KANNUR UNIVERSITY

**(Abstract)**

M.Sc Plant Science with Specialization in Ethnobotany Programme in the Department of Botany, Mananthavady Campus - Revised Scheme (All Semesters) & Syllabus (1st Semester Only) - Approved- Implemented w.e f 2023 admission- Orders Issued

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**ACADEMIC C SECTION**

ACAD C/ACAD C3/26940/2023 Dated: 13.02.2024

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Read:-1. U.O.No ACAD C/ ACAD C3/22373/2019 dated 12/09/2023

2. Circular No dated ACAD C/ ACAD C3/22373/2019 dated 12/09/2023
3. Email dated 23/12/2023 from the Course Coordinator, Dept of Botany, Mananthavady Campus
4. Minutes of the meeting of the Department Council dated 06/11/2023
5. U.O of even number dated 11/01/2024
6. Email dated 20/01/2024 from the Course Coordinator, Dept of Botany, Mananthavady Campus
7. Orders of vice chancellor in file of even No. dtd.09.02.2024.

**ORDER**

1. The revised Regulations for Post Graduate Programmes under Choice Based Credit and Semester System in the University Teaching Departments/ Schools were implemented w.e.f 2023 admissions vide paper read 1 above.

2. As per paper read 2 above, Heads of all Teaching Departments were requested to submit the revised Syllabus in accordance with the approved Regulations along with a copy of the Department Council Minutes.

3. As per paper read 3 above, the Course Co-ordinator, Dept. of Botany, Mananthavady Campus submitted the Scheme (All Semesters) and the Syllabus (1st Semester Only) of M. Sc Plant Science with Specialization in Ethnobotany Programme to be implemented in the University Teaching Department w. e. f 2023 admissions.

4. Department Council vide the paper read 4 above approved the aforementioned scheme and syllabus of M. Sc Plant Science with Specialization in Ethnobotany Programme to be implemented in the Dept. of Botany, Mananthavady Campus w.e.f.2023 admission.

5. As ordered by the Vice chancellor, a Committee was constituted vide paper read 5 above, to scrutinize/evaluate the Scheme & Syllabus of the aforementioned Programme and authorized the Course Coordinator to coordinate the Committee and convene online meetings to scrutinize/evaluate the syllabus and to submit the final Scheme & Syllabus of the Programme after incorporating the corrections / modifications suggested by the Committee along with the minutes of the Department Council approving the same.

6. As per paper read 6 above, the Course Co-ordinator, Dept. of Botany submitted the Scheme (All Semesters) and the Syllabus (1st Semester Only) of M. Sc Plant Science with Specialization in Ethnobotany Programme to be implemented in the University Teaching Department w. e. f 2023 admissions, approved by the department council held on 19.01.2024.

7. The Vice Chancellor, after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11(1), Chapter III of Kannur University Act 1996, ***approved the Scheme (All Semesters) & Syllabus (1st Semester Only) of M.Sc Plant Science with Specialization in Ethnobotany Programme and accorded sanction to implement the same in the Dept. of Botany, Mananthavady Campus w.e.f 2023 admissions, subject to report to the Academic Council .***

8.The Scheme (All semesters) and Syllabus (1st Semester Only) of M.Sc Plant Science with Specialization in Ethnobotany Programme under CBCSS implemented in the Dept of Botany, Mananthavady Campus with effect from 2023 admission, is appended and uploaded in the University website (www.kannuruniversity.ac.in)

9. Orders are issued accordingly.

*Sd/-*

**Narayanadas K**

**DEPUTY REGISTRAR (ACAD)**

For REGISTRAR

To: 1. Course Coordinator, Dept of Botany, Mananthavady Campus
2. Convenor, Curriculum Committee

Copy To: 1.PS to VC/ PA to PVC/ PA to R
2. To Examination Branch (through PA to CE)
3. EP IV/ EXC I
4. Computer Programmer
5. Webmanager (to publish in the website)
6. SF/DF/FC

Forwarded / By Order

SECTION OFFICER

# KANNUR UNIVERSITY

# M.Sc. PLANT SCIENCE

(Specialization in Ethnobotany)

# SCHEME & SYLLABUS

(Under Choice Based Credit & Semester System)

**2023 admission onwards**

## DEPARTMENT OF BOTANY

Kannur University

Mananthavady campus

**Post Graduate Programme in Plant Science**

The M.Sc. Plant Science course is a comprehensive two-year program designed to provide students with an advanced understanding of plant science divided into four semesters, each focusing on different areas of Plant Science.

## VISION

*To be a world class department with excellence in teaching and research by providing scientific and technological contributions*

## MISSION

*Promote quality education and innovative research in Plant Science.*

## PROGRAMME OUTCOMES

**PO 1 :** Demonstrate and apply the fundamental knowledge of the basic principles of major fields of biology. Take informed actions after identifying the assumptions that frame our thinking and actions, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

**PO2 :** Identify, formulate, conduct investigations, and find solutions to scientific problems based on in-depth knowledge of relevant domains.

**PO 3 :** Speak, read, write and listen clearly in person and through electronic media in English/language of the discipline, and make meaning of the world by connecting people, ideas, books, media and technology.

**PO 4 :** Demonstrate empathetic social concern, and the ability to act with an informed awareness of environmental issues. Communicate scientific information in a clear and concise manner both orally and in writing

**PO 5 :** Apply knowledge to solve the issues related to plant sciences with the help of computer technology. Recognize different value systems including your own, understand the moral dimensions of issues, and accept responsibility for them.

**PO 6 :** Acquire the ability to engage in independent and life-long learning in the broadest context socio- technological changes.

**PO 7 :** Apply the knowledge to develop the sustainable and eco-friendly technology in Industrial Botany.

## PROGRAMME SPECIFIC OUTCOMES

**PSO 1 :** A student completing the course can understand different specializations of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, Genetics and molecular biology of various life-forms.

**PSO 2 :** The students gets trained in various analytical techniques of plant biology, use of plants as industrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.

**PSO 3 :** The student completing the course can identify various life forms of plants, design and execute experiments related to basic studies on evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, proteomics and transgenic technology.

**PSO 4 :** The students will get hands-on training in the field of ethnobotany and conservation biology and unique subjects like wetland ecology, landscape ecology etc. Students are also familiarized with the use of bioinformatics tools and databases for the identification of lead molecules for drugs and also to apply statistical tools on biological data.

**PSO 5 :** The student completing the course will be capable to execute short research projects incorporating various tools and techniques in any of the basic specializations of Plant Sciences, in addition to being specialised in ethnobotany and conservation biology

**PSO 6 :** The program will equip students with research skills required for independent study and original research in plant science. They will learn to conduct literature reviews, identify research gaps, formulate research questions, and develop research plans to explore and contribute to the field.

**DURATION**: 2 Years (4 semesters)

**INTAKE**: 13 Nos.

**ELIGIBILITIES:**

- Any B.Sc degree equivalent to B.Sc Botany/Plant Science with 50% marks.

**ADMISSION:**

- The selection of the candidate is based on Admission test. The admission test will cover Plant Science at the undergraduate level.

**COURSE DETAILS:**

A student must register for the required number of courses at the beginning of each semester. No students shall register for more than 24 credits and less than 16 credits per semester.

A total of 80 credits shall be the minimum for successful completion of the course in which a minimum of 56 credits for core course and electives and 8 credit s from outside are mandatory. Those who secure only minimum credit for core/ elective subjects has to supplement the deficiency for obtaining the minimum total credits required for successful completion of the program from the other divisions.

**EVALUATION:**

The faculty member who teaches the course shall do evaluation of the students for each course on the basis of Continuous Evaluation and End Semester Examination shall be evaluated by External Examiners. The proportion of the distribution of marks among the continuous evaluation and end semester examination shall be **40:60**.

