brooks/Cole.

10. Cook F.E.M. (1995). Economic Botany: Data Collection. Standard Royal Botanic Garden, Kew, Richmond

Discipline Specific Elective Botany (DSC 2-3) Introduction to Plant Protection (Credit 2+1) 30 L

Unit 1:	Introduction to plant protection	15 L
	1.1. Introduction and significance of Plant Protection.	(1L)
		3M
	1.2. Oil seed Crop identification, soil types, tillage, seed rate and	(4L)
	spacing, Intercultural operations, Fertilizers, Irrigation, Intercropping of Soybean	6M
	1.3. Fruit Crop identification, soil types, tillage, seed rate and spacing,	(4L)
	Intercultural operations, Fertilizers, Irrigation, Intercropping of grapes	6 M
	1.4. Vegetable Crop identification, soil types, tillage, seed rate and	(3L)
	spacing, Intercultural operations, Fertilizers, Irrigation, Intercropping	5 M
	of brinjal	
	1.5. Floral Crop identification, soil types, tillage, seed rate and spacing,	(3L)
	Intercultural operations, Fertilizers, Irrigation, Intercropping of Rose	5 M
Unit 2.	General Methods of Plant Protection	15 L
	2.1. Cultural Methods: Tillage, sowing and planting dates, crop	(5L)
	hygiene, crop rotation, trap crops and fertilizers.	8 M
	2.2. Mechanical Methods: I) rope dragging, II) netting, III) bagging,	(3L)
		5 M
	2.3. Physical Methods: Heat and soil solarizations	(3 L)
		5 M
	2.4. Chemical Methods: Brief account and uses of bactericides,	(2L)
	rungicides	3M
	2.5. Biological Control: Introduction, biological control of Insect pests	(2L)
	and diseases.	3 M

Practical:

- 1. Study of diseases of crops (Any 4)
- 2. Micrometry (pollen grains / fungal spores)
- 3. Preparation of Culture medium (PDA/MS media)
- 4. Identification of vegetable and Fruit crops
- 5. Study of types of fertilizers
- 6. Study of types of fungicides
- 7. Study of soil pH /water holding capacity

References:

- 1. Agronomy V. J. Vaidya et. al.
- 2. Biofertilizers in Agriculture Subba Rao
- 3. Commercial Vegetable Growing Tindall
- 4. Crop Production and Field Experimentation Vaidya, Shahastrabuddhe and Khupse
- 5. Cropping System and Theory Chattarjee
- 6. Floriculture: Waurie and Ries
- 7. Handbook of Agriculture IARI, New Delhi
- 8. High Yielding Varieties of Crops Mahabal Rani
- 9. Identification of Crop Varieties Agarwal
- 10. Irrigation Michael
- 11. Plant Pathology R. S. Malhaotra
- 12. Plant Protection Mukundan

Unit–1:	Terrace gardening methods	15Hrs
	1.1 Introduction to Terrace gardening	01
	1.2 Natural parameters	04
	1.3 Composting and its types	04
	1.4 Methods of Terrace gardening	04
	1.5 Equipment required for Terrace Garden	02
Unit–2:	Steps to setup Terrace gardening	15 Hrs
	2.1. Organicgardensoil	01
	2.2. Application of fertilizers in Terrace Garden	04
	2.3 Plant disease management	04
	2.5. Frant disease management	03
	2.4. Pest management	02
	2.5. Precautions during Terrace gardening	01

Botany: GE 03 Terrace gardening (2 credits) 30 hrs

Reference:

1. Liu, K."Energy efficiency and environmental benefits of rooftop gardens" (PDF). National Research Council Canada. Retrieved March 12, 2014.

2. Michelle Nowak (May2004). "Urban Agriculture on the Rooftop".City Farmer, Canada's Office of Urban Agriculture. Retrieved March 12, 2014.

3. Louise Lundberg Scandinavian Green Roof Institute (2009). "The benefits of Roof top Gardens" (PDF). Retrieved March 12, 2014.

