PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

Syllabus As per New Education Policy 2020

Subject: BOTANY

Name of the Course: M.Sc. I (Sem I & II)

(Syllabus to be implemented from w.e.f. June 2026)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M. Sc. I Choice Based Credit System (CBCS)
Course Structure (NEP 2020)
M.Sc. I w.e.f. 2026-27

Sr. No	Paper Code	Course/Title	Nature	Credit	Marks	
Semester I						
					CA	UA
1.	**DSC (1)** Theory	**Major mandatory course I** Biology & diversity of Algae, Bryophytes, Pteridophytes and fungi	Theory	4	40	60
2	**DSC (2)** Theory	**Major mandatory course II** Taxonomy of Angiosperms	Theory	4	40	60
3	**DSC (1)** Practical	**Major mandatory course I**	Practical	2	20	30
4	**DSC (2)** Practical	**Major mandatory course II**	Practical	2	20	30
5	**DSE (1)** Theory	**Major elective course I** (Select One) 1) Plant Growth and development 2) Herbal & Drug Technology 3) Plant Biotechnology	Theory	4	40	60
6	**DSE (1)** Practical	**Major elective course I**	Practical	2	20	30
7	**RM**	Research Methodology	Theory	4	40	60
		Total credits with marks		**22**	**220**	**330**
Semester II						
1	**DSC (3)** Theory	**Major mandatory course I** Biology and Diversity of Gymnosperm and Paleobotany	Theory	4	40	60
2	**DSC (4)** Theory	**Major mandatory course II** Advances in Pathology	Theory	4	40	60
3	**DSC (3)** Practical	**Major mandatory course I**	Practical	2	20	30
4	**DSC (4)** Practical	**Major mandatory course II**	Practical	2	20	30
5	**DSE (2)** Theory	**Major elective course I** (Select One) 1) Crop Physiology 2) Angiosperm Systematics 3) Plant Tissue Culture	Theory	4	40	60
6	**DSE (2)** Practical	**Major elective course I**	Practical	2	20	30
7	**OJT/FP**	OJT/In-house Project/ Internship/ Apprenticeship		4	40	60
		Total credits with marks		**22**	**220**	**330**

Revised Syllabus for the Master of Science in Botany,
Punyashlok Ahilyadevi Holkar Solapur University, Solapur
(National Education Policy 2020)

Applicable from academic year 2026 – 2027(June 2027) for M.Sc. Part I and Part II (Botany)

as per Resolution No. 4736 dated 20/05/2026 of Board of Studies in Botany and Resolution No.

……dated ……. of Academic Council of Punyashlok Ahilyadevi Holkar Solapur University, Solapur.

1. Title: M. Sc. Botany, Punyashlok Ahilyadevi Holkar Solapur University, Solapur Revised Syllabus as per NEP 2020

2. Faculty: Faculty of Science and Technology.

3. Year of implementation: For M. Sc. I (Semester I and Semester II): From June 2026 and for M. Sc. II (Semester III and Semester IV): From June 2027.

4. **Preamble**: Education is fundamental for achieving full human potential, developing an equitable and just society and promoting national development. Providing universal access to quality education is the key to India's continued ascent and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country and the world. India will have the highest population of young people in the world over the next decade and our ability to provide high-quality educational opportunities to them will determine the future of our country. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution–a democratic, just socially-conscious, cultured and human nation upholding liberty, equality, fraternity and justice for all. Higher education significantly contributes towards sustainable livelihood and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education. India has tremendous biodiversity, genetic as well as of species and ecosystems which is a biological capital of our country. It contains over 7 percent of the world's biodiversity on 2.5 per cent of the Earth's surface. This diversity can be attributed to the vast variety of landforms and climates resulting in habitats ranging from tropical to temperate, and from alpine to desert. The number of plant species in India is estimated to be over 45,523 representing about 11.8 per cent of the world's flora. It is estimated that 32% of Indian plants are endemic to the country and found nowhere else in the world. Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. There are 17,527 species, 296 subspecies, 2215 varieties, 33 subvarieties and 70 forma, altogether 20,141 taxa of angiosperms under 2991 genera and 251 families in India, representing approximately 7% of the described species in the world. About 5725 species of flowering plants are broadly considered as endemics and represent 33.5% of the flora, of which, 3471 species are found in the Himalayas, 2051 in the Peninsular India and 239 in Andaman & Nicobar Islands. Gymnosperms are woody perennials, either shrubs or trees. There are 58 taxa growing in wild under 15 genera and 8 families in India. Though they are lesser in number, provide timber, wood, resins, tars and turpentine. Estimated number of pteridophytes (fern and fem-allies) are about 1200 taxa under 204 genera are distributed in different biogeographic regions of India. The Eastern Himalaya and the Northeast India with about 845 taxa in 179 genera, representing approximately 67% of the pteridophytes known from

the country, followed by southern India, including Eastern and Western Ghats, with 345 taxa in 117 genera and Northern India, including Western Himalaya, with 340 taxa in 101 genera. Bryophytes less known group of plants, comprising about 2800 species, is the second largest group of green plants in India, next only to the angiosperms. About 16 genera and 678 species are endemic to India. Liverworts are represented by ca. 850 species under 140 genera and 52 families. Lichens are a symbiotic association of fungi and algae and constitute a dominant component of epiphytic and saxicolous vegetation. At present about 2021 species of lichens in 248 genera are known to occur in India. Fungi range from microscopic organisms to huge solid bodies. Approximately 14,500 species in 2300 genera are found in India of which ca. 3500 species are endemic. Algae represented by over 6500 species in ca. 666 genera, they are found growing in a variety of habitats ranging from fresh water, marine, terrestrial and to soil. Of which 1924 species are endemic to the country. The major portion of Indian algal flora accounting for ca. 390 genera and 4500 species followed by terrestrial algae (125 genera and 615 spp.); soil algae (80 genera and 1500 spp.); marine algae (169 genera and 680 spp.).

5. General objectives of the course:

Major Mandatory I: Biology & Diversity of Algae, Bryophyte, Pteridophyte & fungi

This syllabus will provide detailed ideas about lower cryptogamic plants.

- To get idea about Algae, Fungi, Bryophytes & Pteridophytes
- To get knowledge about characters of cryptogamic plant
- To get knowledge about internal structure, methods of identification, classification
- To get knowledge about Current trends of research in lower plants with their economic importance.

Major Mandatory II: Taxonomy of Angiosperms

This syllabus provides detailed knowledge about Plant taxonomy

To get knowledge about morphological characters of plant

To get knowledge about methods of identification of the plants

To get knowledge about importance of plant taxonomy & its importance in research

Major elective 1: Plant Growth & Development

This syllabus gives an idea about physiological parameters of plant growth & development.

- To get knowledge about physiological changes in plants
- To get knowledge about applications of fertilizers, organic fertilizers its applications & utilization
- To get knowledge about post-harvest storage methods for fruits & vegetables
- To get knowledge about different organizations working on different parameters for plant growth & development

Major elective 2: Herbal Technology

This subject gives knowledge to the students of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

Upon completion of this course the student should be able to:

- Understand raw material as source of herbal drugs from cultivation to herbal drug product
- Know the WHO and ICH guidelines for evaluation of herbal drugs
- Know the herbal cosmetics, natural sweeteners, nutraceuticals
- Appreciate patenting of herbal drugs, GMP.

Major elective 3: Plant Biotechnology

- Understand different hybridization techniques and basics of embryogenesis.
- They will be able to learn about different gene delivery techniques.
- Identify different biotechnological techniques used in plant research and breeding.
- Critically assess the scientific validity and reliability of research studies in plant biotechnology.

Research Methodology:

Recall and identify key concepts and terminology related to research methodology.

- Analyze the strengths and weaknesses of different research methodologies in relation to specific research contexts or objectives.
- Apply the principles of a specific research methodology to design a research study or experiment.
- Critically evaluate the reliability and validity of data collection and analysis methods used in a study.
- Design and propose modifications or adaptations to existing research methodologies to address specific research challenges or gaps.