Continuous Evaluation includes assignments, seminars, and written examination for each course. Weightage to the components of continuous evaluation shall be given for all theory papers of the course as follows:

| Theory | | | Practical | |
|---|---|---|---|---|
| Components of CE | Minimum Number | Percentage | Components | Percentage |
| Test paper | 2 | 40 % | Practical Test | 80 % |
| Assignments | 1 | 20 % | Record | 20 % |
| Seminar, Viva, Presentation, Discussion and Debate | 1 | 40 % | - | - |

**GRADE POINTS**

A 7-point direct grading system is used for evaluation of the performance of each answer in an examination. Grade points corresponding to each is given below.

| Letter Grade | Grade Points (P) |
|---|---|
| O (outstanding) | 6 |
| A+ (Excellent) | 5 |
| A (Very good) | 4 |
| B+ (Good) | 3 |
| B (Average) | 2 |
| C (Satisfactory) | 1 |
| F (Poor/ Not attempted) | 0 |

Then the Weighted Grade Point Average (WGPA) is computed as follows

$$\textbf{(WGPA)} = \Sigma \textbf{ (Pi x Wi)/ } \Sigma \textbf{ (Wi)}$$

Where Pi is the grade point awarded to $i^{th}$ answer and Wi is the weightage assigned to that question. Σ (Wi) indicate the total weightage of the examination.

The weighted grade point average of Continuous Evaluation ($P_{CE}$) is computed as follows.

$$\mathbf{P_{CE} = (P1 \text{ x } W1 + P2 \text{ x } W2 + P3 \text{ x } W3 + ...) / (W1 + W2 + W3 + .....)}$$

Where Pl, P2, P3 etc. are the grade points of different components and W1, W2, W3 etc. are the weightages of the components. If the candidate is absent in any of the components. '0' point should be awarded to that component and included in the computation.

The weighted grade point average of a course (G) (scaling-up to maximum grade point 10) is computed as given below.

$$\mathbf{G = (P_{CE} \text{ x } 40 + P_{ESE} \text{ x } 60) /60}$$

Where $P_{CE}$ is the WGPA of CE and $P_{ESE}$ is the WGP.A of ESE. The grade points should be rounded off to two decimal places.

**Test Paper:** For each course there shall be at least two class tests during a semester.

**Assignments:** Each student shall be required to do one assignment for each course.

**Seminar:** Students are required to present a seminar on a selected topic in each paper. The

evaluation of the seminar shall be done by the concerned teacher handling the course.

**Attendance:** Minimum attendance required for each paper shall be 75% of the total number of classes conducted for that semester. Those who secured the minimum requirement of attendance only be allowed to register/appear for End Semester Examination.

Condonation of attendance to a maximum of 10 days in a semester subject to a maximum of two times during the whole period of the PG program may be granted by the university as per university rules.

**Conduct of Examination:**

The vice chancellor will approve the panel of examiners submitted by the Head of the Department. All the teachers of the Department will be the members of the Board of examiners with Head of the Department as the Chairperson. There shall be a minimum of two external examiners. The panel approved by the Vice-Chancellor will be entrusted with the setting of question papers, conduct and evaluation of examination.

**Research Project:**

The students have to complete a project during IV Semester under the guidance of a faculty in the department or with other institutions.

## GRADING

An alphabetical Grading System shall be adopted for the assessment of a student's performance in a Course. The following tables gives the WGPA and corresponding letter grade in course.

| WGPA | Letter Grade |
|---|---|
| 9.5 and above | O |
| 8.5 and above but less than 9.5 | A+ |
| 7.5 and above but less than 8.5 | A |
| 6.5 and above but less than 7.5 | B+ |
| 5.5 and above but less than 6.5 | B |
| 4.5 and above but less than 5.5 | C |
| 4.0 and above but less than 4.5 | D |
| Less than 4.0 | F |

Based on CGPA the overall letter grade of the student and the classification shall be in the following way

| CGPA | Overall Letter Grade | Classification |
|---|---|---|
| 9.5 and above | O | Outstanding |
| 8.5 and above but less than 9.5 | A+ | Excellent |

| | | |
|---|---|---|
| 7.5 and above but less than 8.5 | A | Very Good |
| 6.5 and above but less than 7.5 | B+ | Good |
| 5.5 and above but less than 6.5 | B | Above Average |
| 4.5 and above but less than 5.5 | C | Average |
| 4.0 and above but less than 4.5 | D | Pass |
| Less than 4.0 | F | Fail |

## SCHEME

**Total Credits: 21**, Discipline Specific Core Courses (DSC): **18**, Discipline Specific Elective Course (DSE): **3**

| **FIRST SEMESTER** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Title of Paper** | **Contact hrs./Week** | | | **Grade** | | **Credits** |
| | | **L** | **T/S** | **P** | **ESE** | **CE** | |
| **Discipline Specific Core Courses (DSC)** | | | | | | | |
| MSPSC 01DSC01 | Biology of Archegoniate | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 01DSC02 | Anatomy and Microtechnique | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 01DSC03 | Genetics and Evolution | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 01DSC04 | Mycology and Plant Pathology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 01DSC05 | **PRACTICAL 1** Biology of Archegoniate, Anatomy of Angiosperms and Microtechnique | - | - | 5 | 60% | 40% | 3 |
| MSPSC 01DSC06 | **PRACTICAL 2** Genetics, Mycology and Plant Pathology | - | - | 5 | 60% | 40% | 3 |
| | **Total** | **12** | **4** | **10** | **60%** | **40%** | **18** |
| **Discipline Specific Elective Courses (DSE)** | | | | | | | |
| MSPSC 01DSE01 | Methodology and Philosophy of Science | 3 | 1 | - | 60% | 40% | 3 |
| | **Total** | **30** | | | 60% | 40% | **21** |

**Total Credits: 27**, Discipline Specific Core Courses (DSC): **15**, Discipline Specific Elective Course (DSE): **6**, Multidisciplinary Elective (MDC) to be obtained from other departments: **2**, Ability Enhancement Course (AEC) to be obtained from other departments: **2**, Skill Enhancement Course to be obtained from other departments (SEC): **2**.

| **SECOND SEMESTER** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Title of Paper** | **Contact hrs./Week** | | | **Grade** | | **Credits** |
| | | **L** | **T/S** | **P** | **ESE** | **CE** | |
| **Discipline Specific Core Courses (DSC)** | | | | | | | |
| MSPSC 02DSC07 | Taxonomy and Advanced Plant Systematics. | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 02DSC08 | Cell and Molecular Biology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 02DSC09 | Plant Physiology and Biochemistry | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 02DSC010 | **Practical III** Taxonomy and Advanced Plant Systematics. | - | - | 5 | 60% | 40% | 3 |
| MSPSC 02DSC011 | **Practical IV** Cell and Molecular Biology and Plant Physiology and Biochemistry | - | - | 5 | 60% | 40% | 3 |
| | **Total** | **9** | **3** | **10** | **60%** | **40%** | **15** |
| **Discipline Specific Elective Courses (DSE) (**Any 2 courses to be chosen) | | | | | | | |
| MSPSC 02DSE02 | Developmental Biology of Plants | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 02DSE03 | Environmental Science | 3 | 1 | - | 60% | 40% | 3 |
| 02DSE04 | Seed Technology | 3 | 1 | - | 60% | 40% | 3 |
| | **Total** | **6** | **2** | | **60%** | **40%** | **6** |
| **Multidisciplinary Elective (MDC) offered for other departments** | | | | | | | |
| MSPSC 02MDC01 | Ecology and Environment | 2 | 1 | - | 60% | 40% | 2 |
| MSPSC 02MDC02 | Philosophy of Science | | | | | | |
| **Multidisciplinary Elective (MDC) To be obtained from other departments** | | | | | | | |
| ------ | | 2 | 1 | - | 60% | 40% | 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Ability Enhancement Course (AEC) offered for other departments** | | | | | | | |
| MSPSC 02AEC01 | Organic Farming | 2 | 1 | - | 60% | 40% | 2 |
| MSPSC 02AEC02 | Floriculture | | | | | | |
| **Ability Enhancement Course (AEC) To be obtained from other departments** | | | | | | | |
| ----- | | 2 | 1 | - | 60% | 40% | 2 |
| **Skill Enhancement Course (SEC) offered for other departments** | | | | | | | |
| MSPSC 02SEC01 | Mushroom Technology | 2 | 1 | - | 60% | 40% | 2 |
| **Skill Enhancement Course (SEC) To be obtained from other departments** | | | | | | | |
| -------- | | 2 | 1 | - | 60% | 40% | 2 |
| **Total** | | **44** | | | **60%** | **40%** | **27** |
| *** Value Added Course (VAC)** | | | | | | | |
| MSPSC 02VAC01 | Biology-Ethics and Philosophy | 1 | 1 | - | 60% | 40% | 2 |