4. Ong, Boon Lay (May2003)."Green plot ratio: an ecological measure for architecture and urban planning". *LandscapeandUrbanPlanning*.**63**(4):197–

211.doi:10.1016/S0169-2046(02)00191-3

5. "What to Consider When Designing and Building Your Own Rooftop or Balcony Garden – Projex Group". Projex Group. 2017-11-17. Retrieved 2018-05-23.

6. Trent University (October30,2009). "Roof top Gardens" (PDF). Retrieved March 12, 2014.

Semester III VSC 1 Practical's based on Plant anatomy and Plant Metabolism

- 1) Study of primary structure of dicot root
- 2) Study of primary structure of dicot stem
- 3) Study of double stained permeant micro preparation technique I.
- 4) Study of double stained permeant micro preparation technique II.
- 5) Study of anomalous secondary growth in *Bignonia* stem by double stained micropreparation.
- 6) Study of anomalous secondary growth in *Dracaena* stem by double stained micropreparation.
- 7) Study of anatomy of porous (ring porous &diffused porous) and non-porous wood by permanent slides.
- 8) Study of angiospermic wood by Maceration technique.
- 9) Study of gymnospermic wood by Maceration technique.
- 10) Study of fermentation.
- 11) Study of biofertilizers BGA
- 12) Study of biofertilizers Bacteria
- 13) Separation of Amino acids by Thin Layer chromatography / paper chromatography.
- 14) Botanical Excursion Report.

Semester III VSC - 2 Economic Botany & Introduction to Plant Protection

1. Study of Morphology active compounds and uses of Ginger

2. Study of Morphology and economic importance of fibre yielding plant (any one).

- 3. Preparation of natural dye
- 4. Study of extraction of oil from suitable plant material
- 5. Identification of Spices
- 6. Qualitative and Quantitative Estimation of protein from chick pea.
- 7. Estimation of sugar by calorimetric method
- 8. Study of equipments used in plant protection
- 9. Study of different types of pesticides
- 10. Study of precautions in pesticides handling
- 11. Study of concepts & tools in IPM
- 12. Preparation of neem seed kernel extract
- 13. Preparation of plant based liquid manure
- 14. Study of organic and Chemical Pesticides

SEMESTER - IV Paper–DSC-1-5 Plant Physiology (30 Lectures) (2+1 Credit)

Unit 1:	Plant responses & Translocation	(15)
	1.1. Plant responses (light and temperature): Photoperiodism – Definition,	8L
	Classification (SDP, LDP, Day neutral plants); Phytochrome: Definition, Role	13 M
	of phytochrome (red and far-red light responses on photomorphogenesis),	
	Vernalization: Definition, Mechanism, Significance, Florigen concept.	
	1.2. Translocation: Translocation in phloem: Definition, Symplastic transport	7L
	and apoplastic transport, Phloem loading and unloading, Mechanism of	12M
	translocation in phloem-Mass flow hypothesis, Source and sink relationship:	
	During vegetative and reproductive phase.	
Unit 2:	Photosynthesis and Respiration	(15)
	1.1.Photosynthesis: Introduction, Photosynthetic Apparatus; Photosynthetic	7L
	Pigments (Chl a, b, xanthophylls, carotene), Light reaction-Cyclic and	12M
	non-cyclic, Darkreaction –C3, C4, CAM Pathway (marks)	
	1.2. Respiration: Introduction, Structure of Mitochondrion, Types – Aerobic	6 L
	& anaerobic – Glycolysis, Linkage stage and TCA Cycle, Terminal	9 M
	oxidation	
	1.3. Photorespiration : Introduction: Site of photorespiration, Mechanism of	2 L
	photorespiration Significance	4 M

Practical's:

- 1) Determination of rate of respiration during seed germination.
- 2) Janus green B staining technique for mitochondria.
- 3) Separation of photosynthetic pigments by ascending paper chromatography.
- 4) Study of Kranz leaf anatomy in C4 plants.
- 5) Estimation of TAN value in CAM plants.
- 6) Study of evolution of oxygen during photosynthesis.
- 7) Study of root nodules

References:

- Hopkins, W. G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
- Moore, T. C. 1989. Biochemistry and Physiology of Plant Hormones. (2nd edition). Springer–Verlag, New York, USA.