Major Mandatory I: **Gymnosperms & Paleobotany**

- To study about gymnosperm classification, characters
- To get knowledge about importance of gymnosperms
- To get knowledge about fossils & their characters

Major Mandatory II: Advances in Plant Pathology

This syllabus gives an idea about plant Pathology

- To get knowledge about disease incidence, mechanism, mode of action
- To get knowledge about host pathogen relationship
- To get idea about different types of plant diseases & their causal organisms
- To get knowledge about control measures

Major Elective 1: Crop Physiology

This syllabus gives an idea about crop physiology

- To get knowledge about photoperiodism & vernalization techniques
- To get knowledge about plant growth regulators & their effects on plant physiology
- To get knowledge about plant retardance & their effects on plant physiology
- To get knowledge about different physiological processes in plants.

Major Elective 2: Angiosperm Systematics

In establishing the Phylogenetic relationship that exists naturally many groups of plants

- Using nomenclature principles and rules all plants are named.
- It has a great value in Forestry because all forest trees have been named and classified.
- It has wide importance in Agriculture, Horticulture, etc
- To study ecology, the knowledge of taxonomy / systematic botany became essential, plant ecologist must be aware of the names of plants and their relationship to habitat and environment.

Major Elective 3: Plant Tissue Culture

- Recall the basic principles and history of plant tissue culture.
- Identify the components of plant tissue culture media and their functions.
- Explain the significance of aseptic techniques in plant tissue culture.
- Demonstrate proficiency in using aseptic techniques for culturing plant tissues.
- Assess the commercial applications and benefits of plant tissue culture in various industries.

The program-specific outcomes (PSOs)of an M.Sc. in Botany typically describe the skills, knowledge, and abilities that students are expected to acquire by the end of the program. These outcomes may vary slightly depending on the institution, but here are some common PSOs for an M.Sc. in Botany:

1. **Advanced Knowledge in Plant Sciences**: Students will gain in-depth knowledge of various aspects of plant biology, including taxonomy, physiology, genetics, ecology, and biotechnology. This includes understanding plant evolution, structure, function, and the ecological roles plants play.
2. **Research Skills**: Students will develop the ability to design, conduct, and analyze scientific research in botany. This includes formulating hypotheses, using advanced techniques for data collection and analysis, and interpreting results in the context of current scientific literature.
3. **Practical Skills in Plant Science**: Students will acquire hands-on experience with various laboratory and field techniques used in botanical research. This may include microscopy, plant tissue culture, molecular biology techniques, and ecological survey methods.
4. **Critical Thinking and Problem-Solving**: Graduates will be able to apply critical thinking to solve complex problems related to plant science, including issues in agriculture, environmental conservation, and biotechnology.
5. **Communication and Presentation**: Students will be trained to effectively communicate scientific information, both orally and in writing, to a variety of audiences, including peers, professionals, and the general public.
6. **Ethical and Environmental Awareness**: The program will instil an understand ethical considerations in botanical research and the importance of biodiversity conservation and sustainable practices in managing plant resources.
7. **Preparation for Advanced Studies or Careers**: Graduates will be prepared for further research (e.g., Ph.D. programs) or professional careers in botany, environmental science, agriculture, forestry, biotechnology, and related fields.
8. **Interdisciplinary Approach**: The program will encourage the integration of knowledge from related disciplines (e.g., genetics, chemistry, environmental science) to solve complex botanical problems.

These outcomes ensure that students completing an M.Sc. in Botany are well-equipped for both academic and professional careers in plant sciences and related fields.

General guidelines:

1) There shall be at least a short tour (upto 3 days) and along tour (not exceeding10 days) per year for all M. Sc. I and M. Sc. II students. The long tour may be arranged to a region out of the state covering various Botanical Regions/ Research Institutes/ Centers and Universities. Tour s are the part of curriculum and are obligatory to each student, failing which they will not be considered eligible to appear for the practical examination. Under unavoidable circumstances, if the student fails to attend the tour, he/ she has to produce just if able evidence for not attending the tour. However, in lieu of tour the candidate will have to complete the work assigned by the Department.

2) If there are female students in a batch of sixteen, one additional lady teacher is permissible for excursion. T.A. and D.A. for teachers and non-teaching staff participating in the excursions should be paid as per the rules.

3) Following documents will have to be produced by each student at the time of practical examination (at the end of each Semester):

a. Submission of a laboratory journal of practical records.

b. Submission of a tour report (in his/ her own handwriting) duly signed by the concerned teacher is mandatory.

Important instructions:

The entire course of M. Sc. (Botany) will be of four Semesters spread over two years.

- **Pattern of Examination**: The examinations will be conducted semester wise for both theory as well as practical courses.
- **Fee structure:** As Per PAH Solapur University, Solapur.
- **Eligibility criteria for Admission:** B. Sc. in Botany/B.Sc. Agriculture/Botany subject at subsidiary level
- A student shall be held eligible for admission to the M. Sc. Course in Botany who has passed the B. Sc. examination with Botany as a principal subject from PAH Solapur University Solapur and also has passed the entrance examination conducted by the University.
- A student from other university shall be eligible who qualifies entrance examination of PAH Solapur University, Solapur and scores minimum 55% (B+) marks in the subject at the B. Sc. with Botany as a principal subject or with Botany at B. Sc. II level.
- While preparing merit list, only the marks of entrance examination will be considered.
- Medium of instruction: English

Other Features:

i) Intake capacity/Number of students at M. Sc. I will be 45 per year. D. B. F. Dayanand College, Solapur (20), Shri Shivaji Mahavidyalaya, Barshi (25).

ii) The student may take exit after successful completion of M. Sc. I (Semester I & II) and acquire a certificate of 'PG Diploma in Botany'. Such student may join M. Sc. part II within next five years after exit.

Important instructions:

a. On Job Training /Field Project: Every student shall go for on job training or field project in semester II. The same work will be evaluated in the department at the end of semester.

b. Research Project: Every student will have to work for research project in semester III and IV. The same work will be evaluated in the department at the end of semester III as well as semester IV. Project report shall be submitted in hard bound form and there will be presentation at the time of evaluation.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSC Course Code:2314101** **Course Name:** Biology & diversity of Algae, Bryophytes, Pteridophytes and fungi
Teaching Scheme **Lectures: 04 Hours/week,** **Credits:04**	**Examination Scheme** **UA:60 Marks** **CA:40 Marks**

Unit – I	**Phycology:** Habitat (terrestrial, fresh water, marine), thallus organization, cell ultrastructure, reproduction (vegetative, asexual and sexual), classification of algae as per G. M. Smith General Characters of algae, Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae; Life cycle and economic importance of algae.	**15 L**	**15 M**
Unit – II	**Bryology:** Introduction, General Characters, classification, Origin and evolution, Diversity in Bryophytes with respect to thallus structure, reproduction and life cycle. Salient features, phylogeny and inter-relationship of the following orders– Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Buxbaumiales, funariales and Polytrichales. Economic importance of Bryophytes.	**15L**	**15 M**
Unit – III	**Pteridology:** Introduction, General Characters, classification, Origin and evolution, Diversity in pteridophytes. Salient features, phylogeny and inter-relationship of the following classes – Psilopsida, Lycopsida, Sphenopsida Pteropsida. Morphology, anatomy, reproduction in *Psilotum, Mesipteris, Lycopodium, Selaginella, Isoetes, Equisetum, Ophioglossum, Angiopteris, Gleichenia, Pteris, Salvinia, Azolla,* Economic importance	**15L**	**15 M**
Unit- IV	**Fungi:** General characters and recent trends in classification, Cell ultrastructure and Cell wall composition, nutrition (saprobic, biotrophic, symbiotic), reproduction (vegetative, asexual and sexual), fructification and Spore forming structures, heterothallism, heterokaryosis and economic importance. Study of major classes up to the level of order (As per Ainsworth`s 1973 system) A) Myxomycota: Mastigomycotina B) Eumycota: 1) Zygomycotina 2) Ascomycotina 3) Basidiomycotina 4) Deuteromycotina.	**15L**	**15 M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M.Sc. I (Botany) Semester-I** **Vertical: DSC Course Code:2314104** **Course Name:** Biology & diversity of Algae, Bryophytes, Pteridophytes and fungi
Teaching Scheme **Practical: 04Hours/week,** **Credit: 02**	**Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Practicals

DSC (1): Biology & diversity of Algae, Bryophytes, Pteridophytes and fungi

1-3. Study of algal types as per theory per Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae with the help of specimens and slides (each with one example)

4-6. Study of Bryophytes: Morphological, anatomical and reproductive studies of the following members by using specimens and slides: *Marchantia*, *Targionia*, *Cythodium*, *Fossombronia*, *Notothyllus*, *Pogonatum*, *Polytrichum* and *Sphagnum*. (any four)

7-9. Study of Pteridophytes: Morphological, anatomical and reproductive studies of Psilopsida, Lycopsida, Sphenopsida Pteropsida (minimum one type from each).