* Not to be added to the total credit of the program

**Total Credits: 23**. Discipline Specific Core Courses (DSC): **15**, Discipline Specific Elective Courses (DSE): **6**, Multidisciplinary Elective (MDC) to be obtained from other departments: **2**

| **THIRD SEMESTER** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Title of Paper** | **Contact hrs./Week** | | | **Grade** | | **Credits** |
| | | **L** | **T/S** | **P** | **ESE** | **CE** | |
| **Discipline Specific Core Courses (DSC)** | | | | | | | |
| MSPSC 03DSC12 | Biotechnology and Nano Biology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 03DSC13 | Bioinformatics | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 03DSC14 | Ethnobotany and Ethnopharmacology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 03DSC15 | **Practical V** Plant Biotechnology, Tissue Culture and Bioinformatics | - | - | 5 | 60% | 40% | 3 |
| MSPSC 03DSC16 | **Practical VI** Ethnobotany and Ethnopharmacology | - | - | 5 | 60% | 40% | 3 |
| | **Total** | **9** | **3** | **10** | **60%** | **40%** | **15** |
| **Discipline Specific Elective Courses (DSE) (**Any 2 course to be chosen) | | | | | | | |
| MSPSC 03DSE05 | Methods in Plant Biology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 03DSE06 | Tissue culture and Plant Breeding | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC 03DSE07 | Microbiology | | | | | | |
| | **Total** | **6** | **2** | | **60%** | **40%** | **6** |
| **Multidisciplinary Elective (MDC) offered for other departments** | | | | | | | |
| MSPSC03 MDC03 | Agri-business | 2 | 1 | - | 60% | 40% | 4 |
| MSPSC 03MDC04 | Environmental Auditing and Impact Assessment | 2 | 1 | - | 60% | 40% | 4 |
| | Plant Tissue Culture and Conservation | 2 | 1 | - | 60% | 40% | 4 |
| MSPSC 03MDC05 MSPSC 03MDC06 | Ethnobotany and Conservation | 2 | 1 | - | 60% | 40% | 4 |
| **Multidisciplinary Elective (MDC) to be obtained from other departments** | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ----- | | 2 | 1 | - | 60% | 40% | 2 |
| | **Total** | **39** | | | **60%** | **40%** | **23** |

**Total credits: 16**, Discipline Specific Core Courses (DSC): **3**, Discipline Specific Elective Courses (DSE): **3**, Project (P): **10**

| **Fourth Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Title of Paper** | **Contact hrs./ Week** | | | **Grade** | | **Credits** |
| | | **L** | **T/S** | **P** | **ESE** | **CE** | |
| **Discipline Specific Core Courses (DSC)** | | | | | | | |
| MSPSC04 DSC17 | Conservation Biology | 3 | 1 | - | 60% | 40% | 3 |
| **Discipline Specific Elective Courses (DSE) (**Any 1 course to be chosen) | | | | | | | |
| MSPSC04 DSE08 | Forest Botany | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC04 DSE09 | Land Scape Ecology | 3 | 1 | - | 60% | 40% | 3 |
| MSPSC04 DSE10 | Wetland Ecology | 3 | 1 | - | 60% | 40% | 3 |
| **Project (P)** | | | | | | | |
| MSPSC04 DSC18 | Project Work | - | - | 24 | 60% | 40% | 10 |
| **Total** | | **32** | | | **60%** | **40%** | **16** |
| **Grand Total** | | **145** | | | **60%** | **40%** | **87** |

# FIRST SEMESTER M.Sc. PLANT SCIENCE PROGRAMME

## CORE COURSE

| Course Code& Title: | MSPSC01DSC01: BIOLOGY OF ARCHEGONIATAE | Module Outcome |
|---|---|---|
| **Course Objectives:** | 1. To study the various groups of Algae, Bryophytes, Pteridophytes, Gymnosperms<br>2. To compare the similarities and differences in these groups | |
| **Module1**<br>**16 hours** | **Algae:**<br>Introduction-History of Phycology-General characteristics.<br>1. Classification of Algae according to van den Hoek et al. 1995. A brief account of the recent development in molecular phylogenetics and DNA barcoding of algae.<br>2. Diversity of algae and cyanobacteria.<br>3. Morphology: Range of thallus structure.<br>4. Reproduction and life history.<br>5. Collection, identification, preservation (including herbarium techniques) of algae.<br>6. General account of the structure, reproduction and relationships in the following group Chlorophyta; Xanthophyta; Phaeophyta, Bacillariophyta, Euglenophyta and Rhodophyta. Cyanophyta: structure of cell, akinete and heterocyst, pigments, chromatic adaptation, thallus organization and reproduction.<br>7. Applied aspects of algae and cyanobacteria: biodiesel, hydrogen, methane and ethanol production, carbon dioxide sequestration, industrial applications, food supplements, pharmaceutical industries, biofertilizers, bioremediation, biodegradation, algal blooms, commercial cultivation of algae, mass production and field application of cyanobacteria. | 1. The students will be able to collect, preserve, study and describe the general characteristics, classification and diversity of algae and cyanobacteria, their morphology, anatomy, reproduction and life history.<br>2. The students will also be able to evaluate the applied aspects of algae and cyanobacteria, such as biofuel production, carbon sequestration, industrial applications, food supplements, biofertilizers, bioremediation, algal blooms and commercial cultivation. |

| | | |
|---|---|---|
| | 8. Fossil algae and cyanobacteria.<br><br>**References**<br>Chapman, V. J. 1941. An Introduction to the Study of Algae. Cambridge University Press.<br>Chapman, V. J. & Chapman, D. J. 1973. The Algae. Macmillan.<br>Desikachary, T. V. 1959. Cyanophyta. Indian Council of Agricultural Research.<br>Fritsch, F. E. 1961. The Structure and Reproduction of Algae. Vol. 2. Cambridge University Press.<br>Irvine, D. E. & D. M. John. 1984. Systematics of the Green Algae. Academic Press.<br>Stevensen, J. et al. 1996. Algal Ecology. Freshwater benthic ecosystems. Academic Press.<br>Krishnamurthy, V. 1998. Algae of India and Neighboring Countries. 1. Chlorophycota. Oxford & IBH publishing Co. Pvt. Ltd.<br>Kumar, H. D. 1990. Introductory phycology. East West Press Pvt. Ltd.<br>Prescott, G. W.1969. The Algae. A Review. Thomas Nelson and Sons Ltd<br>Round, F. E. 1975. The Biology of Algae. Edward Arnold.<br>Smith, G. M. 1978. Manual of Phycology. The Ronald Press Company.<br>Trainor, F. R. 1978. Introductory Phycology. John Wiley and Sons.<br>Van Den Hock, Mann, D.G. and Jahns, H.M. 1995. Algae: An Introduction to Phycology. Cambridge University Press.<br>Venkataraman, G. S. 1972. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's publishers.<br>Venkataraman, G. S., Goyal, S. K., Kaushik B. D., and Roychaudhary, P. 1974. Algae form and function. Today and Tomorrow's printers.<br>Vijayaraghavan, M. R. & Bhatia, B. 1997. Red Algae: Structure, Ultrastructure and Reproduction. APH Publishing Corporation. | |