- Salisburry, F.B. and Ross, C. W. 1992. Plant Physiology. (4th edition). Wadsworth Publishing Co., California, USA.19
- Taiz, L. and Zeiger, E. 1998. Plant Physiology. (2nd edition) Sinauer Associates, Inc., Publishers, Massachusetts, USA.
- R.C. Grewal Plant Physiology. Campus Books International 483/24, Prahiad street Ansari Road, Daryaganj, New Delhi–110002.
- V.K. Jain Fundamentals of Plant Physiology. S. Chand & Company Ltd. Ramnagar, New Delhi –110055.
- Salisbury Ross Plant Physiology. CBS, Publishers & Distributions 485/ Jain Bhawan, Bhole Nath Nagar, Shahdara, New Delhi–110032.
- Devlin & Witham Plant Physiology. CBS Publishers & Distributors 485, Jain Bhavan, Bhole Nath Nagar, Shahdara, New Delhi–110032.
- G. Ray Noggle / G. Fritz- Introductory Plant Physiology. Prentice Hall of India Ltd. NewDelhi–110001.
- V. Verma. Text Book of Plant Physiology. Emkay Publications., B-19, East Krishna Nagar, Delhi-1100051.
- V. I. Paladin. Plant Physiology. Arihant Publishers. Jaypur, (India)
- Dr. S. Sundara rajan- Physiology of Transport in Plants. Anmol Publications, Pvt. LTD.NewDelhi.110002.
- D. O. Hall & K.K. Rao. Photosynthesis. Edward Arnold, East Street, Baltimore, Mary-land-21202, U.S.A.
- Bidwell, R.G.S.1974.Plant Physiology. Macmillan Pub. Co., N. Y.
- Devlin, R.M. and F.H. Witham. 1983. Plant Physiology. Willard Grant Press. U.S.A.16.Hans-Walter Heldt. 1997. Plant Biochemistry and Molecular Biology. Oxford University Press, New York. Usa.
- Jain, V.K. (2000): Fundamentals of Plant Physiology, S. Chand & Co, New Delhi.
- Pandey, S.N. (1991): Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
- Verma, V.(2007): Text Book of Plant Physiology. Ane Books India, New Delhi.
- Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology .4th edition Academic Press, UK
- Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Associates, Saunders land, Massachusetts, USA
- Helgi OPik, Stephen A. Rolfe, Arthur J. Willis. 2005. The Physiology of Flowering Plants, Cambridge University Press, UK
- Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
- Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. PlantMetabolism.2nd Edition. Longman Group, U.K.
- Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
- Emil Tmog, Mineral Nutrition of Plants. Oxford and IBH Publishing House, Bombay/NewDelhi.
- S. Sundararajan-Plants Physiology. Anmol Publications, Pvt. LTD. New Delhi.110002.

Semester IV Paper–DSC-1-6 Embryology of Angiosperms (30 Lectures) (2+1 Credit)

Unit1:	Structural organization of flower & Pollination mechanism	(15 L)
	1.1. Flower Structure: Concept of flower as a modified Shoot, structure of typical flower, structure of typical androecium, Structure of tetrasporangiate anther and pollen grain. Structure of typical Gynoecium: Structure of a typical ovule, Types of ovules.	5L 8M
	1.2. Microsporogenesis & Megasporogenesis: Microsporogenesis, male gametophyte development, Megasporogenesis, female gametophyte development: Monosporic (<i>Polygonum</i>) and Bisporic (<i>Allium</i>) embryo sac.	5L 8M
	1.3. Pollination& fertilization - Definition, self and cross Pollination Mechanism in Anemophily (<i>Zea mays</i>), Entomophily (<i>Calotropis</i>) and Hydrophily (<i>Vallisneria</i>) Fertilization: Entry of pollen tube, double fertilization and triple fusion. Significance of double fertilization.	5L 8M
Unit 2:	Embryo, Endosperm Development & Seed and fruit dispersal	(15 L)
	2.1. Embryo Development: Structure and development of embryo in Monocotyledons, Dicotyledons	5L 8M
	2.2. Endosperm Development : Development of endosperm, Types of endosperms-Nuclear, Helobial and Cellular	4L 6M
	2.3. Seed and fruit dispersal: Agents and mechanism of seed and fruit dispersal	4L 6M