10-12. Study of fungi belongs to Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina. (Minimum one type from each).

Reference Books:

Text book of Algae by Kumar H. D. and H. N. Singh (1971)
Text book of Algae by Sharma O.P. (1986)
Text book of Botany - Algae by Pandey B.P. (1994)
Botany for degree students - Algae by Vashishta B.R. (1995)
College Botany Vol. II by Gangulee H. C. and A.K. Kar (1992)
Taxonomy and Biology of blue green algae by Desikachary T.V. (1972)
The structure & reproduction of algae by Fritsch F. E. (1965)
The algae by Chapman V.J. & Chapman D.J. (1973)
Algae form and function by Venkataraman et . al. (1974)

Journals

1) Phykos
2) Phycologia
3) Seaweed Research
4) Mahasagar
5) Indian Journal of Marine Biology.

Bryophytes:

1) Bryophyta by Parihar N. S. (1991)
2) Watson E.V. [1964] The structure and life of Bryophytes.
3) Bryophytes Atma Ram and Sons, Delhi by Puri. P. (1980)
4) Inter relationship of Bryophytes by Cavers F. [1964]
5) Liverworts of Western Himalayas & The Punjab plains Part I and II.by Kashyap S.R. [1929]
6) Bryology in India by RamU-dar [1976]

Pteridophytes:

1) Biology and Morphology of Pteridophytes by Parihar N. S. (1996)
2) Bierhorst D.W. [1971] Morphology of vascular plants.
3) Jermy A.G. [1973] The Phylogeny and Classification of ferns.
4) Rashid A. [1978] An Introduction to Pteridophytes.
5) Sporne K. R. [1966] Morphology of Pteridophytes

Fungi

1) Introductory Mycology John Wiley and Sons Inc. by Alexopoulos C.J. , Mims C.W. and Blackwel M. (1996)
2) Introduction to Bacteria McGraw Hill book Co. , New York by Clifton .A.(1958)
3) Introductory Phycology Affiliated East – West Press Ltd., New Delhi by Kumar H.D.(1988)
4) Introduction to Plant Viruses Chand and Co. Ltd., Delhi by Mandahar .C.L.(1978)
5) An Introduction to Mycology New Age Intermediate Press by Mehrotra R.S. and Aneja R. S. (1998)
6) Diseases of crop plants in India Prentice Hall of India Pvt.Ltd. New Delhi by Rangaswamy G. and Mahadevan A.
7) Biology of Lichens by Hale M., Tos . E. Jr. (1967)
8) The Fungi Vol. – I, II, III, IV A, IV B by Ainsworth G. E. and A.S. Sussman
9) Introduction to Fungi Cambridge University Press, Cambridg by Webster . J. (1985)
10) Textbook of fungi by Sharma O.P. (1989)
11) Morphology and Taxonomy of fungi by Bessey . E.A.
12) College Botany Vol. I by Gangulee H.S. and A.K. Kar (1992)
13) The Myxomycetes of India by Thind. K. S. (1977)
14) Taxonomy of fungi imperfecti Hypomycetes by Kendrick W.B. (1979)
15) Hypomycetes by Subramanian C.V. (1971)
16) Illustrated Genera of Rust Fungi by Cummins G.B. (1959)
17) The Rust fungi of Cereales , Grasses and Bamboo by Cummins G.B. (1971
18) The Rusts of Leguminaceae & 18Compositae by Cummins G.B. (1984)
19) Ustilaginales of India by Mundkur B.B. & M.J. Tirumalachar (1952)
20) Aquatic Phycomycetes by Sparrow F.K. (1960)
21) Aquatic fungi of India by Dayal (1995)
22) New concepts of kingdoms of Organisms [Science 163: 150-160] by Whittaker R.H. (1969)
23) A Text book of Botany: Fungi S. Chand & Co. Ltd. Ramnagar , New Delhi , pp- 416 by Pandey B.P. (1994)
24) Biology of the Fungi (first ed.) Satyajeet Prakashan, Pune, pp.67 by Vaidhya J.G. (1995)
25) The Fungi Hafner Publ. Co. Ltd. N.Y. by Gaumann G.A. (1952)
26) The Fungi Oxford & IBH by Mehrotra B.S. (1976)
27) The Fungi [Vol. I & Vol. II] John Wiley and Sons, Inc, New York by Wolf F.A. and Wolf F. T.
28) Modern topics in Fungi. Ed.D. S. Mukadam. Saraswati press, Aurangabad,
29) Microbiology and plant pathology by P.D. Sharma, Rastogi

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSC Course Code:2314102** **Course Name:** Taxonomy of Angiosperms
Teaching Scheme **Lectures:04Hours/week,** **Credits: 04**	**Examination Scheme** **UA:60 Marks** **CA:40 Marks**

Unit I	**Introduction to Taxonomy:** Definition and scope of taxonomy; Importance of angiosperm taxonomy; Relationship between taxonomy, systematics, and classification **Taxonomic Characters:** Vegetative and floral characters; Diagnostic characters in taxonomy; Importance of reproductive features **Botanical Gardens and Field Taxonomy:** Important Botanical gardens, field observation and documentation in taxonomy	**12L**	**12M**
Unit II	**General evolutionary trends and Species Concept:** **General evolutionary trends:** Concept of evolution, evolutionary principles, Primitive and Advanced characters, significance of evolutionary studies in classification; evolutionary trends in vegetative and reproductive character **Species concept:** Definition and significance of species, species as taxonomic unit, population and variation Morphological species concept, biological species concept, Merits and limitations, Phylogenetic species concept, Ecological species concept, Evolutionary species concept, Genotypic cluster concept, Concept of speciation, Allopatric and sympatric speciation, Reproductive isolation mechanisms, Importance in biodiversity and conservation	**12L**	**12M**
Unit III	**Nomenclature and Classification:** **Nomenclature:** Introduction to Botanical Nomenclature; Principles of Binomial Nomenclature; International Code of Nomenclature (ICN); Typification and Priority of Names; Author Citation, Synonyms and Homonyms; Valid Publication and Conservation of Names **Classification**: Introduction to Plant Classification; Artificial, Natural and Phylogenetic Systems of Classification; Contributions of Major Taxonomists in Plant Classification; Taxonomic Hierarchy and Species Concept; Modern Approaches to Plant Classification; Angiosperm Phylogeny and APG Classification System	**12L**	**12M**
Unit IV	**Biodiversity:** Introduction; Scope and Importance; Levels of Biodiversity: Genetic, Species and Ecosystem Diversity; Patterns of Biodiversity Distribution; Biodiversity Hotspots of the World and India; Biogeographical Regions and Endemism, Threats to Biodiversity, In-situ and Ex-situ Conservation, Biodiversity Laws, Policies and International Conventions.	**12L**	**12M**
Unit V	Salient features, morphological diversity and economic importance of plant families **Dicotyledonae**: Annonaceae, Fabaceae, Meliaceae, Myrtaceae, Polygonaceae, Bignoniaceae, Verbenaceae, Lamiaceae, Sapotaceae, Casuarinaceae, Amaranthaceae, Euphorbiaceae, Urticaceae **Monocotyledonae**: Arecaceae, Amaryllidaceae, Commelinaceae, Orchidaceae, Liliaceae, Poaceae	**12L**	**12M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSC Course Code:2314105** **Course Name:** Taxonomy of Angiosperms
Teaching Scheme **Practical: 04Hours/week,** **Credit: 02**	**Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Practicals