| | | |
|---|---|---|
| **Module2**<br>**12 hours** | **Bryophytes:**<br>1. General habit, habitat, distribution, biogeography, growth forms and systems of classification of bryophytes. A brief account of the recent developments in molecular phylogenetics and DNA barcoding of bryophytes.<br>2.Origin of bryophytes<br>3. General account of the anatomy, reproduction and life history of Marchantiales, Jungermanniales, Polytrichales and Anthocerotales.<br>4. Applied bryology: Ecological uses, household uses, medicinal uses (herbal medicines, transgenic products), decorative bryophytes, aquarium bryophytes, heavy metal detection and clean up, erosion control, horticultural uses (soil conditioning, air layering, pot culture, container gardens and hanging baskets), bioindicators of pollution.<br>5.Fossil bryophytes: a general account. | 1. The students will be able to explain the general habit, habitat, distribution, anatomy, reproduction and classification of bryophytes.<br>2. The students will be also able to assess the applied bryology of bryophytes, such as their ecological, household, medicinal, decorative, horticultural and bioindicator uses. |
| | **References**<br>Smith, A. J. E. (ed.). 1982. Bryophyte Ecology. Chapman & Hall.<br>Shaw, A. J. & Goffinet, B. (eds.). 2000. Bryophyte Biology, Cambridge University Press.<br>Glime, J. M. & Saxena, D.1991. Uses of Bryophytes. Today and Tomorrows Printers & Publishers.<br>Schofield, W. B. 2001. Introduction to Bryology. The Blackburn Press.<br>Nair, M. C. et al. 2005. Bryophytes of Wayanad, Western Ghats. MNHS, Calicut | |
| **Module 3**<br>**14 hours** | **Pteridophytes:**<br>1. Introduction to pteridophytes: general characteristics, life cycle, classification. Brief account of the recent developments in molecular phylogenetics and DNA barcoding of pteridophytes.<br>2. Diversity of forms among pteridophytes: general morphology with special reference to South Indian species of Lycopodiales, Isoetales, Marattiales, Filicales (Gleicheniaceae, Adiantaceae, Cyatheaceae).<br>3. Fossil pteridophytes: Psilophytales, Lepidodendrales, | 1. The students will be able to understand the general characteristics, morphology, anatomy, life cycle and classification of pteridophytes,<br>2. The students will be able to understand the stelar evolution, heterospory and seed habit in pteridophytes. |

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| | 4. Habitat diversity of pteridophytes: epiphytes, lithophytes, climbers, halophytes, saprophytes, sciophytes, xerophytes, mesophytes, hydrophytes.<br>5. Stelar evolution: protostele, siphonostele, solenostele, dictyostele and special stellar types; vessels in pteridophytes.<br>6. The fern gametophytes: pattern of development, the morphology of mature gametophytes.<br>7. Heterospory and evolution of seed habit.<br>8. Cytology: chromosome number and morphology; polyploidy, the origin of polyploids, apospory, apogamy, agamospory.<br>9. Applied pteridology: bio-fertilizer production from Azolla: Azolla - Anabaena symbiosis; Pteridophytes as weeds: Salvinia (aquatic) and Pteridium (terrestrial); ornamental and medicinal pteridophytes.<br><br>**References**<br>Bierhost, D. W. 1971. Morphology of Vascular Plants. Macmillan Co.<br>Dyer, A. C. 1979. The experimental Biology of Ferns. Academic Press.<br>Hameed, C. A., Rajesh, K. P. and Madhusoodanan, P. V. 2003. Filmy Ferns of South India. Penta Book Publishers & Distributors.<br>Jermy, A. C. 1973 (Ed.). The Phylogeny and Classification of Ferns. Academic Press.<br>Kramer, K. U. & Green, P. S. 1991. The families and genera of Vascular Plants, Narosa.<br>Nampy, S. and Madhusoodanan, P. V. 1998. Fern Flora of South India-Taxonomic Revision of Polypodioid Ferns. Daya Publishing House. | |
| **Module 4**<br>**14 hours** | Gymnosperms: 1. General characters, classification. A brief account of the recent developments in molecular phylogenetics and DNA barcoding of gymnosperms. 2. Geological horizon, distribution, general account including morphology, anatomy, phylogeny and interrelationship of the following orders a) Pteridospermales:. b) Glossopteridales: c) | The students will be able to outline the general characters, classification, morphology, anatomy, interrelationships, phylogeny and evolution of gymnosperms and |

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| | Caytoniales : d) Cycadeoidales: e) Pentoxylales: f) Cycadales: g) Ginkgoales: h)Cordaitalesi) Coniferales: j) Taxales: k) Ephedrales: l) Welwitschiales: m) Gnetales: 3. Evolution of gymnosperms 4. Distribution of living and fossil gymnosperms in India. 5. Economic importance of gymnosperm<br><br>**References**<br>Andrews Jr., H. N. 1961. Studies in Paleobotany. John Wiley, New York<br>Arnold, C. A. 1953. Origin and relationships of the cycads. Phytomorphology 3: 51-65<br>Beck, C. B. 1985. Gymnosperm phylogeny: A commentary on the views of S.V. Meyen. Bot. Rev. 51: 273-294<br>Chamberlain, C. J. 1919. The Living Cycads. Chicago University Press, Chicago.<br>Chemberlain, C. J. 1935. Gymnosperms: Structure and Evolution. Chicago University Press.<br>Crepet, W. L. 1972. Investigations of North American cycadeoids: Pollination mechanisms in Cycadeoidea. Amer. J. Bot. 59: 1048-1056<br>Dallimore, W. & Jackson, A. B. 1966. A Handbook of Conifera. 4th edn, E. Arnold.<br>Delevoryas, T. 1962. Morphology and evolution of fossil plants. New York.<br>Favre-Duchartre, M. 1958. Ginkgo, an oviparous plant. Phytomorphology 8: 377-390<br>Freedman, W.E. 1992a. Double fertilization in non-flowering seed plants and its relevance to the origin of flowering plants. Intl. Rev. Cytol. 140: 319-355.<br>Freedman, W. E. 992b. Evidence of a pre-angiosperm origin of endosperm: Implications for the evolution of flowering plants. Science 235: 336-339.<br>Greguss, P. 1955. Identification of Living Gymnosperms based on Xylotomy. AkadKiado.<br>Harris, T. M. 1951. The relationships of the Caytoniales. Phytomorphology 1: 29-39. | their transition to angiosperms. |

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| | Mehra, P. N. 1988. Indian Conifers: Gnetophytes and Phylogeny of Gymnosperms. Pramodh P. Kapur, Raj Bandhu Ind. Complex, New Delhi<br>Meyen, S. V. 1984. Basic features of gymnosperm: Systematics and phylogeny as evidenced by the fossil record. Bot. Rev. 50: 1-111<br>Meyen, S. V. 1986. Gymnosperm systematics and phylogeny: A reply to commentaries by CB Beck, CN Miller, and GW Rothwell. Bot. Rev. 52: 300-320<br>Millay, M. A., & Taylor, T. N. 1976. Evolutionary trends in fossil gymnosperm pollen. Rev. Palaeobot. Palynol. 21: 65-91.<br>Miller Jr., C.N. 1977. Mesozoic confers. Bot. Rev. 43: 217-280<br>Pant, D. D. 1975. The classification of gymnospermous plants. Palaebot. 6: 65-70<br>Pearson HHW (1929) Gnetales, Cambridge Univ. Press, London<br>Madhulata, Sanwal. 1962. Morphology and embryology of Gnetumgnemon L. Phytomorphology 12: 243-264<br>Scott, D. H. 1909. Studies in Fossil Botany, 2nd edn. Vol 1 A and C Black, London<br>Scott, D. H. 1923. Studies in Fossil Botany, Vol 2. A and C Black, London.<br>Sharma, B. D. 1994. Gymnosperms: Morphology, Systematics, Reproductive Biology, In: Johri, B.M. (ed.), Botany in India: History and Progress. Vol. 2. Oxford & IBH, New Delhi. pp 1-23.<br>Singh, H. 1978. Embryology of Gymnosperms. Geb Borntrager, Berlin.<br>Stewart, W.N. 1981. The Progymnospermospsida: The construction of a concept. Can. J. Bot. 59: 1539-1542.<br>Stewart, W. N. 1983. Palaeobotany and the evolution of plants. Cambridge University Press | |

