KANNUR UNIVERSITY

(Abstract)

M.Sc.Plant Science with Specialization in Ethnobotany Programme (CBCSS)- Regulations, Scheme and Syllabus - implemented in the University Department w.e.f.2020 admission - Orders issued

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ACADEMIC C SECTION

Acad/C4/10379/2021 Dated: 30.07.2021

Read:-1. G.O. (Ms) No.389/2020/HEDN dated 05.11.2020

2. Minutes of the meeting of the Syndicate held on 17.11.2020, vide item No.2020.550

3. U.O. No.Acad.A2/5565/ND&C/2008 Vol.II dated 31.12.2020

4. Minutes of the meeting of the Expert Committee held on 12.01.2021

5. E-mail dated 29-07-2021 from the Programme Coordinator,[M.Sc.Plant science with specialization in Ethnobotany Programme] along with the Syllabus

ORDER

1. As per the paper read (1) above, sanction was accorded by the Government to start New Generation Courses in the Teaching Departments of the University during academic year 2020-21.

2. The meeting of the Syndicate as per the paper read (2) above, resolved to start the newly sanctioned programmes in Govt./Aided Colleges/University Departments from the academic year 2020-21.

3. As per the paper read (3) above, the Vice Chancellor accorded sanction for starting the New Generation Course in M.Sc. Plant science with specialization in Ethnobotany Programme (CBCSS) w.e.f. 2020 admission at Mananthavady Campus, Wayanad.

4. The Expert committee constituted to draft Curriculum, Syllabus of New Generation Course in M.Sc. Plant science with specialization in Ethnobotany Programme (CBCSS), prepared the same as per paper read (4), in tune with the Regulations of the PG programmes in University Departments w.e.f. 2020 admission and approved the Scheme and Syllabus for the M.Sc. Plant Science with specialization in Ethnobotany Programme, after incorporation of the suggestions of the subject Expert.

5. The Programme Co-ordinator (M.Sc.Plant Science with specialization in Ethnobotany Programme) submitted the Scheme and Syllabus of M.Sc. Plant Science with specialization in Ethnobotany Programme under CBCSS vide paper read (5), for implementation w.e.f 2020 admission on wards.

6. 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, accorded sanction to implement the Scheme and Syllabus of M.Sc. Plant science with Specialization in Ethnobotany Programme under CBCSS at Mananthavady Campus w.e.f 2020 admission, subject to reporting to the Academic Council.

7. The Scheme and Syllabus of the M.Sc. Plant Science with specialization in Ethnobotany Programme under CBCSS w.e.f 2020 admission are uploaded in the University website (www.kannuruniversity.ac.in).

Orders are issued accordingly.

Sd/-

BALACHANDRAN V K

DEPUTY REGISTRAR (ACAD)

For REGISTRAR

To: 1. Dr. Anu Augustine,Programme Co-ordinator, MSc Plant Science with specilaization in Ethnobotany

2. Campus Director, Mananthavady Campus, Wynad

Copy To: 1. The Examination Branch (through PA to CE).

2. PS to VC / PA to PVC / PA to R

3. DR / AR 1/ AR II (Acad).

4. The Computer Programmer (for uploading in the Website)

5. SF / DF /FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

KANNUR UNIVERSITY

MSc Plant Science

(With Specialisation in Ethnobotany)

2020 ADMISSION ONWARDS

Syllabus preparation committee:

1. Dr Prasadan (Member of syndicate, Kannur University)

2. Dr Anu Augustine (Associate Professor & Course coordinator, Plant Science)

3. Prof. (Dr.) Radhamani PM (Professor, Dept. of Botany,University of Kerala)

4. Dr. A. Yusaf (Associate Professor, Dept. of Botany, University of Calicut)

5. Dr Harilal CC (Associate Professor, Dept. of Botany, University of Calicut)

6. Dr Hrideek TK (CEO, SMPB, Kerala)

7. Dr Prakash Kumar (Director, JNTBGRI, Kerala)

8. Prof. (Dr.) TS Swapna (Professor, Dept. of Botany, University of Kerala)

SYLLABUS : PLANT SCIENCES - KANNUR UNIVERSITY

Kannur University has launched an MSc programme in **Plant Science (with specialisation in Ethnobotany)** at the **Mananthavady Campus**. The Plant Science program proposes to utilise the rich biodiversity of the **Nilgiri** biosphere (World heritage site of UNESCO), which is identified as a **hotspot** of biodiversity in the Western Ghats. This area is an abode of **endemic and endangered species**, that also include medicinal plants commonly used by tribal communities, which remain largely unexplored. North Malabar, a part of the south Western Ghats that covers Wayanad, Kannur and Kasaragod districts has a very rich diversity of flora, ecosystems (Marine Coastal Ecosystems, Mangroves and Laterite hills, etc.) and genetic diversity with a very high level of endemism and several ethnic groups with diverse cultural background.

The MSc programme has two papers dealing with **Ethnobotany** and **conservation biology**. Papers like **Landscape Ecology** and **Wetland Ecology**, related to ecosystem management and conservation are also offered in addition to traditional papers in Plant Science. There is an acute **shortage of trained and committed** manpower in areas like Plant taxonomy, biodiversity conservation and ethnopharmacology, which are the thrust areas of the PG programme.

MSc CURRICULUM

The M.Sc. curriculum of Plant Science follows the level and extent as conceived by the UGC. The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising both core and elective courses. The evaluation

of the courses will be through a grading system and computation of the Cumulative Grade Point Average (CGPA) based on the student's performance in internal and external examinations.

The M.Sc. Plant Science program includes a wide diversity of courses covering all aspects of Plant Sciences. In addition to unique combinations of basic, advanced and applied courses (as Core and Discipline-Specific Elective papers), the programme also has a strong interdisciplinary component. Emphasis is on experiential learning through hands-on laboratory exercises, field trips and projects. Current thrust areas of teaching provide students with substantial exposure and skills in plant biology. The programme covers plant structure, growth and development, molecular biology, physiology, biochemistry, pathology, ecology, genetics, systematics, evolution, bioinformatics, biostatistics and transgenic technology on a variety of taxa ranging from algae, fungi and other microbes, bryophytes and vascular plants (ferns, gymnosperms and angiosperms including crop plants) at the cellular, organismal, community and ecosystem levels, ethnobotany, traditional conservation practices, ethnopharmacology etc.

Post Graduate Attributes

In addition to academic rigour and training in subject-specific areas listed above, students will also become well trained in ethical issues, critical thinking, reasoning and analytical skills, effective communication, laboratory safety, biodiversity, sensitivity to the environment and sustainable living.

Programme Objectives (POs):

The M.Sc. - Plant Science programme is designed to equip students with essential knowledge and technical skills to study plants holistically. Students would be trained in all areas of plant biology using a unique combination of core and elective papers with significant interdisciplinary components. Students would be exposed to cutting-edge technologies that are

currently used in the study of plant life forms, their evolution and interactions with other organisms and with the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

Programme Specific Outcomes (PSOs):

PSO1. 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.

PSO2. The student completing the course is 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.

PSO3. 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. 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.

PSO4. 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.**

1. ELIGIBILITY FOR ADMISSION:

Candidates who have passed and secured at least 55% marks in B.Sc. Botany (Main) Degree Examination of this University or an equivalent examination of any other University is eligible to apply for the M.Sc. Plant Science programme.

Regulations regarding the reservation of the seats are as per the rules of the Government of Kerala/Kannur University. Those who have appeared for the final year examination can also apply; however, they should produce the mark-sheet before the preparation of the rank list.