DSC (2): Taxonomy of Angiosperms

1. Observation and identification of vegetative and floral taxonomic characters in selected five plant species.

2. Comparative study of primitive and advanced characters in angiosperms.

3. Identification of common local flowering plants with the help of flora.

4-12. Study of families as per theory syllabus (available plant families as per Bentham and Hooker's system)

13. Study of APG classification system and phylogenetic relationships among selected angiosperm families. (any four)

14. Excursion report

Reference Books:

Ahmedullar, M. and M.P. Nayar 1987. Endemic plants of the Indian region, Vol. I
Benson, L.1957. Plant classification
Benson, l.1962. Plant Taxonomy
Cronquist, A. 1968 Evolution and Classification of flowering plants.
Cronquist, A. 1981. An integrated system of classification of flowering plants.
Davis, P.H. and V.M. Heywood 1963. principles of Angiosperm taxonomy.
Dahlgren, P.M.T. 1980. A revised system of classification of the Angiosperms Bot. J. Linn.soc. 80;91-124.
Dahlgren, R.M.T.: 1981 Angiosperm classification and phylogeny-A rectifying comment, bot.J.1961.
Hajra, P.K.et.al. 1996. flora of India. Introductory volume (part-I)
Kubitzki, K. 1977.Plant systematics and evolution.
Lawrence, G.H.M. 1951.Taxonomy of vascular plants.
Naik, V.N.1984. Taxonomy of Angiosperms.
Nayar, M.P.1996. Hot spot of endemic plants of India, Nepal and Bhutan.
Quicke, Donald I.J.1993 Principles and Techniques of contemporary taxonomy.
Rao.R.R. 1994. Biodiversity of India (FloristicAspects).
Rendle, A.B. 1925. The classification of flowring plants.
Stace, C.A. 1980. plant taxonomy and biosystematics.
Takhtajan, A.L.1969 Flowering plants: origin and dispersal.
The new global Taxonomy initiatives BOTANY 2000-ASIA Newsletter 5(4) 1996.
Systematics agenda 2000 charting the bosphere: a global initiative to discover, describe, and classify the world's species. Technical report. Published by SA200, New York Botanical Gardens.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSE Course Code:2314107** **Course Name:** Plant Growth and Development
Teaching Scheme **Lectures: 04 Hours/week,** **Credits:04**	**Examination Scheme** **UA:60 Marks** **CA:40 Marks**

Unit I:	**Growth and Photomorphogenesis** Phytochrome & cryptochrome- discovery, properties, role and mechanism of action.	**10L**	**10M**
Unit II:	**Senescence**: Senescence of leaves and petals, Mechanism, biochemical changes and Programmed cell death.	**10L**	**10M**
Unit III:	**Physiology of seed development & seed germination** A brief outline of physiology of seed development & seed germination. Post harvest physiology- ripening of fruits and its regulation, metabolism of stored seeds and leafy vegetables	**10L**	**10M**
Unit IV:	**Plant growth regulators**: Plant growth regulators-signaling mechanism of auxin, cytokinin, gibberellin, ABA, ethylene. a brief idea about discovery and possible mechanism of action of triacontanol, Brassinosteroids, salicylic acid, jasmonates, polyamines & morphactins. A brief idea about role of growth retardants- CCC, Paclobutrazol, Maleic hydrazide and TIBA	**15L**	**15M**
Unit V:	**Secondary messengers and signaling in plants cells** A brief idea about role of mutants in physiological studies with references to *Arabidopsis thaliana*	**15L**	**15M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical : DSE Course Code:2314106** **Course Name:** Plant Growth and development
Teaching Scheme **Practical: 04Hours/week,** **Credit: 02**	**Examination Scheme** **UA:30 Marks** **CA: 20 Marks**

Practical

DSE (1): Plant Growth and development

1. Comparative growth study of etiolated and light grown seedlings and analysis of Photosynthetic pigments
2. Study of change in nitrate reductase activity during leaf senescence.
3 & 4. Hormonal and chemical regulation of leaf and Petal senescence. (Kinetin / ethephon / SA / KCl / $CaCl_2$)
5. Pigment changes during ripening of fruits.
6. Study of enzyme acid phosphatase during ripening of fruits.
7. Study of changes in respiration rate during ripening of fruits
8. Effect of different chemical compounds on pollen germination.
9. Effect of various PGR on seedling growth.
10. Effect of growth retardants on plants.
11. Study of changes in starch & sugars during fruit ripening of Banana / Guava.
12. Study of changes in acidity and TSS (total soluble solids) during grape ripening.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSE Course Code:2314108** **Course Name:** Herbal and Drug Technology		
Teaching Scheme **Lectures: 04 Hours/week,** **Credits:04**		**Examination Scheme** **UA:60 Marks** **CA:40 Marks**	
Unit I	**Introduction to Herbal and Drug Technology:** History and scope of herbal medicine, Traditional systems of medicine: Ayurveda, Siddha, Unani, Chinese medicine, Role of medicinal plants in modern drug development, Classification of crude drugs based on source, morphology, chemical nature, Herbal drugs vs synthetic drugs, Ethnobotany and ethnopharmacology, Intellectual Property Rights (IPR) in herbal drugs, Traditional Knowledge Digital Library (TKDL), WHO guidelines on herbal medicines, Global market and future prospects of herbal drugs	12L	12M
Unit II	**Aromatic Plants and spices:** Botanical name, morphology, biochemical composition and uses of: **A) Aromatic Plants:** Lemongrass (*Cymbopogon citratus*), Vetiver (*Vetiveria zizanioides*), Sandalwood (*Santalum album*), Eucalyptus (*Eucalyptus globulus*), Tulsi (*Ocimum sanctum*), Rose (*Rosa damascena*) **B) Spices:** Black Pepper (*Piper nigrum*), Cardamom (*Elettaria cardamomum*), Clove (*Syzygium aromaticum*), Cinnamon (*Cinnamomum verum*), Turmeric (*Curcuma longa*), Ginger (*Zingiber officinale*)	12L	12M
Unit III	**Cultivation Practices of Important Medicinal Plants** Cultivation p*ractices* of *Withania somnifera* (Ashwagandha), *Adathoda zeylanica* (Adulsa), *Aloe vera* (*Korfad)*, *Rauvolfia serpentina* (Sarpagandha) *Asparagus racemosa* (shatawari), Cropping systems and intercropping with medicinal plants, Organic cultivation of medicinal plants, Post-harvest handling and storage, Processing and marketing.	12L	12M
Unit IV	**Herbal Drug Formulation:** Introduction to Herbal Drugs, Classification and Sources of Crude Drugs Phytochemical Constituents of Medicinal Plants, Extraction methods of Herbal Drugs, Formulation of Herbal Products (Churna, Oils, Syrups, Creams), Standardization and Quality Control of Herbal Drugs, Adulteration and Evaluation of Crude Drugs, Storage and Preservation of Herbal Medicines, Safety, Toxicity and Regulatory Aspects of Herbal Drugs, Role of Herbal Medicine in Modern Healthcare	12L	12M
Unit V	**Drug Technology:** Definition and scope of drug technology, Herbal drugs, pharmaceuticals, nutraceuticals, Drug discovery from plants, Ethnobotanical approaches, Steps in drug development, Secondary metabolites (alkaloids, terpenoids, phenolics, glycosides), Biosynthetic pathways of secondary metabolites, Structure–activity relationship (SAR), Extraction methods (maceration, Soxhlet, infusion, decoction), Biotechnology in drug production (tissue culture, hairy root culture, bioreactors), regulatory aspects, industrial scale-up, Current trends in drug technology	12L	12M