| **Course Code& Title:** | **MSPSC01DSC02<br>ANATOMY AND MICROTECHNIQUE** | **Module Outcome** |
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| **Course Objectives:** | To study the internal organisation of plants and the techniques associated with the study. | |
| **Module I**<br>**16 hrs** | **Anatomy:** Introduction -Internal organisation of plant body -Methods of studying the Anatomy of the plant. Meristems: Shoot apical meristem and functional zones, axillary floral and inflorescence meristems – structural diversity of the vegetative meristems. Cell differentiation: tracheary element differentiation, secondary wall formation, vascular differentiation, development of aerenchyma, development of laticifers. Origin and structure of secondary plant body: vascular cambium formation-structure and formation of vascular cambium, anomalous secondary growth-classification, origin and function, primary thickening meristem in monocots, secondary growth in arborescent Liliaceae.<br><br>**References**<br>Beck, C. B. (2005) An Introduction to Plant Structure and Development. Cambridge University Press.<br>Esau, K. (1977) Anatomy of Seed Plants. 2nd edition. John Wiley & Sons.<br>Fahn, A. (1990) Plant Anatomy. 4th edition. ButterworthHeinemann Ltd.<br>Mauseth, J. D. (1988) Plant Anatomy. The Benjamin Cummings Publishing Co.<br>Raghavan V. (1999) Developmental Biology of Flowering Plants. Springer. | The module aims to provide students with a thorough understanding of the anatomy of the plant body, the development and differentiation of plant cells and tissues, the differentiation, structure and function of vascular systems and the origin and structure of secondary plant body with various types anatomical adaptations during secondary growth |
| **Module II**<br>**14 hrs** | Structure and function of vascular tissues: xylem - structure and water movement. Phloem - structure and metabolite translocation, transfer cells, phloem loading and unloading. Secondary cambium: classification, origin and constitution of cambium, cambial activity, cambium in wound healing and grafting, cork-cambium, origin and function. Root: development, structural organization of root apical meristem, developmental activities, developmental zones, longitudinal files of cells, Q. C. concept and pro-meristem concept. T- division. Leaf: development, structural diversity, anatomy of C3 and C4 plants. | Students will get interrelated concept of the structure and function of vascular tissues, such as xylem and phloem, and their role in water and nutrient transport in plants. To comprehend development and diversity of root and leaf anatomy, and their adaptations to different ecological conditions. The course also examines |

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| | Ecological leaf anatomy, sun and shade leaves, xeromorphic leaves, succulent leaves, halophytic leaves and hydromorphic leaves. Stress anatomy: anatomy and pollution, anatomical response to water stress and mineral deficiency, effects of pollution, insecticides and herbicides.<br><br>**References**<br>Beck, C. B. (2005) An Introduction to Plant Structure and Development. Cambridge University Press.<br>Esau, K. (1977) Anatomy of Seed Plants. 2nd edition. John Wiley & Sons.<br>Fahn, A. (1990) Plant Anatomy. 4th edition. Butter worth Heinemann Ltd.<br>Mauseth, J. D. (1988) Plant Anatomy. The Benjamin Cummings Publishing Co.<br>Raghavan V. (1999) Developmental Biology of Flowering Plants. Springer. | the effects of stress factors, such as pollution, water deficiency, and mineral deficiency, on plant anatomy. |
| **Module III 14hrs** | **Microtechnique:**<br>1. Microscope-Construction and Use-Light microscope, Phase contrast and electron microscope, Micrometric measurements and camera lucida.<br>2. Microtomes: Rotary, Sledge, and Cryostat.<br>3. Processing procedure for micro preparation:<br>(i) Fixation and Storage-Killing and fixing: Principle and purpose, Common chemical fixatives, their preparation and specific uses; FAA, Carnoy's fluid, acetic alcohol, CRAF, Nawashins fluid, and Zircle's fluid.<br>(ii) Dehydration: Principle and procedure, Dehydrating agents – Ethyl alcohol, n-Butyl alcohol, Tertiary butyl alcohol, Isopropyl alcohol and Chloroform. Different dehydrating series: Alcohol-Xylene method, Alcohol-TBA method & Alcohol Chloroform method.<br>(iii) Paraffin infiltration – use of embedding oven (iv) Embedding: Preparation of blocks. 'L' block and paper boat. (v) Sectioning of paraffin blocks using rotary microtome: Trimming individual blocks and section cutting.<br><br>**References** | Students will be familiarised with of various types of microscopes, microtomes, and staining techniques to prepare and observe plant specimens. They will be exposed to the principles and procedures of fixation, dehydration, embedding, sectioning, mounting, and clearing of plant tissues<br>Perform histochemical staining, enzyme histochemistry, and vital staining to localize and detect various molecules and |

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| | Miksche, J. P. (1976). Botanical Microtechnique and Cytochemistry. Iowa State University Press.<br>Gahan, P. B. (1984) Plant Histochemistry. Academic Press.<br>Jensen, W. A. (1962) Botanical Histochemistry. WH Freeman & Company.<br>Johansen, D. A. (1940) Plant Microtechnique. McGraw Hill.<br>Khasim, S. M. (2002) Botanical Microtechnique: Principles and Practice. Capital Publishing Company.<br>Pearse, A. G. E. (1980) Histochemistry, Theoretical and Applied. 4th Edition, Vol. 1 & 2. Churchill Livingstone.<br>Sanderson, J. B. (1994). Biological Microtechnique. Bios Scientific Publishers. | enzymes in plant tissues |
| **Module IV**<br>**10 hrs** | Adhesives and their preparations. Mounting and spreading of paraffin ribbons on micro slides. Staining: Stains used in microtechnique; Classification – Natural – Hematoxylene, Carmine, Orcein.Synthetic (coal tar) – Basic: Safranin, Crystal violet, Basic fuchsin, Cotton blue - Acidic: Fast green, Orange G, Erythrosine, Eosin, and Toluidine blue.Staining procedure: Single, double and triple staining. Staining combination: safranin and fast green /cotton blue crystal violet and orange-G/erythrosine, Hematoxyline, and safranin. Techniques of clearing, mounting, labelling and storing of permanent slides.Whole mounts, Vein clearing, and tissue maceration. Histochemical staining: Localization of proteins, nucleic acids, insoluble carbohydrates & lipids. Enzyme histochemistry – General account. Vital staining: Principle, procedure, and applications.<br>**References**<br>Miksche, J. P. (1976). Botanical Microtechnique and Cytochemistry. Iowa State University Press.<br>Pearse, A. G. E. (1980) Histochemistry, Theoretical and Applied. 4th Edition, Vol. 1 & 2. Churchill Livingstone.<br>Sanderson, J. B. (1994). Biological Microtechnique. Bios Scientific Publishers.<br>Krishnamoorthy K. V. (1999) Methods in Cell Wall Cytochemistry. C.R.C. Press. | The module enables students to acquire the knowledge and skills of using various adhesives, mounting techniques, and staining procedures to prepare and observe plant specimens.<br>Train students to perform single, double, and triple staining, and to use various staining combinations to enhance the contrast and visibility of plant tissues<br>Introduce students to the methods and applications of histochemistry, whole mounts, vein clearing, and tissue maceration techniques |