2. ADMISSION PROCEDURE:

Admission to the M.Sc. Plant Science programmes of the University department shall be made purely based on an entrance test.

3. REGISTRATION

The Department has faculty members as Student Advisors. Each student at the time of admission will be assigned to an advisor by the Department Council. He/she will advise the student about the academic programme and counsel on the choice of courses depending on the student's academic background and objective. The student will then register for the courses she/he plans to take for the semester before the classes begin.

3.1 M.Sc. Plant Science programme shall have a maximum of 12 students that can be admitted taking into consideration the facilities available. The proposed expert committee will be the authority to fix the optional subjects that can be offered for a programme while ensuring that sufficient choice is given to each student in all semesters other than Semester I. Elective courses for the next semester will be announced within 10 days of the end of the previous semester.

3.2 The student has to complete the prescribed prerequisites for the course before registration. The student within a maximum of 10 working days after the commencement of class can change the Optional Course with the consent of the Head of the Dept. and in consultation with the advisor.

3.3 The Department shall make available to all students a bulletin, listing all the courses offered in every Semester specifying the Credits, a list of topics the course intends to cover, the name of the instructor, the timetable and examination schedule. This will be made available in the last week of each semester after it is approved by the Department Council, the Dean and the VC.

4. COURSE DETAILS:

4.1 Credit and Semester system will be followed for the programme. Credit is the measure to assess the value or relative importance of a course, computed based on the time to be devoted for teaching theory and/or practical. Credit defines the quantum of contents/ syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus, credits will be assigned based on the number of lectures/tutorials/ laboratories works and other forms of learning required to complete the course content in a **sixteen-week schedule** per semester.

4.2 Three kinds of Courses are offered - Core, Elective and Open Elective Courses (including MOOC courses). Core and Elective Courses are offered by the Department conducting the programme. Open Elective Courses are offered either by the department conducting the programme or by any other department of the University or via MOOC**.**

4.3 Elective Courses are offered by the Department concerned. Open Elective Courses will be offered by other Departments/Centres/Institutions. as options. The maximum number of students that can be admitted to an Open Elective Course is limited to forty (40) except for MOOC courses. If the student intake in a department is more than 40,

then the maximum number of students that can be admitted to an Open Elective course is equal to the student intake. Students can opt for one elective (open elective) course relevant to the Plant Science program from online sources approved by the University (Swayam Platform or similar platforms) or other Departments during the second and third semester. The choice of the student must be reported to the Head of the Department and approved by the Department Council. The minimum number of credits per semester is 16 and the maximum credits per semester (core and elective inclusive) cannot cross 24. All students have to opt for an equal number of electives in each semester.

4.4 The minimum duration for completion of a two-year PG Programme in any subject is four (4) semesters and the maximum period for completion is eight (8) Semesters from the date of registration.

4.5 Zero Semester: A Semester in which a student is permitted to opt-out due to unforeseen genuine reasons.

4.6 No regular student shall register for more than 24 credits and less than 16 credits per semester.

4.7 The total credits required for the successful completion of a four-semester Programme will be **80.**

4.8 The Department Council shall design Core, Elective and Open Elective Courses including the detailed syllabus for each Programme offered by the Department. The Department Council shall have the freedom to introduce new courses and/or to modify/redesign existing Courses and replace any existing Course with a new Course to facilitate better exposure and training for the students, with the approval of the Faculty Council and the Academic Council.

4.9 There shall be a one-hour lecture excluding tutorials/seminars and two to three hours of practical work per week for one credit.

4.10 If the student does not earn the required credits by not appearing for the exam or due to other reasons, the course will have to be repeated along with the concurrent semester of the next batch after the approval by the DC and concurrence by the university.

4.11 The minimum attendance required for each Course shall be 60% of the total number of classes conducted for that semester. Those who secure the minimum attendance in a semester alone will be allowed to register for the End Semester Examination. Condonation of attendance to a maximum of 10 days in a Semester subject to a maximum of two spells within a Programme will be granted by the Vice-Chancellor. The benefit of condonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meetings of the University Bodies and participation in extra-curricular activities on the production of genuine supporting documents with the recommendation of the Head of the Department concerned. A student, who is not eligible for condonation of absence, shall repeat the Course along with the subsequent batch.

Definitions

(i) '**Academic Programme'** means the entire course of study including its programme structure, details of the course, evaluation methods etc. This will be carried out by teaching and evaluation process in the parent department/centre or jointly under more than one such Department/ Centre

(ii) **'Course'** means is a subject that is part of an Academic Programme

(iii) **'Programme Structure'** includes the list of courses (Core, Elective, Open Elective) that forms an Academic Programme which specifies the syllabus, credits, hours of teaching, evaluation process and examination schemes, the minimum credits required for successful completion of the programme etc. prepared in conformity to University Rules and eligibility criteria for admission

(iv) **'Core Course'** means a course that a student admitted to a particular programme must complete compulsorily to receive the degree and that which cannot be substituted by any other course

(v) **'Elective Course'** means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) '**Open Elective'** means an elective course that is available from recognized online resources like Swayam/ MOOCS or offered by other departments within the framework of the subject.

(vii) **'Credit'** is the value assigned to a course which indicates the level of instruction; 1 lecture per week equals 1 Credit, 3 hours practical class per week equals 1 credit.

(viii) '**SGPA'** means Grade Point Average of the semester calculated for an individual semester.

(ix) **'CGPA'** is Cumulative Grade Points Average calculated for all courses completed by the students at the end of the programme. The formula for conversion of CGPA into percentage marks will be given in the mark sheet.

5. EVALUATION:

5.1 Evaluation of the students shall be done by the Faculty member who teaches the course, based on Continuous Evaluation and an End Semester Examination. The proportion of the distribution of marks among End Semester Examination and Continuous Evaluation shall be 60:40.

5.2 Continuous Evaluation includes Assignments, Seminars and periodic written examinations.

5.3 The allocation of marks for each component under Continuous Evaluation shall be in the following proportions

Theory		Practical	
Components	% of marks	Components	% of marks
Test paper	40% (16 marks)	Tests / Viva	75% (30 marks)
Viva, Seminar presentations, Discussion, Debate etc.	40% (16 marks)	Record	25%(10 marks)
Assignment	20% (8 marks)	--	--
Total Internal marks	40	Total internal marks	40

5.4 Mode of assessment i.e., administering of Test or Tutorial etc. will be decided by the department.

5.5 A copy of all records of Continuous Evaluation shall be maintained in electronic format in the Department and shall be made available for verification by the University.

5.6 For end semester examinations, the duration shall be 3 hours.

6. GRADING:

6.1 An alphabetical Grading System shall be adopted for the assessment of a student's performance in a Course. The grade is based on a 6-point scale. The following table gives the range of marks %, grade points and alphabetical grade.

Range of Marks%	Grade Points	Alphabetical Grade
90-100	9	A+
80-89	8	A
70-79	7	B+
60-69	6	B
50-59	5	C
Below 50	0	F

6.2. A minimum of grade point 5 (Grade C) is needed for the successful completion of a Course. A student who has failed in a Course can reappear for the End Semester Examination of the same Course along with the next batch without taking re-admission or choose another Course in the subsequent Semesters of the same programme to acquire the minimum credits needed for the completion of the Programme. There shall not be a provision for improvement of CE and ESE. A student can attend ESE again if she/he has completed the CE requirements in a subsequent semester subject within the maximum duration permitted.