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. (Botany) Semester-I** **Vertical : DSE Course Code:2314106** **Course Name:** Herbal and Drug Technology
Teaching Scheme **Practical: 04Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Practical's based on DSE (1): Herbal & Drug Technology:

1. Identification, morphological characters and uses of aromatic plants (as per theory syllabus).
2. Identification, morphological characters and uses of spices (as per theory syllabus).
3. Identification, morphological characters and uses of medicinal plants (as per theory syllabus).
4. Preparation and Evaluation of Herbal Hair Oil
5. Formulation of Herbal Face Pack/lotion Using Natural Ingredients
6. Preparation of Herbal Tooth Powder and Its Antimicrobial Activity
7. Preparation of Herbal Cough Syrup Using Medicinal Plants
8. Preparation of perfumes and rose water
9. Preparation of crude plant extracts using simple extraction methods.
10. Preliminary phytochemical screening for major secondary metabolites (alkaloids, flavonoids, tannins, saponins).
11. Preparation of churna (Trifala, shatawari)
12. Basic quality control tests of crude drugs (moisture content, ash value – demonstration).
13. Study of herbal drug formulations and dosage forms (powders, tablets, syrups – demonstration).
14. Field visit / project work: survey of medicinal plants/herbal unit/pharmacy or medicinal plant garden (report submission).

References:

1. Glossary of Indian medicinal plants, R. N. Chopra, S. L. Nayar and I. C. Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book-Distributors.
3. Herbal plants and Drugs Agnes Arber,1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.OxfordIBH-publishing Co.
5. Ayurveda and Aromatherapy. Miller, Lightand Miller, Bryan, 1998.Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr. C. K. Kokate et al. 1999.Nirali Prakashan

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSE Course Code:2314109** **Course Name:** Plant Biotechnology
Teaching Scheme **Lectures: 04 Hours/week,** **Credits:04**	**Examination Scheme** **UA:60 Marks** **CA:40 Marks**

UNIT-I	**Plant Biotechnology, Plant Genomics and Genetic Engineering** Definition, scope, and historical development of plant biotechnology. Overview of the plant biotechnology industry. Ethical considerations and public perception of plant biotechnology. Basics of plant molecular genetics. Techniques for gene isolation and characterization. Ti & Ri Plasmid and their uses, viral vectors & their applications. Methods of gene transfer into plants.	**15L**	**15M**
UNIT-II	**Micropropagation** Organogenesis, Somatic Embryogenesis, Synthetic seeds. Shoot tip culture/Axillary bud culture. Rapid clonal propagation. Embryo Culture & Embryo Rescue. Acclimatization of Plants. Soma clonal Variations/In vitro mutagenesis Selected successful examples of Plants of Diverse Origin using Tissue Culture technology Rescue of endangered Plants.	**15L**	**15M**
UNIT-III	**Plant Tissue Culture and Transformation** Principles and applications of plant tissue culture Callus induction and regeneration techniques Protoplast Isolation, Culture, Fusion, Selection of Hybrid Cells and Regeneration of Hybrid Plants, Symmetric and Asymmetric hybrids. Anther, Pollen and Ovary culture for production of Haploid Plants and Homozygous lines. Genetic transformation methods in plants Cryopreservation, Slow growth & DNA Banking for germplasm Conservation.	**15L**	**15M**
UNIT-IV	**Tools and Applications of plant biotechnology** Polymerase chain reaction (PCR) and its applications DNA sequencing and gene expression analysis Functional genomics and transcriptomics Commercial micro propagation. Metabolic engineering & Industrial products, Plant secondary metabolites, Industrial enzymes, Biodegradable plastics, Therapeutic proteins: lysosomal enzymes, Antibodies and edible vaccines.	**15L**	**15M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical : DSE Course Code:2314106** **Course Name:** Plant Biotechnology
Teaching Scheme **Practical: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

Practical

DSE (1): Plant Biotechnology

1. Aseptic technique for plant tissue culture
2. Preparation of culture media and sterilization techniques.
3. Callus induction and regeneration experiments using explants
4. Anther and ovule culture.
5. Embryo culture, Protoplast isolation and fusion technique.
6. Micropropagation of plants through shoot proliferation
7. In vitro rooting and acclimatization.
8. Protein extraction from plant tissues.
9. Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) for protein separation.
10. Study of Gene Expression Analysis through PCR.
11. RNA/DNA extraction from plant tissues.
12. Designing and executing controlled experiments in plant biotechnology.

Submission

Project report based upon this paper.

Reference Books:

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers,USA.
2. Textbook of plant biotechnology, Chawala P.K.2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture: Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
6. Verpoorte, R. and A.W. Alfermann (Eds) 2000.Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
7. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
8. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14Blackwell Publ)
9. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the21st century (Academic press).
10. Bhojwani SS. & Razdan MK (1996). - Plant Tissue Culture: Theory & Practice (Elsevier)

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-I** **Vertical: DSE Course Code:2314103** **Course Name:** Research Methodology		
Teaching Scheme **Lectures: 04 Hours/week,** **Credits:04**		**Examination Scheme** **UA:60 Marks** **CA:40 Marks**	
Unit-I:	**Introduction to Research** Meaning, Objectives and Importance of Research; Types of Research: Basic, Applied and Action Research; Research Process and Steps in Research; Identification and Formulation of Research Problem; Review of Literature and Sources of Information; Hypothesis: Meaning, Types and Formulation; Research Design and its Types; Variables and Data Collection Methods; Qualitative and Quantitative Research; Ethical Issues in Research; Use of ICT and Digital Tools in Research; Preparation of Research Proposal and Summary	**15L**	**15 M**
Unit-II:	**Sampling Techniques & Parametric Tests** Introduction to Sampling and Population; Census Method vs Sampling Method; Probability Sampling Techniques; Simple Random Sampling; Stratified and Systematic Sampling; Cluster and Multistage Sampling; Non-Probability Sampling Techniques; Sampling Errors and Sample Size Determination Introduction to Parametric Tests; t-Test: Types and Applications; ANOVA and F-Test; Correlation, Regression and Interpretation of Results	**15L**	**15 M**
Unit-III:	**Thesis and Manuscript writing:** Introduction to Thesis and Manuscript Writing; Structure and Components of Thesis; Title Page, Abstract and Keywords; Writing Introduction and Review of Literature; Methodology and Data Presentation; Analysis, Interpretation and Discussion; Conclusion, Findings and Recommendations; Referencing Styles: APA, MLA, Vancouver etc.; Citation Management Tools; Plagiarism and Academic Integrity; Manuscript Preparation for Journals; Research Paper Submission and Publication Process	**15L**	**15 M**
Unit-IV:	**Introduction to IPR and Patents:** Meaning and importance of Intellectual property; Types of Intellectual Property; Copyrights and Related Rights; Trademarks and Industrial Designs; Geographical Indications and Trade Secrets; Introduction to Patents; Patentability Criteria and Patent Search; Patent Filing Procedure; Patent Drafting and Documentation; Patent Infringement and Legal Protection; National and International IPR Organizations; Recent Trends and Case Studies in IPR and Patents	**15L**	**15 M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical:** DSC Course Code:2314201 **Course Name:** Biology and diversity of Gymnosperms and Paleobotany
Teaching Scheme **Lectures: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 60 Marks** **CA: 40 Marks**