| Course Code & Title | MSPSC01DSC03<br>GENETICS AND EVOLUTION | Module Outcome |
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| **Course Objectives:** | Understand the basic principles of genetics and heredity like Mendelian laws of inheritance, chromosome theory of inheritance, sex determination, linkage and mapping, extrachromosomal inheritance, prokaryotic genetics and population genetics. | |
| **Module 1**<br>**12 hours** | **Science of Genetics :**<br>An overview of modern history of the science of Heredity-Classical, Molecular and Evolutionary Genetics-The discovery and re discovery of Genes. Probability factor in Mendelian genetics- A critical analysis. Chi- square analysis, pedigree analysis and probability.<br>**Allelic interactions**- Incomplete Dominance and Codominance, Lethal Alleles, Hierarchy of Dominance, Multiple Alleles, Pleiotropy,<br>**Non allelic interactions**-Epistasis<br>Polygenic inheritance, Quantitative trait loci (QTL), Statistics of quantitative genetics- Heritability. Genetic analysis pathways-Complementation test for alleles, Penetrance and Expressivity, Genes and Environment-Genetics and society.<br>**Chromosomal Basis of Inheritance**: Chromosomal theory of inheritance, Sex-linked traits, Pedigree analysis of sex-linked traits, Activation and inactivation of X-chromosome, Sex-influenced traits, Sex-limited traits, Sex Determination. | The students will be able to solve the problems related to allelic interactions and understand the chromosomal basis of inheritance |
| **References Module I** | 1. Snustad PD, Simmons MJ. 2015. Principles of Genetics, 7th edition. Wiley.<br>2. Klug WS, Cummings MR, Spencer CA, Palladino MA, Darrell Killian. 2018.<br>Concepts of Genetics, 12th edition. Pearson.<br>3. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 2015. Introduction to Genetic<br>Analysis, 11th edition. W.H. Freeman & Worth Publishers.<br>4. Pierce BA. 2016. Genetics: A Conceptual Approach 6th edition. W. H. Freeman.<br>Strickberger MW. 2015. Genetics, 3rd edition. Pearson.<br>5. Samuels ML, Witmer JA, Schaffner A. 2015. Statistics for the Life Sciences, 5th<br>edition. Pearson.<br>6. Brooker R. 2017. Genetics: Analysis and Principles, 5th edition. McGraw-Hill Higher | |

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| | Education<br>7. Tamarin R, 7th edition. 2017. Principles of Genetics.<br>McGraw Hill Education.<br>8. Elrod S, Stansfield W. 2010. Schaum's Outline of Genetics,<br>5th edition. McGraw-Hill | |
| **Module 2**<br>**12 hours** | **Linkage and Gene Mapping:**<br>Linkage, Crossing over, Evolutionary significance ofrecombination, Two-point test cross, Three-point test cross, Genetic Mapping, Genetic mapping in Drosophila, Linkage and mapping using tetrads, Physical mapping, Application of mapping.<br><br>**Eukaryotic chromosomes-structure, classification and organization**, Banding, karyotyping,Chromosomal aberrations. Extra chromosomal inheritance: Cytoplasmic inheritance, Mitochondrial DNA, interplay between mitochondria and nuclear gene products, Chloroplast DNA, chloroplast biogenesis, Origin and evolution of mitochondria and chloroplast, Maternal effect. Introduction to Epigenetic inheritance: Epigenetic inheritance, Genomic Imprinting and Anticipation | Students will be able to describe about the molecular, quantitative and evolutionary genetics. |
| **References**<br>**Module 2** | 1. Snustad PD, Simmons MJ. 2015. Principles of Genetics, 7th edition. Wiley.<br>2. Klug WS, Cummings MR, Spencer CA, Palladino MA, Darrell Killian. 2018.<br>Concepts of Genetics, 12th edition. Pearson.<br>3. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 2015. Introduction to Genetic<br>Analysis, 11th edition. W.H. Freeman & Worth Publishers.<br>4. Pierce BA. 2016. Genetics: A Conceptual Approach 6th edition. W. H. Freeman. | |

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| **Module 3**<br>**12 hours** | **Methods of gene transfer in prokaryotes**- Transformation, Conjugation and Transduction mapping.Phage genetics and mapping. Developmental genetics- genetic control of development in plants- genetic control of cell lineages. Behavioural genetics- general account Applied genetics- Eugenics, euphenics and euthenics. Immunogenetics.<br><br>**Evolutionary Genetics-Population genetics**<br>Genetic variation in populations and measuring - changes in genetic structure, causes and consequences – speciation and evolution. Hardy - Weinberg Equilibrium, Sewall Wright effect, Inbreeding, Natural selection, inbreeding and co-ancestry.**Molecular Evolution:** Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence. | Describe major evolutionary lineages of plants and their defining characteristics |
| **References**<br>**Module 3** | 1. Snustad PD, Simmons MJ. 2015. Principles of Genetics, 7th edition. Wiley.<br>2. Klug WS, Cummings MR, Spencer CA, Palladino MA, Darrell Killian. 2018.<br>Concepts of Genetics, 12th edition. Pearson.<br>3. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 2015. Introduction to Genetic<br>Analysis, 11th edition. W.H. Freeman & Worth Publishers.<br>4. Pierce BA. 2016. Genetics: A Conceptual Approach 6th edition. W. H. Freeman.<br>5. Hartl DL, Clark AG. 2006. Principles of Population Genetics 4th edition. Sinauer<br>Associates is an imprint of Oxford University Press.<br>6. Crow JF, Kimura M. 2009. An Introduction to Population Genetics Theory. The<br>Blackburn Press.<br>7. Hedrick PW. 2010. Genetics of Populations, 4th edition. Jones & Bartlett Learning<br>8 Brooker R. J. Genetics: Analysis and Principles. Addison Wesley Longman Inc.<br>9 Hedrick P. W. Genetics of Populations. Jones and Bartlett Publishers. | |
| **Module 4**<br>**12 hours** | **Evolution**<br>**History of development of early evolutionary principles-** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.Neo Darwinism | The students will be able to explain the mechanisms which |

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| | **The Origin and Early history of life**: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.<br>**Palaeontology and Evolutionary History**: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo sapiens.<br>**Origin of species-**Species are the basic unit of evolution-Species maintain their genetic distinctiveness through the barriers to reproduction-clustures of species reflect rapid evolution. Adaptive radiation; Isolating mechanisms; Evolution and Speciation; -Allopatric and Sympatric; Convergent evolution; Sexual selection; Co-evolution.<br>**Evolution and Plant diversification-**The universal tree of life-an overview-cladistics-From single cell organisms to Kingdoms-Early plant life-The algal ancestry-Bryophytes—Early vascular plants-origin of land plants-Angiosperms—The culmination of plant Evolution-The main line of plant evolution-Retrospect and prospect. | underlie evolution at the molecular level. |
| **References Module 4** | 1.Futuyma, Douglas J Evolution - Sunderland, Sinauer Associates, 2013 - 656p.<br>2.Guttman, Burton S. Evolution : a beginner's guide - Oxford Oneworld 2005. - 203p.<br>3.Young, David, The discovery of evolution - 2 - Cambridge ; New York : Cambridge University Press, in association with Natural History Museum, London, 2007. - viii, 281 p<br>4.Hall, Brian Keith, Strickberger's evolution - 5 - Burlington, Mass. Jones & Bartlett Learning, c2014. - xxvi, 644 p. ill.<br>5.Lull, Richard Swann Organic evolution - New York, The Macmillan Company, 2009 - 744p.ISBN:9788181160447<br>6.Ingrouille, Martin Plants : Diversity and Evolution - Cambridge : Cambridge University Press, 2006. - 440p.<br>7.Charles Darwin Origin of Species - New Delhi Goyl Saab - 479p.<br>8.Benton, M. J.Introduction to paleobiology and the fossil record - Chichester, UK Hoboken, NJ Wiley Blackwell, 2009. - xii, 592 p.<br>9. Delevoryas, Theodore Plant Diversification (2ndEdn),Halt,rinehart and winston<br>10. Dobzhansky, B (1961) Genetics and the origin of species Columbia University press,New york.<br>11. Simmonds N.W.(Ed)(1976) Evolution of crop plants. Longman London and NewYork | |