6.3. Performance of a student at the end of each Semester is indicated by the **Semester Grade Point Average** (**SGPA)** and is calculated by taking the weighted average of grade points of the courses completed. The following formula is used for the calculation. The average is rounded off to two decimal places.

$$\textbf{SGPA} = \frac{\textit{Sum of } (\textit{grade points in a course multiplied by its credit})}{\textit{Sum of Credits of courses}}$$

6.4 At the end of the Programme, the overall performance of a student is indicated by **the Cumulative Grade Point Average (CGPA**) and is calculated using the same formula given above.

6.5. Empirical formula for calculating the percentage of marks will be

% Marks = **(CGPA x 10) +5**

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

CGPA	**Overall Letter Grade**	**Classification**
8.5 and above	A+	First Class with Distinction
7.5 and above but less than 8.5	A	
6.5 and above but less than 7.5	B+	First Class
5.5 and above but less than 6.5	B	
5 and above but less than 5.5	C	Second Class

6.7. Appearance for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are compulsory and no Grade shall be awarded to a candidate if he/she is absent for CE/ESE or both.

6.8. A student who fails to complete the Programme/Semester can repeat the full Programme / Semester once if the Department Council permits to do so. Absence in an examination will be marked as zero.

6.9. No student shall be allowed to take more than eight consecutive Semesters for completing the four Semester Programme from the date of enrolment.

7. GRADE CARD

7.1. The Controller of Examinations shall issue the grade cards of all semesters and the consolidated grade card and certificates on completion of the programme, based on the details submitted by the Head of the Departments. This will be in digital form only.

7.2. The Grade Card shall contain the following

(a) Title of the Courses taken as Core, Elective & Open Elective.

b) The credits associated with and grades awarded for each Course.

c) The number of credits (Core /Elective / Open Elective) separately earned by the student and the SGPA.

d) The total credits (Core / Elective / Open Elective) separately earned by a student till that Semester.

7.3. The consolidated grade statement issued on completion of the Programme shall contain the name of the Programme, the Department/School offering the Programme, the title of the Courses taken, the credits associated with each Course, grades awarded, the total credits (Core /Elective/Open) separately earned by the student, the **CGPA** and the class in which the student is placed. Rank Certificates will be issued based on CGPA calculated at the end of the last semester of that Programme.

8. DEPARTMENT COUNCIL

8.1 All the Permanent and Contract teachers of the Department shall be members of the Department Council.

8.2 The Department Council shall monitor every academic programme conducted in the Department.

8.3 Department Council shall prescribe the mode of conduct of courses, conduct of examinations and evaluation of the students.

Programme Structure: The Master's programme in Plant Science is a two-year course divided into four semesters. A student is required to secure **80** credits for completion of the course and award of degree.

INTERNSHIP

The students of the proposed programme can carry out their internship/project work with leading research organizations like M S Swaminathan Research Foundation, (Kalpetta, Wayanad), Proposed International Ayurveda Research Institute (Kalliad, Kannur), Sugar Cane Breeding Institute (Kannur Regional Centre), CPCRI (Kasargod), Central Food Technology

Research Institute (Mysore), Central Tuber Crop Research Institute, RGCB, JNTBGRI (Thiruvananthapuram), Aryavaidyasala Kottakkal etc.,

COURSES OFFERED IN THE M.SC PLANT SCIENCE PROGRAMME :80 credits

SEMESTER I 22	SEMESTER II 21	SEMESTER III 21	SEMESTER IV 16
Biology of Archegoniatae(4)	Taxonomy and Advanced Plant Systematics (4)	Plant Biotechnology and Tissue culture (4)	
Anatomy and Microtechnique (4)	Cell and Molecular biology (4)	Bioinformatics (4)	Project/Internship (16)
Genetics and Plant Breeding (4)	Plant Physiology and Biochemistry (4)	Ethnobotany and Ethnopharmacology (4)	
Mycology and Plant Pathology (4)	Forest Botany and Phyto Geography (3)	Conservation Biology with an emphasis on Tribal communities and Bio Conservation Practices (3) Compulsory elective	
History and Philosophy of Science (3) Compulsory Elective	Landscape Ecology (3)	Recent advances in plant biology (3)	
	Wetland Ecology (3)		
Environmental Science (3)		Bioprocess Technology (3)	

Compulsory Elective.	Developmental Biology of Plants (3)	Methods in Plant Biology (3) Compulsory elective	
		Biomass and Bioenergy (3)	

TOTAL CREDITS: 80

Semester I

Courses: 6 Core courses: 4 (Theory 4 and Practical 2) Electives: 2

Credits: Core: 16, Elective: 6, Total: 22

Sl. No	Course Code	Title of the course	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
Core Courses									
1	MSPSC01C01	Biology of Archegoniatae	3	2		60	40	100	3
2	MSPSC01C02	Anatomy and Microtechnique	3	2		60	40	100	3
3	MSPSC01C03	Genetics and Plant Breeding	3	2		60	40	100	3
4	MSPSC01C04	Mycology and Plant Pathology	3	2		60	40	100	3
5	MSPSC01C05	PRACTICAL I Biology of Archegoniatae, Anatomy and Microtechnique			3+3	60	40	100	2

6	MSPSC01C06	PRACTICAL II Genetics & Plant Breeding & Mycology and Plant Pathology			3+3	60	40	100	2
	Electives								
7	MSPSC01E01	History and Philosophy of Science	3	2		60	40	100	3
8	MSPSC01E02	Environmental Biology	3	2		60	40	100	3

Semester II

Courses: 5 Core courses: 3 (Theory 3 and Practical 2) Electives: 3/4

Credits: Core: 12, Elective: 9, Total: 21

Sl. No	Course Code	Title of the course	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
Core Courses									
1	MSPSC02C07	Taxonomy and Advanced Plant Systematics	3	2		60	40	100	3

2	MSPSC02C08	Cell and Molecular biology	3	2		60	40	100	3
3	MSPSC02C09	Plant Physiology and Biochemistry	3	2		60	40	100	3
4	MSPSC02C10	Practical III Taxonomy and Advanced Plant Systematics			3	60	40	100	1
5	MSPSC02C11	PRACTICALIV Cell and Molecular biology and Plant Physiology and Biochemistry			3+3	60	40	100	1+1=2
6	MSPSC02 E03	Developmental Biology of Plants	3	2		60	40	100	3
7	MSPSC02E04	Forest Botany and Phyto Geography	3	2		60	40	100	3
8	MSPSC02E05	Landscape Ecology	3	2		60	40	100	3
9	MSPSC02E06	Wetland Ecology	3	2		60	40	100	3

Semester III

Courses: Core courses: (3Theory and Practical) Electives:

Credits: Core: 12, Elective: 9, Total: 21

Sl. No		Course Code	Title of the course	Contact hours/week			Marks			Credi
				L	T/S	P	ESE	CE	Total	
	Core Courses									
1		MSPSC03C12	Plant Biotechnology and Tissue culture	3	2		60	40	100	3
2		MSPSC03C13	Bioinformatics	3	2		60	40	100	3
3		MSPSC03C14	Ethno botany and Ethno pharmacology	3	2		60	40	100	3
4		MSPSC03C15	Practical V Plant Biotechnology and Tissue culture and Bioinformatics			3+3	60	40	100	1+1=
5		MSPSC03 C16	Practical VI Ethno botany and Ethno pharmacology			3	60	40	100	1

6		MSPSC03E07	Conservation Biology with emphasis on Tribal communities and bio conservation Practices Compulsory elective	3	2		60	40	100	3
7		MSPSC03E08	Recent advances in plant biology	3	2		60	40	100	3
8		MSPSC03E09	Bioprocess Technology	3	2		60	40	100	3
9		MSPSC03E10	Methods in Plant biology Compulsory elective	3	2		60	40	100	3
10		MSPSC03E11	Biomass and Bioenergy	3	2		60	40	100	3

Semester IV

Courses: Core: 1 Credits: 16

Sl. No	Course Code	Title of the course	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
Core Courses									
27	MSPSC03 C17	Project Research & Dissertation		5	25	60	40	100	16

The continuous evaluation of the project work shall be done by the research supervisor based on the performance of the student in the lab. The end semester evaluation consists of a presentation and a viva voce based on the project.