Unit- I	**Introduction to Gymnosperm:** Definition, Characteristics and Scope; Origin and Evolution of Gymnosperms; Geological Time Scale and Fossil Gymnosperms; Classification of Gymnosperms; Distribution and Economic Importance of Gymnosperms; General Morphology of Gymnosperms; Anatomy of Root, Stem and Leaf in Gymnosperms; Reproductive Structures in Gymnosperms; Life Cycle Pattern of Gymnosperms; Study of Cycadales General Characters; Study of ***Cycas***: Morphology and Anatomy, Reproduction and Life Cycle of *Cycas*, Study of Coniferales – General Characters, Morphology and Anatomy of *Pinus*, Reproduction and Life Cycle of *Pinus*	**15L**	**15M**
Unit –II	**Advanced Study, Evolutionary Trends and Economic Importance of Gymnosperm:** Study of Gnetales – General Characters; Morphology and Reproduction of *Gnetum*; Comparative Account of *Cycas*, *Pinus* and *Gnetum*; Evolutionary Trends in Gymnosperms; Fossil Gymnosperms and Their Significance; Stelar Evolution in Gymnosperms; Seed Habit and Evolution of Seed; Pollination and Fertilization in Gymnosperms; Embryogenesis in Gymnosperms; Affinities of Gymnosperms with Pteridophytes and Angiosperms; Modern Trends in Gymnosperm Research	**15L**	**15M**
Unit –III	**Introduction to Palaeobotany:** Definition, scope and importance of Palaeobotany; Relationship of Palaeobotany with geology and evolution; Contribution of major palaeobotanists; Geological time scale and major eras of plant evolution **Fossil and Fossilization:** Definition and types of fossils; Modes of fossil preservation: Compression, Impression, Petrification, Cast and mould, Coal balls; Processes of fossilization; Importance of fossils in evolutionary studies	**15L**	**15M**

	Techniques in Palaeobotany: Collection and preservation of plant fossils; Preparation of fossil specimens; Maceration and thin section techniques; Dating of fossils: relative and absolute dating methods		
Unit IV	**Fossil Plants and Applied Palaeobotany:** **Fossil Pteridophytes:** General characteristics and geological history **Fossil genera:** Lepidodendron, Calamites, Sphenophyllum and Evolutionary importance **Fossil Gymnosperms:** General characteristics and geological distribution; **Cycadofilicales; Bennettitales;** Glossopteris flora; Origin and evolution of seed habit **Fossil Angiosperms:** Origin and evolution of angiosperms, Evidence from fossil records, Brief account of important fossil angiosperms **Applied Palaeobotany:** Economic importance of fossils, Coal and petroleum formation, Role of Palaeobotany in palaeoecology and palaeoclimate, Indian contributions to palaeobotany with special reference to the Birbal Sahni Institute of Palaeosciences	**15L**	**15M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical: DSC Course Code:2314204** **Course Name:** Biology and diversity of Gymnosperms and Paleobotany
Teaching Scheme **Practical: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

DSC (3): Biology and diversity of Gymnosperms and Paleobotany

1-2. Habit, morphology, anatomy and reproductive parts of *Cycas*

3-4. Habit, morphology, anatomy and reproductive parts of *Pinus*

5-6. Habit, morphology, anatomy and reproductive parts of *Gnetum*

7-9. Identification of Gymnosperm: *Zamia, Auraucaria, Podocapus, Cupressus, Ginkgo, Taxus, Ephedra*

10. Types of fossils- Impression, compression, petrifaction, coal ball

11. Study of Fossil Pteridophytes (available specimens)

12. Study of Fossil Gymnosperms (available specimens)

13-14. Maceration and Thin Section Techniques in Palaeobotany

Reference Books:

1. Bierhorst D.W. [1971] Morphology of Vascular plants Macmillan and co. New York
2. Chamberlein C.J. [1966] Gymnosperms. Structures and evolution.
3. Coulter & Chamberlein J. M. [1978] Morphology of Gymnosperms Central Book Depot. Allahabad.
4. Foster A. S. & Gifford E. M. [1959] Comparative Morphology of Vascular Plants Vakil, Feffer & Simons Ltd.
5. Ramanujan c. G. K. [1979] Indian Gymnosperms in Time and space. Today & Tommorows Publisher.
6. Sporne K. R. [1967] Morphology of Gymnosperms-Hutchinson vaiv. Lib. London
7. Vashistha, P. C. Gymnosperms [1976]

Paleobotany

1. Arnold C.A. [1972] An Introduction to Paleobotany
2. Andrevs H.N. Studies in Paleobotany [1961]
3. Darroh, W.C. [1960] Principles of Paleobotany
4. Surange K.R. Indian Fossil Pteridophytes
5. Shukla A. C. and Mishra S.D. [1975] Essentials of Paleobotany

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical:** DSC Course Code:2314202 **Course Name:** Advances in Plant Pathology		
Teaching Scheme **Practical: 04 Hours/week,** **Credit: 02**		**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**	
Unit – I	**Introduction plant diseases:** Concept and classification of plant diseases, plant pathogens-concept and classification. Importance of plant diseases. Methods of diagnosis of plant diseases. Mechanism of infection – Pre penetration, penetration, post penetration and colonization	**12L**	**12M**
Unit – II	**MLO:** Classification, morphology and characteristics of MLO, Identification Techniques of MLOs.	**08L**	**08M**
Unit – III	**Defense mechanism and Epidemiology:** Defense mechanism against pathogen- structural, physiological, genetical and chemical, systematic acquired resistance Role of environmental factors on disease development, Epidemiology- slow and rapid epiphytotics, Disease forecasting, assessment of disease incidence and crop loss.	**12L**	**12M**
Unit – IV	**Principles of plant disease control:** Prophylaxis - Exclusion, Eradication, Protection, Immunization- Chemical control, genetic resistance. Plant diseases and disorders- a brief idea of following important diseases.	**12L**	**12M**
Unit – V	**Diseases: (Pathogen, Symptoms and disease management)** 1. Viral diseases: TMV, BMV 2. Phytoplasma diseases: little leaf of brinjal, Grassy Shoot disease of sugarcane 3. Bacterial diseases: Canker, Blight, Leafspot. 4. Fungal diseases: club root, white rust, Downy mildew, powdery mildew Rusts, smuts Ergot, Leaf spot, fruit rot, study of seed borne pathogens. 5. Algal diseases: Red rust. 6. Phanerogamic diseases: Total and partial stem and root parasites 7. Nematodes: Root knot of vegetables.	**16L**	**16M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical: DSC Course Code:2314205** **Course Name:** Advances in Plant Pathology
Teaching Scheme **Practical: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

DSC (4): Advances in Plant Pathology

1 Study of Fungal diseases (as per theory)

2 Study of bacterial diseases (as per theory)

3 Study of viral diseases (as per theory)

4 Study of Phytoplasma diseases (as per theory)

5 Study of diseases caused by Nematodes

6 Study of phanerogamic total and partial stem and root parasites

7 Estimation of chlorophylls, from healthy and infected plant parts.

8 Estimation of sugars from healthy and infected plant parts.

9 Estimation of polyphenols from healthy and infected plant parts.

10 Study of some fungicides, biopesticides (Demonstration)

11&12 Isolation of Soil fungi

13 Demonstration of antibiotics using a bacterial culture and known antibiotics

Reference Books:

1. Mehrotra. R.S. (1980)- plant pathology. Agrios, G.N. (1978)-plant pathology.
2. Ny vail, R. F. (1979) – Field Crop Diseases Hondbook. Stingh, R.S. (1963) – Plant diseases
3. Padoley, S.K. and P.B. Mistry – A manaual of plant pathology.
4. Gangopadhyay,S. (1984)- Clinical plant pathology. Rangaswami, G. (1979) Diseases of crop plants in India.
5. Mahadevan A.and R.Sridhar (1982)- Methods in physiological plant pathology. Aneja, K. R. (1993) – Experiments in Microbiology plant Pathology and Tissue culture. Gangulee, H.C.&A.K. kar (1992) – College Botany Vol. II.
6. Cooke, A.A. (1981) – Diseases of Tropical and subtropical field, Fiber and Oil Plants. Paul Khurana, S.M. (1998) – Pathalogical problems of Economic Crop plants and their management.
7. Kuljit,J.(1969)- The Biology of parasitic flowering plants. Univ. of California Press, U.S.A. Plank, J.E. Van der (1963)- Plant diseases, Epidemics and Control.
8. Plank, J.E. Van der (1968)- Diseases Resistance in Plants. A.P. London and New York. Chaube and Pundhir (2005)- Crop diseases and their management
9. Microbiology and plant pathology by P.D. Sharma. Rastogi publication Shivaji Road, Meerut.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical:** DSE Course Code:2314207 **Course Name:** Crop Physiology
Teaching Scheme **Lectures: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 60 Marks** **CA: 40 Marks**