Practicals:

- 1) Study of typical flower and its parts (floral whorls with their functions).
- 2) Study of young /mature anther by permanent slide.
- 3) Study of germination of pollen grains.
- 4) Study of types of ovules (by permanent slide or photograph).
- 5) Study of dicotyledon embryo (by permanent slide or photograph).
- 6) Study of monocotyledon embryo (by permanent slide or photograph).
- 7) Excursion Report / Field Visit Report.

References:

1. P. C. Vashista. Plant Anatomy. Pradip Publications, Opposite Sitla mandir, Jalandhar-144008.

2. B. P. Pandey - Plant Anatomy. S. Chand & Company, LTD. Ram Nagar, New Delhi.110055.

3. A. C. Datta. -Botany For Degree Students. Press-Delhi, Bombay, Madras

4. Carlquist, S. 1998.- Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of dicotyledonous Wood. Springer–Verlag, Berlin.

5. Culter, E.G. 1969.PartI. -Cells and Tissues. Edward Arnold, London.

6. Culter, E.G. 1971. Part II- Organs. - Plant Anatomy: Experiment and Interpretation. Edward Arnold, London.

7. Esau, K.1977.- AnatomyofSeedPlants.2ndedition, John Wifey and Sons, New York.

8. Fahn, A.1974. -Plant Anatomy. 2ndedition.PergamonPress, Oxford.

9. Lyndon, R.F.1990.- Plant Development: The Cellular Basis. Unwin Hyman, London.

10. Mauseth, J.D. 1988.- Plant Anatomy. The Bonjamin /Cummings Publishing Company Inc., Metro Park, California, USA.

11. Nair, M.N.B. 1998. - Wood Anatomy and Major Uses of Wood. Faculty of Forestry, University Putra Malaysia,43400Serdang, Selangor D.E., Malaysia.

12. Rahvan, V. 2000.- Developmental Biology of Flowering Plants. Springer- verlag, New York.

13. Raven, P.H., Evert, R. F. and Eichhorn, S.E. 1999. - Biology of Plants. 5th edition .W. H. , Freeman and Co., Worth Publishers, New York.

14. Steeves, T.A. and Sussex, I.M. 1989. - Patterns in Plant Development.2ndedition.CambridgeUniversity,Press,Cambridge.

15. Thomas, P. 2000. - Trees: Their Natural History. Cambridge University Press, Cambridge.

16. Chandurkar P. J. Plant Anatomy. OxfordandIBH publicationCo.NewDelhi1971

17. Greulach V A and Adams J E Plant- An introduction to Modern Biology. Toppen Co. Ltd, Tokyo,

18. Eams and Mc Daniel. An Introduction to Plant Anatomy. McGraw –Hill Book Co.Ltd and Kogakusha Co, Tokyo, Japan

19. AdrianceSFoster.PracticalPlantAnatomy.DVanNostrandCo.INC,Newyork

20. Pijush Roy. Plant Anatomy. New Central Book Agency Ltd, Kolkata

21. Pandey S N and Ajanta Chadha. Plant Anatomy and Embryology. Vikas Publishing House, Pvt, Ltd, New Delhi

22. Bhojwani S S and Bhatnagar S P. An Embryology of Angiosperms.

23. Maheshwari P. An introduction to Embryology of Angiosperms.

24. Nair P K K. Essentials of Palynology.

25. S.C. Datta. Systematic Botany. New Age International Publishers, New Delhi.(2015).

Discipline Specific Elective Botany (DSC 2-5) Minor: Basic Genetics Credit 2+1 (30L)