SEMESTER I

BIOLOGY OF ARCHEGONIATAE

48 hours Theory Credit 3 (3hrs/week)

Practical credit 1 (3hrs/week)

Course Code: MSPSC01C01

Course Objectives:

1. To study the various groups of Algae, Bryophytes, Pteridophytes, Gymnosperms
2. To compare the similarities and differences in these groups

Course Outcome:

Upon completion of this course, students will be able to identify these groups of plants in the field; also, they will have a thorough understanding of their anatomy, evolution and importance.

Course content:

Module1 **14 hours**

Algae: Introduction-History of Phycology-General characteristics.

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.

2. Diversity of algae and cyanobacteria.

3. Morphology: Range of thallus structure.

4. Reproduction and life history.

5. Collection, identification, preservation (including herbarium techniques) of algae.

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.

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.

8. Fossil algae and cyanobacteria.

Module2

Bryophytes: **12 hours**

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.

2.Origin of bryophytes

3. General account of the anatomy, reproduction and life history of Marchantiales, Jungermanniales, Polytrichales and Anthocerotales.

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.

5.Fossil bryophytes: a general account

Module 3 **14 hours**

Pteridophytes:

1. Introduction to pteridophytes: general characteristics, life cycle, classification. Brief account of the recent developments in molecular phylogenetics and DNA barcoding of pteridophytes.

2. Diversity of forms among pteridophytes: general morphology with special reference to South Indian species of Lycopodiales, Isoetales, Marattiales, Filicales (Gleicheniaceae, Adiantaceae, Cyatheaceae).

3. Fossil pteridophytes: Psilophytales, Lepidodendrales,

4. Habitat diversity of pteridophytes: epiphytes, lithophytes, climbers, halophytes, saprophytes, sciophytes, xerophytes, mesophytes, hydrophytes.

5. Stelar evolution: protostele, siphonostele, solenostele, dictyostele and special stellar types; vessels in pteridophytes.

6. The fern gametophytes: pattern of development, the morphology of mature gametophytes.

7. Heterospory and evolution of seed habit.

8. Cytology: chromosome number and morphology; polyploidy, the origin of polyploids, apospory, apogamy, agamospory.

9. Applied pteridology: bio-fertilizer production from *Azolla: Azolla - Anabaena* symbiosis; Pteridophytes as weeds: *Salvinia* (aquatic) and *Pteridium* (terrestrial); ornamental and medicinal pteridophytes.

Module 4 **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) Caytoniales : d) Cycadeoidales:

e) Pentoxylales: f) Cycadales: g) Ginkgoales: h)Cordaitales

i) 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

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Bierhost, D. W. 1971. Morphology of Vascular Plants. Macmillan Co.

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Stewart, W. N. 1983. Palaeobotany and the evolution of plants. Cambridge University Press.

Practicals – Credit – 1

Course Code: MSPSC01C05

Algae:

1. Collection, preparation and presentation of algal herbarium (minimum 5 herbarium sheets).

2. Field collection and study of the types mentioned below and their classification up to generic level.

Cyanobacteria: *Nostoc, Anabaena*

Chlorophyta: *Cladophora, Pithophora, Bryopsis, Codium,*

Xanthophyta: *Botrydium, Vaucheria*.

Bacillariophyta: *Pinnularia*, *Navicula*

Phaeophyta: *Padina, Sargassum,*

Rhodophyta: *Gracilaria, Batrachospermum*.

Bryophytes:

Field collection, Morphological and structural study of the following genera:

Asterella, Cyathodium, Anthoceros, Bryum, Pogonatum, Porella, Marchantia.

Pteridophytes:

1. Morphological, anatomical and reproductive features of *Lycopodium, Isoetes,*

Angiopteris, Osmunda, Lygodium, Salvinia.

2. Fossils: *Rhynia, Lepidodendron,*

3. Habitat study of *Lycopodium, Selaginella, Actiniopteris,*

Drynaria and *Salvinia*.

4. Spore germination and development of prothallus in Knop's Agar medium.

5. Submission of a field study report and 5 herbarium specimens of common, local

pteridophytes.

Gymnosperms:

1. Identification of petrifactions, compressions, impressions, slides of fossil types

included in gymnosperm groups mentioned above

2. Comparative study of vegetative and reproductive structures of Zamia, Araucaria, Cupressus, Podocarpus and Ephedra (living gymnosperms)

3. Morphological and anatomical studies of the above-mentioned taxa.

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Chapman, V. J. 1941. An Introduction to the Study of Algae. Cambridge University Press.

Chapman, V. J. & Chapman, D. J. 1973. The Algae. Macmillan.

Desikachary, T. V. 1959. Cyanophyta. Indian Council of Agricultural Research.

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Nampy, S. and Madhusoodanan, P. V. 1998. Fern Flora of South India-Taxonomic Revision of Polypodioid Ferns. Daya Publishing House.

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ANATOMY AND MICROTECHNIQUE

48 hours Theory Credit 3 –3hrs/week

Practicals - 3hrs/week credit-1

Course Code: MSPSC01C02

Course Objectives:

1. To study the internal organisation of plants and the techniques associated with the study.

Course Outcome:

Upon completion of this course, students will have a thorough understanding of plant anatomy. They will be trained in different techniques in anatomy like staining, fixing, sectioning and preparation of permanent slides

Course content:

Module I **16hrs**

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.

Module II **14hrs**

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. 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.

Module III

Microtechnique: **14hrs**

1. Microscope-Construction and Use-Light microscope, Phase contrast and electron microscope, Micrometric measurements and camera lucida.

2. Microtomes: Rotary, Sledge, and Cryostat.

3. Processing procedure for micro preparation:

(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.

(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.

(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.

Module IV **10hrs**

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.

References:

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Press.

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Sanderson, J. B. (1994). Biological Microtechnique. Bios Scientific Publishers.

Anatomy of Angiosperms & Microtechnique (Practical) Credit 1

MSPSC01C06

Anatomy:

Anomalous secondary growth: *Dracaena, Bignonia, Amaranthus, Nyctanthes,*

Mirabilis, Bougainvillea and beetroot. Leaf anatomy: C3 and C4 plants, succulents, xeromorphic leaves, halophytes and hydrophytes. Stomata: types, stomatal index.

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.

References:

Beck, C. B. (2005). An Introduction to Plant structure and Development. Cambridge University

Press.

Esau, K. (1977) Anatomy of Seed Plants. 2nd edition. John Wiley & Sons

Fahn, A. (1990) Plant Anatomy. 4th edition. Butterworth-Heinemann Ltd;

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GENETICS AND PLANT BREEDING

48 hours Theory – 3 credits (3hrs/week)

Practical-credit-1 (3hrs/week)

Course Code: MSPSC01C03

Course Objectives:

1. 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.

2. Understand the principles and methods of both conventional and modern plant breeding.

Course Outcome

Upon completion of this course, students will have a thorough understanding of heredity and mechanisms of inheritance in eukaryotes and prokaryotes. Also acquired is familiarity with basic and applied methods of plant breeding.