Unit I	**Crop growth:** Crop growth analysis and its applications, crop productivity, harvest Index, water use efficiency and N- use efficiency, plant growth regulators in agriculture and anti transpirants Reproductive development- Photoperiodism and vernalization Fertilizers- Types, application through soil, foliar application, organic farming and its importance.	**15L**	**15M**
Unit II	**Crop weed interactions:** Common weedicides and their mode of action. Source sink relationship Phloem transport, vegetative and reproductive phase and factors affecting source sink relationship, Agronomy	**10L**	**10M**
UNIT III	**A brief idea of physiological basis of yield** in sugar cane, Jowar, cotton, groundnut & wheat	**10L**	**10M**
UNIT IV	**Physiology of crops with reference to following aspects-** i) Mineral nutrition of groundnut. ii) Nitrogen fixation in chickpea. Fruit physiology of Ber, Pomegranate, Mango, lemon and grape. Post harvest technology of grapes/ Ber/ and pomegranate w.r.t. market strategy	**15L**	**15M**
Unit V	**A brief idea of crop physiological 5 stations in India** ICRISAT, IARIT, CIMAP Lucknow, central soil salinity research lab Karnal, CAZRI Jodhpur, BARC, UAS, Bangalore.	**10L**	**10M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical: DSC Course Code:2314206** **Course Name:** Crop Physiology
Teaching Scheme **Practical: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

DSE (2): Crop Physiology

1. Growth analysis of any two crop plants (RGR, NAR, LAR, LAI etc).
2. Study of the effect of anti transpirants on stomatal behavior.
3. Study of the effect of source manipulation on sink capacity in any crop plant.
4. Estimation of acid invertase during ripening of sugarcane stalk.
5. Study of allelopathic effect of weed extract on germination of crop seeds.
6. Estimation of total lipids in oilseeds.
7. Study of effect of weedicide on some aspects of weed metabolism.
8. Study of Crop varieties
9. Visit to ware houses to study proper storage conditions for grains, seed and fruits.
10. Isolation, smear preparation and staining of bacteria from root nodule by using gram stain.
11. Study of fertilizers (Chemical and Biofertlizers)
12. Effect of biofertilizers on growth and development of plant.

Reference Books:

Cherry J.H. 1989. Environmental Stress in Plants. Biochemical & Physiological Mechanisms.2 Fageria N.K. 1992. Maximizing Crop Yield.

Gupta U.S. 1975. Physiological Aspects of Dry land Farming.4 Kozlowski T.T. 1984. Flooding and Plant Growth.

Rice E.L. 1982. Allelopathy (Physiological Ecology)

Sharma S.K. & Gupta I.S. 1986. Physiological Aspects of Dryland Farming.

Turner N.C. & Kramer P.J. 1980. Adaptations of Plants to Water and High Temperature Stress.8 Yawalkar & Agrawal, Manures and Fertilizers.

Evans L.T. 1972. Crop Physiology.

Levitt J. 1980. Responses of Plants to Environmental Stresses. Vol. 1 And 2.12 Indian Journal of Plant

Physiology. New Delhi.

13 Agros Annual Review of Plant Physiology. Jodhpur.

14 Environmental Plant Physiology.

15 Journal of Experimental Botany. 16 Environmental Plant Physiology.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical:** DSE Course Code:2314208 **Course Name:** Angiosperm Systematics
Teaching Scheme **Lectures: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 60 Marks** **CA: 40 Marks**

Unit I	**Biosystematics** Introduction, Aims, Principles and components of systematics; Alpha taxonomy, Beta taxonomy and omega taxonomy, Numerical taxonomy, taxonomic keys. Advancement Levels in Systematics and basic terminologies.	**12L**	**12M**
Unit II	**Tools of Taxonomy and Floristics** **Tools of Taxonomy:** Floras, monographs, revisions, websites, Computer, GPS, GIS, Herbarium, flora, Botanical Garden. **Floristics**: Need and significance. History of botanical exploration in India and recent works with special emphasis on Maharashtra.	**12L**	**12M**
Unit III	**Identification and Classification of Plants** **Identification**: Collection, specimen preparation, herbarium methods, Identification methods **Classification**: phylogenetic, Phenetic and cladistic method of classification.	**12L**	**12M**
Unit IV	**Taxonomic evidences** Based on morphology, anatomy, embryology, palynology, cytology, metabolites and molecular level	**12L**	**12M**
Unit V	Studies on the following as per Bentham and Hooker's system of classification. Dicot: Malvales, Celastrales, Rosales, Rubilaes, Ebenales, Lamiales Series: curvembrae Monocot: Microspermae and Glumaceae	**12L**	**12M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical: DSC Course Code:2314206** **Course Name:** Angiosperm Systematics
Teaching Scheme **Practical: 04 Hours/week** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

DSE (2): Angiosperm Systematics

1-5. Taxonomical description illustration and economic importance of family (as per theory syllabus). Note: Select available material belongs to order mentioned in theory.

6. Study of Herbarium Techniques: Collection, Pressing, Drying and Mounting of Plant Specimens

7. Study of Botanical Gardens, Floras, Monographs and Digital Taxonomic Tools

8. Identification of Plants Using Floras, Manuals and Taxonomic Keys

9. Studies on variation between genus of same family

10. Studies on variation between species of same genus

11. Classification of plants by using Phylogenetic Systems of Classification

12. Classification of plants by using Phenetic and cladistic method

13. Studies on taxonomic evidences in angiospermic plants (any two)

14. Field visit

References

1. Briggs, David. 2009. Plant microevolution and Conservation in Human-influenced Ecosystems. Cambridge University Press.
2. Cooke, T. 1903-1908. The Flora of Presidency of Bombay, Vol. I-III.
3. Cronquist, A. 1981.An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
4. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A. Hickey, M. and King, C. 2000. The Cambridge Illustrated Glossary of Botanical Terms. Cambridge University Press, UK.
5. Hutchinson, J. 1959. Families of Flowering plants. Clarendon Press, Oxford.
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	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical:** DSE Course Code:2314209 **Course Name:** Plant Tissue Culture
Teaching Scheme **Lectures: 04 Hours/week,** **Credit: 02**	**Examination Scheme** **UA: 60 Marks** **CA: 40 Marks**

Unit I	**Plant tissue culture** Objectives and goals of plant tissue culture, laboratory design and development, Operation and management. Tissue nutrition-Basic principles of in vitro culture, factors influencing morphogenesis and Physiological significance of tissue nutrition Media preparation: Media preparation and handling: Sterilization methods, equipment and apparatus, procedures of media preparation and stock solutions.	**15L**	**15M**
Unit II	**Plant regeneration and plant propagation** Types of Cultures: Explant culture, Callus formation and culture, Callus desiccation. Organogenesis, Meristem culture- Axillary Bud culture, protocols and schedules of observation. Callus culture- Somatic Embryogeny Cell suspension culture, Cell line and bioreactors	**15L**	**15M**
Unit III	**Organ culture** Anther culture, ovary culture, Isolation of haploids &its significance. Embryo culture, embryo rescue. Hardening of tissue cultured plants Synthetic seed- Concept, method and applications.	**15L**	**15M**
Unit IV	**Cell and Protoplast Culture** Cell suspension culture: Types and Application. Cell line isolation, Cell immobilization and synseed production Somaclonal variation: Nomenclature; schemes for obtaining somaclonal variations- without invitro selection and with invitro selection; factors influencing somaclonal variation; Applications and Limitations; Gametoclonal variations. Protoplast isolation, culture and somatic hybridization, Cryopreservation: Introduction, principle, procedure, importance and future prospects	**15L**	**15M**

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur **M. Sc. I (Botany) Semester-II** **Vertical: DSC Course Code:2314206** **Course Name:** Plant Tissue Culture
Teaching Scheme **Practical: 04 Hours/week** **Credit: 02**	**Examination Scheme** **UA: 30 Marks** **CA: 20 Marks**

DSE (2): Plant Tissue Culture

1.Designing of plant tissue culture laboratory.
2. Preparation of culture media.
3. Sterilization techniques.
4. Callus culture, organogenesis, Meristem culture.
5. Anther culture,
6. Somatic embryogenesis.
7. Cell suspension culture.
8. Techniques of hardening.
9. Encapsulation of embryos.
10. Synthetic seed preparation.
11. Visit to commercial greenhouse/ Tissue culture laboratory.
12. Project Report Submission

Nature of Practical Question Paper

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur

M. Sc. I (Botany) Semester – I

Practical Examination

(As per NEP 2020 syllabus)

DSC (1): Biology and Diversity of Algae, Bryophytes, Pteridophytes and Fungi

Date: / /202 **Total Marks: 30**

Time: 11.00am to 1:00pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) write brief procedure wherever necessary.