Unit 1:	Introduction to Genetics	15 L
	1.1. History of Genetics: Concept of allele, gene and genome, Phenotype and	3L
	Genotype; Heredity, variation, Pure lines and Inbred Lines.	5M
	1.2. Mendelian experiments on pea plant	1L
		2M
	1.3 Mendel's Law of Inheritance: a) Law of Dominance b) Law of Segregation	4 L
	c) Law of Independent Assortment	6M
	1.4. Gene Interactions: Incomplete inheritance and co- dominance, non-epistasis,	4 L
	Epistatic interactions, Supplementary, Inhibitory and Complementary gene	6M
	interaction	
	1.5. Multiple Alleles: Definition, ABO blood groups and Rh factor in Human	3L
		5M
Unit 2	Sex Determination	15 L
	2.1. Sex Linkage: Definition, non – disjunction, Chromosome theory of inheritance.	3L
		5M
	2.2. Bridges theory of non-disjunction, Attached X chromosome.	3L
		5M
	2.3. Sex linkage in <i>Drosophila</i> , Sex linked inheritance in man (Colour-blindness,	4 L
	hypertrichosis, Haemophilia).	6M
	2.4. Chromosome theory of Sex determination: XXXY, XX-XO, ZZ-ZW.	2L
		3M
	2.5. Genic balance theory of Bridges Sex Determination, Intersexes and Super sexes	3L
	in Drosophila, Hormonal control of Sex determination	5M

Practical's:

- 1. Solve the problems based on monohybrid cross (at least four examples)
- 2. Solve the problems based on dihybrid cross. (at least four examples)
- 3. Studies on Mendelian traits by using pea plant.
- 4. Studies on genetic traits related to the colour blindness and haemophilia.
- 5. Study of Hypertrichosis using pedigree chart.
- 6. Study of giant chromosome in Drosophila.
- 7. Study of sex determination in *Drosophila* (photograph/slides)

Reference Books:

1. Plant Chromosomes: Analysis Manipulation and Engineering. Hawood Sharma A K and Sharma A.1999: Academic Publishing Co. Australia.

2. Principles of Gene Manipulation. Old R. W. and Primrose, S. B.1989 Blackwell Scientific Publications. Oxford UK.

3. Genetics: M. L. Shrivastav, Shri Publishers and Distributors, Ansari Road New Delhi, 110002.

4. Genetics, P. K. Gupta, Rastogi Publications, Meerut, 250002.

5. Genetics and Evolution, H. S. Bhamrah, Kavita Juneja, Anmol Publications, Pvt. Ltd. New Delhi,110002

6.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. (Chapters2-4, 6, 15-19 for Units 1-7).

Discipline Specific Elective Botany (DSC 2-6) Minor: Food Adulteration Credit 2+1 (30L)

Unit 1	Introduction to Plant Adulteration	15 L
	1.1. Adulteration-Definition; types-Intentional, incidental, metallic and packaging	(2L)
	hazard	3M
	1.2. Causes and methods of food adulteration. General Impact on Human Health.	(2L)
		3M
	1.3. Detection and Prevention of Food Adulteration, Mitigation measures for	(4L)
	addressing food adulteration.	6M
	1.4. Food additives- Definition, Antioxidants, preservatives, nutrient supplements,	(4L)
	emulsifier, thickening agents, colors & flavoring agent's role of additives in	6M
	processed foods.	
	1.5. Safe levels of additive uses and the institutions involved in the process.	(3L)
		5M
Unit 2	Methods of detection & laws	(4L)
		6M
	2.1. Methods of detection of adulterants in oil, grains, sugar & spices	(4L)
		6M
	2.2. Methods of detection of adulterants in processed food, fruits & vegetables	(4L)
		6M
	2.3. Food laws voluntary & mandatory- national & international	(4L)
		6M
	2.4 Responsibilities for maintaining and enforcing food safety FSSAI	(3L)
		5M
	2.5. Auditing and accreditation (BIS, QCI, AGMARK etc.).	(2L)
		3M