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| | 12.Stebins G.L(1950)Variation and Evolution in plants.Columbia University press, Newyork<br>13. StebinsG.L(1970) The process of organic evolution. prenticehall, new Delhi<br>14. Strwart W.N (1983) paleobotany and Evolution of plants-Cambridge University press.<br>15.Harlan.P.Banks(1972) Evolution and plants of the past,Macmillan<br>16. Jay.M.Savage (1977) Evolution .Halt,rinehart and winston,New York<br>17. Joan Eiger Gottlieb (1971) Plants Adaptation through evolution.<br>18.Delevoryas,Theodore-PlantDiversification(2nd Edn),Halt, Rinehart and winston<br>19. Dobzhansky,B(1961) Genetics and the origin of species Columbia University press,Newyork. | |

| Course Code: | MSPSC01DSC04<br>MYCOLOGY AND PLANT PATHOLOGY | Module Outcome |
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| **Course objectives:** | 1. To learn about major pathogen groups that infect plants<br>2. The impact of plant diseases on food security and ecosystems<br>3. To learn about how plant defend against the pathogens and how to manipulate plant pathogen interaction in favour of plants. | |
| **Module I**<br>**12hrs** | **Introduction:**<br>Need to study plant diseases- important plant diseases that shaped the history of human civilization. 10 most important plant diseases of the world & India. Plant- Virus-Vector Interactions: Plant viral diseases, symptoms, major viral pathogens. Viral genomes, size and nature of proteins, viral replication within the host cell and viral movement from cell to cell within the host. Viral movement from plant to plant. Insect vectors involved in transmission, persistent and non-persistent transmission. Plant response to viral pathogens and resistance mechanisms.<br><br>**References**<br>Agrios, G. N. 2006. Plant Pathology, Academic Press.<br>Dickinson,M. Molecular Plant Pathology. 2003. BIOS Scientific Publishers.<br>J.S. Huang. 2001. Plant pathogenesis and resistance: biochemistry and physiology of plant-microbe interactions. Kluwer Academic. | The students will be able to acquire knowledge on diverse groups of viruses that affect plants |
| **Module**<br>**12hrs** | **Plant- Bacterial Interactions:**<br>Plant bacterial diseases, classes of plant pathogenic bacterium, general symptoms. Alpha and beta proteobacterial phytopathogens (Agrobacterium and Ralstonia), gamma proteobacterial phytopathogens (Erwinia, Xanthomonas). Gram-positive and fastidious phytopathogenic bacteria: Clavibacter and Xylella. Plant pathogenic mycoplasmas. Quorum sensing, Virulence factors- Toxins, EPS, Cell wall degrading enzymes, type I, II, III and IV | The students will be able to Recognize the host and pathogen interaction |

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| | secretion system. Regulation of Hrp genes, hairpins and type III effectors. Modes of transmission. Plant response to pathogenic bacteria.<br><br>**References**<br>Clarence I. Kado Plant Bacteriology, Published by American Psychopathological Society.<br>Agrios, G. N. 2006. Plant Pathology, Academic Press.<br>Dickinson,M. Molecular Plant Pathology. 2003. BIOS Scientific Publishers.<br>J.S. Huang. 2001. Plant pathogenesis and resistance: biochemistry and physiology of plant-microbe interactions. Kluwer Academic. | |
| **Module III**<br>**12 hrs** | **Plant –Fungal interactions:**<br>Necrotrophic phytopathogenic fungi –Diseases, symptoms, mode of pathogenesis, Host selective toxins, non-host selective toxins, Genetics of toxin biosynthesis and toxin resistance, Plant susceptibility to toxins. Biotrophic phytopathogenic fungi – Diseases, symptoms, mode of pathogenesis, Specialized structures for nutrition, Effectors - apoplastic and cytoplasmic., Plant response to fungal infection and resistance. Quelling Importance of the plant diseases; the concept of plant disease; causes of plant diseases; classification of plant diseases; parasitism and pathogenesis; Koch's postulates; effect of the pathogen on the plants; symptoms of plant diseases; development of epidemics; plant disease management; major crop diseases of Kerala.<br><br>**References**<br>H.H. Prell and P. Day, Plant–Fungal Pathogen Interaction: A Classical and Molecular View; Published by Springer-Verla<br>Agrios, G. N. 2006. Plant Pathology, Academic Press.<br>Dickinson, M. Molecular Plant Pathology. 2003. BIOS Scientific Publishers. | Students will be able for handling disease free varieties and<br>Implement the disease management techniques in the fields. |

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| **Module IV**<br>**12 hrs** | **Plant – Nematode interactions:**<br>Classes of plant parasitic nematodes, feeding organs, Ecto and Endo parasitic nematodes, Nematode dissemination, important plant diseases caused by nematodes, Nematode effectors and host targets, Plant response to nematodes and resistance mechanisms. Plant interaction with parasitic plants. Plant Resistance and Susceptibility factors: Preformed defence, Host resistance and non-host resistance, Induced resistance and Systemic Acquired Resistance, PAMPS and PAMP Triggered Immunity (PTI), Effector Triggered Immunity (ETI), Effector Triggered Susceptibility (ETS). Theories and models on Plant Resistance to pathogens. Applied Plant Pathology: Methods of Plant pathogen diagnostics. Evolution of Plant-Pathogen interactions- its significance on breeding disease-resistant plants, Genetic engineering of Plants for resistance.<br><br>**References**<br>Roland N. Perry and Maurice Moens. Plant Nematology, Published by CABI | Students will be able to understand how plant defend against the pathogens and how to manipulate plant pathogen interaction in favour of plants. |

| Course Code and Title | MSPSC01DSE01<br>METHODOLOGY AND PHILOSOPHY OF SCIENCE | Module Outcome |
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| **Course Objectives** | i) Understand what science is and in what ways science differs from non-science and pseudoscience subjects<br>ii) Understand the different methods of reasoning in Science.<br>iii) Get an idea about the modes of scientific explanations.<br>iv)Understand the role of paradigm shifts in various branches of scientific research; also get an idea about the scientific revolutions in various branches of science<br>v) Understand the value, its acceptance and the criticism to Science.<br>vi)Understand the historical milestones in the evolution of scientific thoughts and research.<br>vii)Distinguish between different centuries concerning the growth of science and scientific thoughts. | |
| **Module I**<br>**12hrs** | **1.What is science?** Scientific knowledge- Streams of Science-Basic and applied science- A summary of the History of science - Science and society – Science as a human activity - Origin of modern science.<br>Philosophy of Science- A brief Historical introduction-definition, scope and the evolution of concepts - Science and pseudo-science.<br>**2. Scientific Method and Reasoning**<br>Scientific method - Observations, pieces of evidence and proofs- Hypothetico-deductive model, Inductive model home's problem of induction-Significance of verification (proving) - corroboration and falsification (disproving)- Positivism. Karl popper and the concept of falsification. Realism and Antirealism- Observable and unobservable distinctions.<br>**3. Explanation in science**<br>Hempel's covering law model of explanation - The problem of symmetry Explanation and causality - Can science explain everything? - Explanation and Reduction. | To understand what science is and in what ways science differs from non-science and pseudoscience subjects and Students will be able to understand the different methods of reasoning in Science. |

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| **Module II**<br>**10hrs** | **4. Scientific Change and Scientific Revolutions**<br>Logical positivist philosophy of science – Empiricism-New Paradigms and Scientific Change -The structure of scientific revolutions - Incommensurability and theory-ladenness of data - Thomas Kuhn and the rationality of science<br>**5. Scientific temper and its fostering.**<br>Critical thinking and logical reasoning in science. Science and its critics- Science as just one narrative -scientism- Science and religion debates, Science and values. Is Science value-free? | Understand the historical milestones in the evolution of scientific thoughts and research. |
| **Module III**<br>**14hrs** | **Experimentation in science**<br>Introduction-Selecting a problem-Hypothesis-auxiliary hypothesis and ad-hoc hypothesis. Experimental Design-Variables-Correlation and causality-sampling—control in experiments.-Experimental bias-performing experiments-Measurement error.<br><br>**Philosophy of Biology.**<br>What is biology? -The nature and logic of biological sciences -Logic of life. -Molecular logic of life-Problems of Biological classification — biological species concept- Evolution and Natural selection- Function and adaptation-The gene-centric view of evolution- Philosophical issues in Genetics - Classical and Molecular -Genes and information -Genetic determinism. Reductionism in Biology – argument from molecular biology-Ecological concepts- Anthropocentric and Ecocentric- Deep and Shallow - Biological determinism. Biology and Ethics. -Early history and development of methods in Biology. | Get an idea about the modes of scientific explanations based on experiments |
| **Module IV**<br>**12hrs** | **History of Biology in the Seventeenth century:**<br>Anatomists, Microscopists History of Biology in the Eighteenth century: Carolus Linnaeus-The founder of biological Taxonomy; Precursors to modern evolutionary theory- Lamarck and Cuvier<br>**History of Biology in the Nineteenth century:**<br>Birth of associations and societies to promote science; Charles Darwin; Pre-Darwinian evolution; Origin of species-Gregor Mendel's | The students will have an understanding of the ups and downs in the history of science, the pace of scientific research during the 17th to 20th |