Course content: **Total 48 hours**

Module 1 **14 hours**

Science of Genetics – An overview of the modern history of the science of Heredity- Classical, Molecular and Evolutionary Genetics-The discovery and rediscovery of Genes. Probability factor in Mendelian genetics- A critical analysis. Chi-square analysis, pedigree analysis and probability. Allelic interactions- Incomplete Dominance and Codominance, Lethal Alleles, Hierarchy of Dominance, Multiple Alleles, Pleiotropy.

Non-allelic interactions-Epistasis, 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.

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.

Module 2 **12hours**

Linkage and Gene Mapping: Linkage, Crossing over, Evolutionary significance of

recombination, Two-point test cross, Three-point test cross, Genetic Mapping, tetrad analysis, mitotic recombination, Physical mapping, Application of mapping.

Cytogenetics: Eukaryotic chromosomes-structure, classification and organization, Banding, karyotyping, Molecular Cytogenetics (FISH, GISH, FIBER-FISH, Flow Cytogenetics, Flow karyotyping), Chromosomal aberrations. Genetic mapping in Drosophila, Linkage and mapping using tetrads,

Extrachromosomal inheritance: Cytoplasmic inheritance, Mitochondrial DNA, the 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.

Module 3 **10 hours**

Methods of gene transfer in prokaryotes-transformation, conjugation and transduction and 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.

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, Molecular evolution.Evolution of genomes, Inbreeding and co-ancestry

Module 4 **12 hours**

Plant Breeding:

Introduction- History-Biological foundations of plant breeding- conventional

techniques- advanced techniques- special methods. Biological foundations of Plant breeding- Role of heredity and environment in character expression- Systems of reproduction in plants- Mating systems in sexually reproduced plants. Plant propagation- sexual, pseudosexual and asexual methods- special methods of plant propagation- micropropagation. Conventional methods of plant breeding- plant domestication, plant introduction, selection and hybridization. Modern methods of plant breeding- mutation breeding, polyploidy breeding and distant hybridization. Biotechnological approaches in plant breeding. Breeding for special purposes- breeding for pest, disease and stress resistance. Quality breeding- Heterosis breeding. Breeding synthetic varieties. Breeding composite varieties.

References:

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2. Klug WS, Cummings MR, Spencer CA, Palladino MA, Darrell Killian. 2018. Concepts of Genetics, 12th edition. Pearson.

3. Griffiths AJF, Wessler SR, Carroll SB, Doebley J. 2015. Introduction to Genetic Analysis, 11th edition. W.H. Freeman & Worth Publishers.

4. Pierce BA. 2016. Genetics: A Conceptual Approach 6th edition. W. H. Freeman.

5. Hartwell L, Goldberg ML, Fischer J, Hood L. 2017. Genetics: From Genes to Genomes 6th edition. McGraw-Hill Education.

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7. Mathew PM. Fundamentals of population genetics with emphasis on human inbreedings, 1st edition. Southern book star.

8. Strickberger MW. 2015. Genetics, 3rd edition. Pearson.

9. Samuels ML, Witmer JA, Schaffner A. 2015. Statistics for the Life Sciences, 5th edition. Pearson.

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11. Tamarin R, 7th edition. 2017. Principles of Genetics. McGraw Hill Education.

12. Elrod S, Stansfield W. 2010. Schaum's Outline of Genetics, 5th edition. McGraw-Hill Education.10

13. Hartl DL, Clark AG. 2006. Principles of Population Genetics 4th edition. Sinauer The associate is an imprint of Oxford University Press.

14. Crow JF, Kimura M. 2009. An Introduction to Population Genetics Theory. The Blackburn Press.

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Genetics and Plant Breeding (Practical)

MSPSC01C06

Credit: 1

Genetics:

1. Problems based on independent assortment, gene interaction and multiple allelism.

2. Problems based on linkage and chromosome mapping.

3. Problems based on quantitative genetics

4. Problems based on population genetics.

Plant Breeding:

1. Floral biology of rice, legumes, cashew, Capsicum and Solanum.

2. Emasculation and hybridization in plants like rice, legumes, cashew, Capsicum and Solanum.

3. Special methods of plant propagation- budding, layering and grafting

References:

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Dabholkar A. R. Elements of Biometrical Genetics. Concept Publishing Company.

Frankel O. H. and Bennet E. Genetic Resources in Plants. Blackwell.

Hotter P. Textbook of Genetics. Ivy Publishing House.

Satpathy G. C. Genetics. Kalpaz Publications.

Sadhu M. K. Plant Propagation. New Age International Publishers.

Allard R. W. - Principles of Plant Breeding. John Wiley & Sons.

Jain H. K. and Kharkwal M. C. Plant Breeding. Narosa Publishing House.

Chahal G. S. and Gosal S. S. Principles and Procedures of Plant Breeding. Narosa Publishing House.

Mohanan K.V. Essentials of Plant Breeding. PHI Learning Private Limited, New Delhi.

Roy D. Plant Breeding. Narosa Publishing House.

Hayward M. D., Bosemark N. O. and Romagosa I. Plant Breeding- Principles and prospects. Chapman and Hall.

Gupta S.K. Plant Breeding. Agrobios.

Khan M. A. Plant Breeding. Biotech Books.

Sharma J. R. Plant Breeding. Tata McGraw Hill.

Joshi R. M. Biosafety and Bioethics. Isha Books.

Pagano M. and Gauvreau K. Principles of Biostatistics. Duxbury.

Sharma J. R. Statistical and biometrical techniques in Plant Breeding. New Age International Publishers.

Panse V. G. and Sukhatme, P. V. Statistical Methods for Agricultural Workers. ICAR.

Rangaswamy R. A Text Book of Agricultural Statistics. New Age International Publishers.

Jasra P. K. Biostatistics. Krishna Prakashan Media (P) Ltd.

MYCOLOGY AND PLANT PATHOLOGY

Theory credit 3 (3hrs/week)

Practical credit1(3hrs/week)

Course Code: MSPSC01C04

Course objectives

1. To learn about major pathogen groups that infect plants

2. The impact of plant diseases on food security and ecosystems

3. To learn about how plant defend against the pathogens and how to manipulate plant pathogen interaction in favour of plants

Course outcome: After completion of this course the students can identify different pathogen groups, the symptoms of the diseases and have an understanding of the molecular process that underlies the mechanism of plant susceptibility and resistance

Course content

Module I **12hrs**

Introduction**:** 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.

Module II **14hrs**

Plant- Bacterial Interactions: 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. Quorum sensing, Virulence factors- Toxins, EPS, Cell wall degrading enzymes, type I, II, III and IV secretion system. Regulation of Hrp genes, hairpins and type III effectors. Modes of transmission. Plant response to pathogenic bacteria.

Module III **14hrs**

Plant –Fungal interactions: 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; major plant pathogenic fungi, bacteria, mycoplasmas, nematodes and phanerogams; plant disease management; major crop diseases of Kerala.

Module IV **16hrs**

Plant – Nematode interactions: 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.

References

Agrios, G. N. 2006. Plant Pathology, Academic Press.

Dickinson,M. Molecular Plant Pathology. 2003. BIOS Scientific Publishers.

J.S. Huang. 2001. Plant pathogenesis and resistance: biochemistry and

physiology of plant-microbe interactions. Kluwer Academic.

Roland N. Perry and Maurice Moens. Plant Nematology;, Published by CABI

Clarence I. Kado Plant Bacteriology, Published by American

Psychopathological Society.