Practical's:

- 1. Determination of adulteration in spices
- 2. Determination of margarine in ghee
- 3. To detect the adulteration of Red lead salts/brick powder in chili powder, yellow lead salts/ colored saw dust in turmeric and dried papaya seeds in pepper.
- 4. Determination of metanil yellow color in jiggery
- 5. To detect sugar as an adulterant in honey
- 6. To detect the adulterants like paraffin wax/hydrocarbons, dyes and argemone in the fats, oils and ghee
- 7. Detection of clay, chicory powder, iron fillings in coffee & tea

Semester IV VSC 3 Practicals based on Embryology of Angiosperm and Plant Physiology

- 1) Study of endosperm from developing seeds (Grevillea/Cucumis).
- 2) Dispersal of seeds.
- 3) Dispersal of Fruits.
- 4) Study of self-pollinated plants
- 5) Study of cross-pollinated plants
- 6) Study of pollination mechanism in Maize
- 7) Study of pollination mechanism in *Calotropis*
- 8) Detection of pollen fertility by staining technique.
- 9) Study of carbohydrates test: reducing and non-reducing sugars.
- 10) Study of enzymes
- 11) To Study the effect of CO₂ on the rate of photosynthesis
- 12) To Study the effect of light quality on photosynthesis
- 13) Determination of sugar percentage by hand refractometer
- 14) Horticulture Term Paper / Field Visit Report / Project Report

Semester IV VSC - 4 Basic Genetics and Food Adulteration

- 1. Study of models on DNA and RNA structures.
- 2. Study on sex linked inheritance in Drosophila
- 3. Practice on mitotic cell division
- 4. Practice on meiotic cell division
- 5. Study of mutations in Drosophila
- 6. Study of Mendelian inheritance
- 7. Study of problems based on Test cross and Back cross
- 8. Study of types of food adulteration
- 9. Determination of starch in ghee
- 10. Determination of other oils in coconut oil
- 11. Determination of Chalk powder in sugar
- 12. Determination of excess bran in wheat flour
- 13. Detection of added colors in food grain
- 14. Detection of argemone seeds in mustard seeds

Semester IV GE - 04 Analytical Techniques in Plant Sciences

Unit 01	Imaging And Cell Fractionation	15 L
	1.1: Principles and application of microscopy; Light microscopy;	2 L
	Fluorescence microscopy	3M
	1.2: Transmission and Scanning electron microscopy, staining techniques.	4L
		6M
	1.3: Introduction, Basic Principle of Sedimentation,	3L
		5M
	1.4. Components and different types of centrifuges	3L
		5M
	1.5 Differential and density gradient centrifugation, analytical centrifugation,	, 3L
	ultracentrifugation.	5M
Unit 02	Chromatography & Characterization of proteins and nucleic acids	15L
	2.1: Principle & types of chromatography, Paper chromatography	2L
		3M
	2.2: TLC techniques	4L
		6M
	2.3: Isolation and purification of RNA, DNA	3L
		5M
	2.4: Isolation and purification of proteins	3L
		5M
	2.5: Different separation methods. Analysis of RNA, DNA and proteins	3L
	by PAGE	5M

References:

- 1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- 2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York.U.S.A.
- 3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
- 4. Upadhyay, Updhyay and Nath (2009) Biophysical Chemistry : Principles and Techniques, Himalaya Publishing House, Mumbai.
- 5. Glasel, J. and Deutscher, M. B., "Introduction to Biophysical Methods for Protein and Nucleic acid Research", Academic Press, 1995.
- 6. Analytical Techniques in Plant Sciences, by Dr. Sanjeeb Kumar Nath , Mahaveer publication , 2022.
- 7. Practical Manual on Plant Molecular Biology and Analytical Techniques, Dr. S. Girija, AkiNik Publications, 2020
- 8. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology.
- John Wiley & Sons. 3 rd edition. 4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4 th edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur B.Sc. II Practical Examination in Botany (CBCS NEP 2020) March/April 2026 Semester III