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| | Experiments - The emergence of biological disciplines; Experimental Physiology; Cell theory, cell pathology and germ theory.<br>**History of Biology in the Twentieth century:**<br>The first half of 20$^{th}$century: Growth of microbiology and Biochemistry; Genetics and heredity Second half of 20$^{th}$century: The architects of life - proteins, DNA and RNA; The origins and borderlines of life; Growth of genetic engineering; Growth of Biotechnology; Growth of Genomics; Growth of Recombinant DNA. | Centuries, contributions made by scientists in the past centuries and the methods and philosophy behind scientific experimenting. |
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| Course Code& Title | PRACTICAL 1: MSPSC01DSC05 BIOLOGY OF ARCHEGONIATE, ANATOMY OF ANGIOSPERM AND MICROTECHNIQUE | Module Outcome |
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| **Course Objectives** | To gain knowledge on the diversity, structural organization and reproduction of algae, Bryophytes, Pteridophytes and Gymnosperms<br>To compare the similarities and differences in these groups<br>To acquire knowledge about the anatomical features of Plants | |
| **Module I 24hrs** | **Module I. Algae and Bryophytes**<br><br>**Algae**<br>1. Collection, preparation and presentation of algal herbarium (minimum 5 herbarium sheets).<br>2. Field collection and study of the types mentioned below and their classification up to generic level. Cyanobacteria: Nostoc, Anabaena Chlorophyta: Cosmarium, Cladophora, Pithophora, Bryopsis, Codium, Xanthophyta: Botrydium, Vaucheria. Bacillariophyta: Pinnularia, Navicula Phaeophyta: Padina, Sargassum, Rhodophyta: Gracilaria, Batrachospermum,<br><br>Bryophytes: Field collection, Morphological and structural study of the following genera: Asterella, Cyathodium, Anthoceros, Bryum, Pogonatum, Porella, Marchantia. | **Module I. Algae and Bryophytes**<br>The module aims to teach students how to collect, prepare, and present algal and bryophyte specimens for taxonomic and morphological study. The course also covers the identification and classification of various genera of algae and bryophytes, based on their external and internal features. The course also introduces students to the diversity and distribution of algae and bryophytes in different habitats. |
| **Module II 20 hrs** | **Pteridophytes**<br>1. Morphological, anatomical and reproductive features of Lycopodium, Isoetes, Angiopteris, Osmunda, Lygodium, Salvinia.<br>2. Fossils: Rhynia, Lepidodendron,<br>3. Habitat study of Lycopodium, Selaginella, Actiniopteris, Drynaria and Salvinia.<br>4. Spore germination and development of prothallus in Knop's Agar medium.<br>5. Submission of a field study report and 5 herbarium specimens of common, local pteridophytes. | **Module II. Pteridophytes**<br>The module aims equip students to observe and analyze the morphological, anatomical, and reproductive features of various pteridophytes. It also covers the identification and classification of different orders and genera of pteridophytes, based on |

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| | | their external and internal characteristics. The course also trains students to perform spore germination and prothallus development experiments in laboratory conditions. |
| **Module III**<br>**20 hrs** | **Module III. Gymnosperms:**<br>1. Identification of petrifactions, compressions, impressions, slides of fossil types included in gymnosperm groups mentioned above<br>2. Comparative study of vegetative and reproductive structures of Zamia, Araucaria, Cupressus, Podocarpus and Ephedra (living gymnosperms)<br>3. Morphological and anatomical studies of the above-mentioned taxa | **Module III. Gymnosperms:**<br>After completing this modulestudents will be able to identify mentioned gymnosperms using morphological and anatomical characters of vegetative and reproductive structures |
| **Module IV**<br>**30 hrs** | **Anatomy of Angiosperms and Microtechnique**<br>Anomalous secondary growth: Dracaena, Bignonia, Amaranthus, Nyctanthes, Mirabilis, Bougainvillea and beetroot.<br><br>**Leaf anatomy**: C3 and C4 plants, succulents, xeromorphic leaves, halophytes and hydrophytes. Stomata: types, stomatal index.<br><br>**Microtechnique:** Preparation of stained permanent slides of the following: Whole mounts, freehand sections, maceration and serial microtome sections using double, triple, and histochemical staining procedures. At least twenty permanent micro preparations representing whole mounts, freehand sections and serial sections should be submitted for evaluation | **Module IV. Anatomy of Angiosperms and Microtechnique**<br>The course aims to train students to prepare and identify sections of plant tissues that show anomalous secondary growth. The course also covers the microtechnique skills of preparing stained permanent slides of various plant tissues, using whole mounts, freehand sections, maceration, and serial microtome sections. The course also trains students to use different types of staining procedures, such as double, triple, and histochemical staining. |

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| Course Code& Title | PRACTICAL 2: MSPSC01DSC06 GENETICS, MYCOLOGY AND PLANT PATHOLOGY | Module Outcome |
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| **Course Objectives** | To learn about major pathogen groups that infect plants<br>To analyse the impact of plant diseases on food security and ecosystems<br>Apply quantitative problem-solving skills to genetics problems and issues. | |
| **Module 1**<br>**36 hrs** | **Genetics**:<br>**Independent assortment**-Systems for solving dihybrid crosses.<br>**Genetic Interactions-**Two factor interactions-Epistatic interactions-Non Epistatic Interactions-Multiple allelism and Quantitative genetics.<br>**Linkage and chromosome Mapping**,Tetrad analysis in Ascomycetes-Recombination Mapping with Tetrads<br>**The Binomial and Chi square distributions**-Testing genetic ratios.<br>**Genetics of Microorganisms**-Problems on prokaryotic chromosome mapping<br>**Population genetics**- Calculating gene frequencies | The students will be able to apply the basic principles of genetics for genetic improvement of plants. |
| **Module 2**<br>**20 hrs** | **Mycology**<br>1. Plant disease symptoms: recognition and identification<br>2. Isolation of pure culture of a fungal plant pathogen from a diseased plant.<br>3. Application of Koch's postulate<br>4. Preparation of culture media<br>5. Isolation of fungi from soil by dilution-plate method.<br>6. Isolation of fungi from dung. | The students will be able to recognize the host and pathogen interaction |
| **Module 3**<br>**20 hrs** | **Study of morphology and anatomy of the reproductive structures of the following genera of fungi**:<br>*Phytophthora, Pythium, Albugo, Pilobolus, Glomus, Mucor, Rhizopus, Saccharomyces, Taphrina, Ascobolus, Xylaria, Trichoglossum, Phomopsis, Drechslera, Aspergillus, Penicillium,* | The students will get a knowledge on disease forecasting and management. |

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| **Module 4**<br>**14 hrs** | *Alternaria, Cercospora, Fusarium, Tremella, Auricularia, Puccinia.*<br><br>**Plant pathology**<br>1. Study of the symptoms and signs of the following plant diseases in the laboratory and in the field and identification of the pathogens: abnormal leaf fall of rubber, coffee rust, plumeria rust, blister-blight of tea, quick wilt of pepper, white rust of amaranth, Cercospora leaf-spot of okra, powdery mildew of any locally available crop, rice blast, brown spot of rice, whip-smut of sugar cane, soft rot of carrot, sesamum phyllody, cassava mosaic.<br>2. Molecular diagnostics of plant-pathogen using PCR<br>3. Detection of plant virus using ELISA | The students will be able to analyze the plant-pathogenic interaction and implement the disease management techniques in the fields. |
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