H.H. Prell and P. Day, Plant–Fungal Pathogen Interaction: A Classical and Molecular View; Published by Springer-Verlag

Practicals – 1 credit

1 Plant disease symptoms: recognition and identification\

2. Isolation of pure culture of a fungal plant pathogen from a diseased plant.

3. Application of Koch's postulate

4. Preparation of culture media

5. Isolation of fungi from soil by dilution-plate method.

6. Isolation of fungi from dung.

7. Study of morphology and anatomy of the reproductive structures of the following

genera of fungi:

Phytophthora, Pythium, Albugo, Pilobolus, Glomus, Mucor, Rhizopus, Saccharomyces, Taphrina, Ascobolus, Xylaria, Trichoglossum, Phomopsis, Drechslera, Aspergillus, Penicillium, Alternaria, Cercospora, Fusarium, Tremella, Auricularia, Puccinia.

5. 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.

6. Molecular diagnostics of plant-pathogen using PCR

7. Detection of plant virus using ELISA

References:

Alexopoulos, C. J. 1962. Laboratory manual for Introductory Mycology. Burgess Pub. Co.

Beck, J. V. et al. 1968. Laboratory Manual for General Microbiology. Burgess Pub. Co.

Koneman, E. W. 1985. Practical Laboratory Mycology. Williams & Wilkins.

Pollack, R. A. et al. 2004. Laboratory Exercises in Microbiology. Wiley.

Rangaswami G. 1999. Diseases of crop plant of India, 4th ed. Prentice Hall of India.

Roberts, G. 1979. Mycology Laboratory Procedure Manual. Mayo Clinic.

HISTORY AND PHILOSOPHY OF SCIENCE

Credit - 3 **48hrs**

Course Objectives

Course Code: MSPSC01E01

i) Understand what science is and in what ways science differs from non-science and pseudoscience subjects

ii) Understand the different methods of reasoning in Science.

iii) Get an idea about the modes of scientific explanations.

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

v) Understand the value, its acceptance and the criticism to Science.

vi)Understand the historical milestones in the evolution of scientific thoughts and research.

vii)Distinguish between different centuries concerning the growth of science and scientific thoughts.

Course outcome:

After the completion of this course, 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 Centuries, contributions made by scientists in the past centuries and the methods and philosophy behind scientific experimenting.

Course Content:

MODULE I: **12 hrs**

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.

Philosophy of Science- A brief Historical introduction-definition, scope and the evolution of concepts - Science and pseudo-science.

2. Scientific Method and Reasoning

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.

3. Explanation in science

Hempel's covering law model of explanation - The problem of symmetry

Explanation and causality - Can science explain everything? -Explanation and Reduction

MODULE II: 10 hrs

4. Scientific Change and Scientific Revolutions

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

6. Scientific temper and its fostering.

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?

MODULE III: 14hrs

Experimentation in science

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.

B. History and philosophy of biology

Philosophy of Biology.

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 – Anti reductionist 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-Biology and social sciences.

MODULE IV: **12hrs**

2. History of biology:

History of Biology in the Seventeenth century: Anatomists, Microscopists

History of Biology in the Eighteenth century: Carolus Linnaeus-The founder of biological Taxonomy; Precursors to modern evolutionary theory- Lamarck and Cuvier

History of Biology in the Nineteenth century:

Birth of associations and societies to promote science; Charles Darwin; Pre-Darwinian evolution; Origin of species-Gregor Mendel's Experiments - The emergence of biological disciplines; Experimental Physiology; Cell theory, cell pathology and germ theory**.**

History of Biology in the Twentieth century:

The first half of 20thcentury: Growth of microbiology and Biochemistry; Genetics and heredity Second half of 20thcentury: 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.

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2. Elliott Sober. Philosophy of Biology, West view press2000

3. Richard Dewitt. Worldviews: an introduction to history and philosophy of science. Blackwell publishing 2004.

4. Boyd, R., Gasper, P., and Trout, J.D. (eds., 1991), The Philosophy of Science, Blackwell Publishers, Cambridge, MA.

5. Glaze brook, Trish (2000), Heidegger's Philosophy of Science, Fordham University Press.

6. Gutting, Gary (2004), Continental Philosophy of Science, Blackwell Publishers, Cambridge, MA.

History and philosophy of biology:

1. Allen, Garland E. Thomas Hunt Morgan: The Man and His Science. Princeton University Press: Princeton, 12 1978. ISBN 0-691-08200-6

2. Allen, Garland E. Life Science in the Twentieth Century. Cambridge University Press,1975.

3. Annas, Julia Classical Greek Philosophy. In Boardman, John; Griffin, Jasper; Murray, Oswyn (ed.) The Oxford History of the Classical World. Oxford University Press: New York, 1986. ISBN0-19-872112-9

4. Bowler, Peter J.The Earth Encompassed: A History of the Environmental Sciences. W. W. Norton & Company: New York, 1992. ISBN0-393-32080-4

5. Bowler, Peter J. Evolution:The History of an Idea. California University Press, 2003. ISBN0-52023693-9.

6. Browne, Janet. The Secular Ark: Studies in the History of Biogeography. Yale University Press: NewHave, 1983. ISBN 0300024606

7. Bud, Robert. The Uses of Life: A History of Biotechnology. Cambridge University Press: London, 1993. ISBN 0521382408

8. Coleman, William Biology in the Nineteenth Century: Problems of Form, Function, and Transformation. Cambridge University Press: New York, 1977. ISBN0-521-29293-X

9. de Chadarevian, Soraya. Designs for Life: Molecular Biology after World War II. Cambridge University Press: Cambridge, 2002. ISBN0521570786

10. Davies, Kevin. Cracking the Genome: Inside the Race to Unlock Human DNA. The Free Press: New York, 2001. ISBN 0-7432-0479-4

11. Holmes, Frederic Lawrence. Meselson, Stahl, and the Replication of DNA: A History of "The Most Beautiful Experiment in Biology". Yale University Press: New Haven, 2001. ISBN0300085400

12. Kay, Lily E. The Molecular Vision of Life: Caltech, The Rockefeller Foundation, and the Rise of the New Biology. Oxford University Press: New York, 1993. ISBN0-19-511143-5

13. Larson, Edward J. Evolution: The Remarkable History of a Scientific Theory. The Modern Library: New York, 2004. ISBN0-679-64288-9

14. Lennox, James (2006-02-15). "Aristotle's Biology". Stanford Encyclopedia ofPhilosophy.

15. Lovejoy, Arthur O. The Great Chain of Being: A Study of the History of an Idea. Harvard University Press, 1936. Reprinted by Harper & Row, ISBN 0-674-36150-4, 2005 paperback: ISBN0-674-36153-9.

16. Magner, Lois N. A History of the Life Sciences, third edition. Marcel Dekker, Inc.: New York, 2002. ISBN 0-8247-0824-5

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18. Mayr, Ernst. The Growth of Biological Thought: Diversity, Evolution, and Inheritance. The Belknap Press of Harvard University Press: Cambridge, Massachusetts, 1982. ISBN0-674-36445-7

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20. Morange, Michel. A History of Molecular Biology, translated by Matthew Cobb. Harvard University Press: Cambridge, 1998. ISBN0-674-39855-6

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25. Spangenburg R and D K Moser. History of Science in the 18thCentury. 2000. Universities Press.