Q.1.	Identify, Classify and Prepare the slide of given specimen's **'A'** and **'B'** and show it to the examiner. (A = Algae, B = Fungi)	**(08)**
Q.2.	Identify, classify, and prepare the slide of given specimen's '**C**' & '**D**' and show it to the examiner. (C = Bryophyte, D = Pteridophyte)	**(08)**
Q.3.	**Identification** **E)** Identify and Describe (Algae) **F)** Identify and Describe (Fungi) **G)** Identify and Describe (Bryophyte) **H)** Identify and Describe (Pteridophyte)	**(08)**
Q.4.	Journal	**(03)**
Q.5	Viva voce	**(03)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur
M. Sc. I (Botany) Semester – I
Practical Examination
(As per NEP syllabus)
DSC (2) Taxonomy of Angiosperm

Date: / /202 **Total Marks: 30**

Time: 11:00 am to onwards

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) Write brief procedure wherever necessary.

Q. 1:	Identify, classify and describe the morphology of specimen **A** and **B** assigned to you and write floral formula/floral diagram.	**(10)**
Q. 2:	Identify the genus and species of the given plant material **C** with the help of suitable flora.	**(05)**
Q. 3:	Identify Primitive/Advanced character of the given plant material **D.**	**(05)**
Q. 4:	**Identification** E. Identify and describe (taxonomic character) F. Identify and describe (Flora/Monograph)	**(04)**
Q. 5:	a) Journal	**(03)**
	b) Viva-voce	**(03)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur
M. Sc. I (Botany) Semester – I
Practical Examination
(As per NEP syllabus)
DSE (1) Plant Growth and Development

Date: **Total Marks: 30**
Time: 11:00am to 01:00pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) Write brief procedure wherever necessary.

Q. 1:	Perform the experiment to show effect of chemical compounds on Pollen germination of plant material 'A' **OR** changes in respiration rate during ripening of given material 'A' **OR** Pigment changes during ripening of given material 'A'	**(08)**
Q. 2:	Determine the changes in Starch and Sugars from plant material 'B' **OR** Acidity and TSS during ripening of plant material 'B' .	**(07)**
Q. 3:	**Identification** C) Identify and Describe D) Identify and Describe E) Identify and Describe F) Identify and Describe G) Identify and Describe	**(10)**
Q. 4:	Journal	**(05)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur
M. Sc. I (Botany) Semester – I
Practical Examination
(As per NEP syllabus)
DSE (1) Herbal and Drug Technology

Date: / /202 **Total Marks: 30**
Time: 11:00am to 01:00pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) Write brief procedure wherever necessary.

Q. 1:	Identify the given plant material. Write its morphological characters and uses of A and B (Aromatic/Spices/ medicinal plants)	**(10)**
Q. 2:	Prepare Churna by using given plant material C.	**(05)**
Q. 3:	Prepare Herbal lotion from given material D.	**(05)**
	OR	
	Prepare Herbal tooth powder from given plant material E.	
	Identify and Comment.	**(04)**
	E and **A)** Identify and Describe (Herbal oil/Herbal cough syrup)	
	B) Identify and comment (Perfume/Rose water)	
Q. 4:	Journal	**(03)**
Q. 5:	Viva voce	**(03)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur
M. Sc. I (Botany) Semester – II
Practical Examination
(As per NEP 2020 syllabus)
DSC (1): Biology and diversity of Gymnosperms and Paleobotany

Date: / /202 **Total Marks: 30**

Time: 11.00am to 1:00pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) write brief procedure wherever necessary.

Q.1.	Identify, Classify and Prepare the slide of given specimen's **'A'** and **'B'** and show it to the examiner. (*Cycas/Pinus/Gnetum*)	**(08)**
Q.2.	Macerate the given plant material show it to the examiner	**(08)**
Q.3.	**Identification** **E)** Identify and Describe (Gymnosperm) **F)** Identify and Describe (Gymnosperm) **G)** Identify and Describe (Paleobotany) **H)** Identify and Describe (Paleobotany)	**(08)**
Q.4.	Journal	**(03)**
Q.5	Viva voce	**(03)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur

M. Sc. I (Botany) Semester – II

Practical Examination

(As per NEP 2020 syllabus)

DSC (2): Advances in Plant Pathology

Date: / /202 **Total Marks: 30**

Time: 11.00am to 1:00 pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) write brief procedure wherever necessary.

Q.1.	Identify, write causal organism, symptoms and disease management of disease **'A'** and **'B'** and show it to the examiner. (*Fungal/Bacterial/viral/Phytoplasma*)	**(10)**
Q.2.	Estimate the chlorophyll/sugar/Polyphenol from healthy and diseased plant leaves **OR** Isolate the fungi from given soil Sample and inoculate on nutrient media	**(10)**
Q.3.	**Identification** **E)** Identify and Describe (Fungal Disease) **F)** Identify and Describe (Bacterial Disease) **G)** Identify and Describe (Viral Disease) **H)** Identify and Describe (phanerogamic Stem parasite/root parasite/fungicide/Biopesticide)	**(04)**
Q.4.	Journal	**(03)**
Q.5	Viva voce	**(03)**

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur

M. Sc. I (Botany) Semester – II

Practical Examination

(As per NEP 2020 syllabus)

DSE (2): Crop Physiology

Date: / /202 **Total Marks: 30**

Time: 11.00am to 1:00 pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) write brief procedure wherever necessary.

Q.1. Estimate the acid invertase in a given sample 'A' (08)

OR

Estimate the total lipids from given sample A.

Q.2. Perform the experiment effect of anti transpirants on stomatal behavior of given plant sample 'B' (08)

OR

Isolate the bacteria from given root nodule 'B', prepare smear preparation, stain it with proper stain and show it to the examiner

Q. 3. **Identification** (08)

C. Identify and describe (growth regulators)

D. Identify and describe (formula on growth parameters)

E. Identify and describe (instrument: centrifuge/spectrophotometer/pH meter)

F. Identify and describe (crop variety/ biofertilizer)

Q. 4. **Journal** (03)

Q. 5. **Viva** (03)

Punyashlok Ahilyadevi Holkar, Solapur University, Solapur

M. Sc. I (Botany) Semester – II

Practical Examination

(As per NEP 2020 syllabus)

DSE (2): Angiosperm Systematics

Date: / /202 **Total Marks: 30**

Time: 11.00am to 1:00 pm

Instructions:

1) Answer each question on separate answer book.
2) Show your requirements / preparation / Observations / to the examiners.
3) write brief procedure wherever necessary.

Q.1	Write the taxonomic description and economic importance of given family A & B (Dicot and Monocot)	12
Q.2	Compare the two different genus of same family and find out variation between two genera of given plant material C & D. **OR** Compare the two different species of same genus and find out variation between two species of given plant material C & D.	05
Q.3	**Identification** F) Identify and Describe (type of classification) G) Identify and Describe (Taxonomic tool/Herbarium equipment)	04
Q.4	Journal	03
Q.5	Submission of Herbarium (05)	05