Practical Based on DSC 1– (3&4): Plant Anatomy and Plant Metabolism Center: Date: Batch Total Marks: 30

N.B.-

1. Draw neat & labeled diagrams wherever necessary

2. Do not write about points of theoretical information unless asked specifically

3. Perform the experiment as per instructions given by the examiner.

1.	Double stain permanent preparation of T.S. of specimen A and show it to the exam	aration of T.S. of specimen A and show it to the examiner	
	(No written answer)	06	
2	Prepare the slide to show tissue system of specimen B (No written answer)	04	
3.	Perform the physiological experiment C assigned to you and record your		
	observations, submit the report to the examiner (written answer)	06	
4.	Identification	03	
	D Identify & Describe		
	E Identify & Describe		
	F Identify & Describe		
5.	A) Journal	05	
6.	B) Submission	05	

B. Sc. II Practical Examination in Botany (CBCS NEP 2020) March/April 2026 Semester-III

Practical Based on DSC 2 (3 and 4): Economic Botany and Plant Protection

Center: Date: Batch Total M		
		/Iarks:30
N.I	B	
• 1	Draw neat &labeled diagrams wherever necessary	
• 1	Do not write about points of theoretical information unless asked specifically	
• 1	Perform the experiment as per instructions given by the examiner.	
Q.1.	Determine the sugar percentage of given specimen A by using hand refractometer	04
Q.2.	Describe the morphology and economic importance of specimen B	03
Q.3.	Measure the dimensions of the given spore or pollen grains from the specimen C	04
	under low and high power of microscope record your observations.	
Q.4.	Identify and write causal organism and describe symptoms of given specimen D.	03
Q. 5	Identification	03
	E- Identify and Describe	
	F- Identify and Describe	
	G-Identify and Describe	
Q.6.	a) Journal	05
	b) Submission	05

B.Sc. II Practical Examination in Botany (CBCS NEP 2020) March/April 2026 Semester- IV

Practical Based on DSC1 (5 & 6): Plant Physiology and Embryology of Angiosperm Center: Date: Batch Total Marks: 30

N.B.-• Draw neat &labeled diagrams wherever necessary • Do not write about points of theoretical information unless asked specifically • Perform the experiment as per instructions given by the examiner. Perform the physiological experiment A assigned to you. (Written answer) Q.1. 06 Q.2. Perform the physiological experiment B. (No written answer) 03 Q.3. Perform the practical C for detection of pollen germination. (Written answer) 04 Describe the specimen D dicot / monocot embryo by using permanent Q.4. 04 slide/photograph (Written answer) Q.5. Identification 03 E- Identify & Describe F- Identify & Describe G-Identify & Describe 05 Q.6 A) Journal 05 B) Tour report

B.Sc. II Practical Examination in Botany (CBCS NEP 2020) March/April 2024 Semester-IV

Practical Based on DSC 2 (5 and 6): Basic Genetics and Food Adulteration

Center: Date:		Date:	
Batch Total Marks			
N.B	3		
• D	Draw neat &labeled diagrams wherever necessary		
• D	Do not write about points of theoretical information unless asked sp	ecifically	
• P	Perform the experiment as per instructions given by the examiner.		
Q.1. So	olve the given problem A on monohybrid/dihybrid cross		03
Q.2. Describe the giant chromosome of Drosophila using slides/photograph		bh	04
Q.3. Fi	nd the adulteration in given specimen C.		04
Q.4. Find the adulteration ingiven specimen D.			03
Q. 5 Id	lentification		
E- Iden	ntify and Describe		
F- Iden	ntify and Describe		
G-Iden	tify and Describe		
Q.6.	a) Journal		05
	b) submission		05