26. Spangenburg R and D K Moser. History of Science in the 19thCentury. 2000. Universities Press.

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31Brian Garvey Philosophy of Biology (2007) Acumen Publishing Limited Stocksfi eld Hall Stocksfi eld

32 Alex Rosenberg and Daniel W. McShea -Philosophy of Biology A Contemporary Introduction (2008) by Routledge 270 Madison Ave, New York

33David L. hull and michael R-Use -The Philosophy of Biology Oxford university press 1998

ENVIRONMENTAL BIOLOGY

Credit: 3 (3hrs/week) 48 hours

Course Code: MSPSC01E02

Course objectives:

This course will introduce students to the major concepts and issues related to the ecology of plants. In this course, we will emphasize the factors affecting the distribution and abundance of plant species, interactions between plants and their biotic as well as the abiotic environment.We will also consider the issues related to large-scale ecology and global climate change.

Course Outcome

At the end of this course, students will be able:

To explain the processes that are responsible for species distribution and abundance.

Understand how these processes shape populations and communities. Comprehend interactions between species and the environment that determine community composition and structure. Apply ecological principles to current conservation issues.

Course Content

Module I **12hrs**

Ecosystem: concept, structure, function and services; Ecological energetics and productivity; Homeostasis and feedback mechanisms. Natural Resources: Biotic and abiotic resources; nature and composition of Air, Water and Soil (Mineral) resources, nature and types of biotic and energy resources; Methods of quantitative and qualitative estimation of abiotic resources. Concept of reserve and resources; Problems with the exploitation of resources. Natural Resources Conservation, Role of individuals in Sustainable Environmental Management.

Module II **10hrs**

Climatology: Elements of climate and weather, Climatic controls, Energy balance in the atmosphere; Elementary ideas about weather systems; Climatic variability and climate change; Climatic classifications; Climates of Indian region; Use of satellite technologies in climate studies. Population ecology: Definition and concept of population, density, frequency, dominance, IVI, natality, mortality, age distribution, biotic potential, carrying capacity, aggregation, dispersion, ecotypes and ecophene.

Module III **14hrs**

Community Ecology: Definition and concept of community, community diversity, structure, dominance, stratification and periodicity; Community interdependence, Ecotone, Edge effect and Ecological Niche. Biodiversity: concepts, types of diversity, centres of diversity, endemism, threats to biodiversity. Hotspots, Red Data Book and Red list Categories, Threatened plants and animals of India and Kerala.

Agrobiodiversity and its significance. Bioresource conservation: In situ and ex-situ conservation, protected area concepts, Wildlife Sanctuaries, National Parks and Biosphere Reserves; Botanical gardens and zoos. Environmental legislation: Wildlife Preservation Act (1972), Indian Forest Conservation Act (1980), Biodiversity Conservation Act (2002), Environmental Impact Assessment, Intellectual Property Rights (IPR) and patents. Conservation Organizations: IUCN, WWF, CITES, TRAFFIC, Species Survival Commission;

Module IV **12hrs**

The Ecological crisis -Industrialization- The human transformation of the earth- Human activity is placing the biosphere under increasing stress. Growth of the world economy- Urbanization.- The vulnerable planet. World Earth summits and protocols. The failure of the ecological reforms-Environmental revolution. Conservation programmes: UNEP, MAB, Ramsar convention, Convention on Biodiversity. Conservation and Ecological movements in India and Kerala. Environmental pollution: causes of air, water and land; pesticides, radiation, noise and automobile pollution; case studies; effect on plants and animals; control with emphasis on biological methods like Bioremediation and Bio sequestration.

References:

Misra, R. 1968. Ecology workbook, Oxford & IBH Publishing Co.

Nayar, M.P. and Sastry, A.R.K. 1987,1989,1990. Red Data Book of Indian Plants. 3 vols.

Odum, E.P. 1976. Fundamentals of Ecology, W.B. Sanders Co.

Puri, G. Indian Forest Ecology, Oxford Book & Stationery Co.

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Cunningham, W.P. and Saigo, B.W. 1999. Environmental Science (5th Edition) McGraw Hill.

Chapman, J.L. and Reiss, M.J. 1992. Ecology-Principle and Application, Cambridge University Press.

Park, C. 1997. The Environment-Principles and Applications, Routledge.

Smil, V. 1997. Cycles of Life. Civilization and Biosphere W.H. Freeman and Co. N.Y.

Smith, R.L. and Smith, T.M. 1998. Elements of Ecology (4th Edition). The Benjamin Cummings Publishing Co.

SEMESTER II

TAXONOMY AND ADVANCED PLANT SYSTEMATICS

48 hours Theory credit -3

(3hrs/week)

Practical credit- 1(3hrs/week)

Course code: MSPSC02C07

Course Objectives:

To make students familiar with the foundations of plant systematics, methods used and the research goals of a systematic study.

To make students familiar with the concepts and the terminologyused in plant systematics including modern molecular systematics.

To present the most recent knowledge of evolutionary relationships of plants as well as practical information vital to the field.

Course Outcome: After completing this course, students will be able to:

Describe the methods and principles of classical taxonomy and modern molecular systematics. Relate systematics analysis to the evolution of the taxa under investigation.

Course content

Module 1 **16 hours**

Taxonomy: Definitions, Objectives, Importance, Scope. Conceptual bases of the classifications of the following: Bentham & Hooker, Engler & Prantl, Hutchinson & Overview of APG System of classification. Taxonomic structure, taxonomic hierarchy, taxonomic categories – supra specific and infraspecific categories; Concept of species, genus and family. Modern trends in Plant Taxonomy: Biosystematics, Numerical Taxonomy: Phenetics and Cladistics; Cladistic methodology; Molecular Taxonomy; Phylogenetic systematics -basic principles. A brief account of DNA barcoding in plants. Taxonomic characters: Concept of character, character variations and their taxonomic implications. Plant description terminologies; method of describing a plant species using

morphological characters. Sources of taxonomic characters: Morphology, Anatomy, Embryology, Cytology, Palynology, Phytochemistry.

Module2 **16 hours**

Plant Nomenclature: Brief History on the origin and development of nomenclature; detailed study of the major provisions of the International Code of Nomenclature for Algae, Fungi and Plants (ICN) Major changes from the preceding Code- Effective and Valid Publication, Rule of Priority and its limitations, Typification, Different kinds of types, Author citation, Rejection and retention of names, Conserved names; Nomenclature of hybrids; Nomenclature of cultivated plants. Common technical terms used in Plant nomenclature.

Module 3 **12hours**

Practical identification of plants: Different kinds of Identification keys, Construction of dichotomous keys – Indented and bracketed keys. Various kinds of Taxonomic literature:

Floras, Revisions, Manuals, Monographs, Periodicals and Journals. Methods of plant exploration; Management of Herbaria; Major Herbaria in India and the World; Role of Herbaria in taxonomy. Floristic studies in India; Major centres of taxonomic and floristic studies in India; Organization and functions of the Botanical Survey of India. Botanical Gardens: Role of taxonomy in biodiversity conservation.

Module 4 **10 hours**

Cytotaxonomy, chemotaxonomy, biosystematics and numerical taxonomy. Molecular taxonomy. DNA bar-coding in plants.

References:

Cronquist, A. 1988. The evolution and classification of flowering plants. New York

Botanical Garden Press.

Dahlgren, R. M. T., Clifford, H. T. & Yeo, P. F. 1985. The Families of Monocotyledons.

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Davis, P. H. & Heywood, V. H. 1973. Principles of Angiosperm Taxonomy. Robert Krieger Publishing Co.

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Harris J. G. & M. W. Harris. 2007. Plant Identification Terminology. Spring LakePublishing.

Hutchinson, J. 1959. The Families of Flowering plants. Oxford.

Mc Neill, J. et al. 2006. International Code of Botanical Nomenclature (ICBN) (ViennaCode). A.R.G. Gautner Verlag K.G.

Janick, J. et al. 2002. International Code of Nomenclature of Cultivated Plants.International Society for Horticulture Science.

Judith, E. W. 2002. Describing Plant Species. Bishen Singh Mahendrapal Singh.

Kitching, I. J.et al. 1998. Cladistics – the theory and practice of Parsimony Analysis. Oxford University Press.

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University Press.

Douglas E. Soltis, Pamela E. Soltis, Peter K. Endress, and Mark W. Chase, 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc., Publishers, Sunderland, USA.

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Lawrence, G.H.M. 1951. Taxonomy of Vascular. Plants. Oxford and IBH Publishing Co. 14. Michael George Simpson, 2006. Plant systematics. Elsevier Academic Press.

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Radford, A.E., W.C. Dickinson, J.R. Massey and C.R. Bell. 1974. Vascular Plant Systematics, Harper and Row, New York.

Salemi, M. and A.-M. Vandamme (Eds.) 2003.The Phylogenetic Handbook. A Practical Approach to DNA and Protein Phylogeny. Cambridge University Press.

Sivarajan, V.V. 1991 (2nd ed.). Introduction to the Principles of Plant Taxonomy (Ed. N S K Robson). Oxford and IBH publishing Co. Pvt. Ltd. 19. Stuessy, Tod F., 2009. Plant taxonomy: the systematic evaluation of comparative data (2nd ed.). New York: Columbia University Press.

Practicals – Credit 1

Course code: MSPSC02C10

1. During this study, the student shall get familiar with the local flora.

2. The students should get familiar with the method of dissecting and studying plants in the laboratory, describing them in technical terms, preparing scientific illustrations, constructing

artificial keys and identify them based on Bentham and Hooker's system of classification. For this purpose, each student shall work out at least 2 members of each of the following families of angiosperms available in the area: Ranunculaceae, Menispermaceae, Polygalaceae, Caryophyllaceae, Myrtaceae, Clusiaceae, Sterculiaceae, Meliaceae, Sapindaceae, Rosaceae, Rhizophoraceae, Melastomataceae, Aizoaceae,Oleaceae, Gentianaceae, Boraginaceae, Scrophulariaceae, Lentibulariaceae, Convolvulaceae, Pedaliaceae, Lauraceae, Loranthaceae, Nyctaginaceae, Casuarinaceae, Amarylliaceae, Commelinaceae, Zingiberaceae, Cyperaceae

3. During this study, each student shall undertake a field study tour for at least 3 days, under the guidance and supervision of a teacher, at a place ecologically and

floristically different from their place of regular study. Each one shall also collect plant

specimens for herbarium preparation and shall submit at least forty, well preserved,

correctly identified and labelled herbarium specimens along with the field book and report for evaluation during their practical examination.

4. Exercises in nomenclatural citations and solving nomenclatural problems.

References:

Cronquist, A. 1988. The evolution and classification of flowering plants. New York Botanical Garden Press.

Dahlgren, R. M. T., Clifford, H. T. & Yeo, P. F. 1985. The Families of Monocotyledons. Springer-Verlag.

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CELL AND MOLECULAR BIOLOGY

48 hours Theory - Credit: 3 (3hrs/week)

Practical credit -1(3hrs/week)

Course code: MSPSC02C08

Course Objectives

To study the organization of the cell and the molecules of heredity.

To study cell and their components

To understand the features of various nucleic acids

To understand how genes are expressed and regulated

To study the basic techniques involved in cell and molecular biology

Course Outcome

After the completion of this course, the learner will have an understanding of the features of cell and hereditary molecules. The learner will know how genes are expressed and regulated in organisms. This knowledge will aid the learner during further research in molecular biology, including plant molecular biology

Course content

Module I **14hrs**

Cell Biology: Introduction to the study of cell biology-The Discovery of cells cellular properties and organization- the size of cells-visualizing cells- History of the Progress of cell Biology-the Development of the cell theory- pre cellular evolution-Modern cell Biology.

Cell structure in eukaryotes and prokaryotes, cell organelles and their ultra-structure, functions, cytoskeleton, cytoplasmic streaming and cell adhesion, Cell communication: junctions between cells and cell signalling, Cell membranes: membrane dynamics and solute transport across membranes.

Structural organization of chromosomes: Structural organization of chromosomes in Prokaryotes and Eukaryotes. Structural hierarchy of chromosomes. packaging the DNA- Each chromosome has a single DNA molecule-Chromatin reticulum- Heterochromatin and Euchromatin- Chromosome morphology- fine structure -Organisation of Centromeres and telomeres.

Cell Division: Interphase: preparing for mitosis (G1, S and G2) and M phases- Significance of G0 - Cell cycle and Regulation. Mitosis, Meiosis

Module II **12hrs**

Nucleic acids: Structural organization of genetic material in Prokaryotes and Eukaryotes. Structure, composition and function of DNA and RNA. Different types of RNA- mRNA, tRNA, rRNA, snRNA, snoRNA, miRNA, Xist RNA, siRNA,

Mechanism of DNA replication: Mechanism of DNA replication, DNA polymerase I, II, III, DNA gyrases, topoisomerases, ligases, initiation of replication, roles of RNA polymerase (primase) and replisome complex, the current concept of DNA replication in prokaryotes and eukaryotes.

Module III **14hrs**

Gene expression: The genetic code, one gene-one enzyme, one gene-one

polypeptide, Mutations and recombination within a gene, Experiments conducted to decipher the genetic code, salient features, exceptions.

Transcription - General features of transcription, transcription unit, Current concepts of transcription in prokaryotes and eukaryotes, Regulatory sequences and transcription factors involved, Post-transcriptional modifications.

Translation - Basic structure of proteins, ribosomes, tRNA. Wobble hypothesis, Mechanism of translation and factors involved in prokaryotes and eukaryotes, factors affecting translation accuracy, non-ribosomal peptide synthesis.

Module IV **10hrs**

Regulation of gene expression: Regulation in prokaryotes - Constitutive, Inducible and Repressible expression, positive and negative control. Induction and catabolite repression in *lac* operon, repression and attenuation in *trp* operon, Translational and post-translational regulation. Lysogenic and lytic switches in lambda phage. Regulation in Eukaryotes - Regulation at the chromatin level, Epigenetic changes at the chromosome level, genome imprinting, transcriptional gene regulation, epigenetic mechanisms of transcriptional gene regulation, regulation by cis-acting control elements, alternative promoters, trans-acting factors, transcriptional activator proteins, enhancers, silencers, post-transcriptional gene regulation including alternative splicing, RNA editing, RNA interference, Riboswitches, RNA

stability, the role of RNA-decaying factors in gene regulation, translational regulation, post-translational control, protein processing, proteasome complex and protein degradation.

Laboratory/ Practical

Course code: MSPSC02C11

1. Reagent preparation for Plasmid isolation.

2. Raising *E. coli* with a plasmid, by streaking on antibiotic-containing media.

3. Raising *E. coli* liquid culture for plasmid isolation.

4. Plasmid DNA isolation using the alkaline lysis method.

5. Gel electrophoresis to see the isolated plasmid, study the DNA staining

procedure and alternative forms of plasmid obtained after extraction.

6. Preparation of Reagents and Buffers for plant DNA isolation.

7. Plant genomic DNA isolation from plant tissues by CTAB method.

8. Gel electrophoresis to see the isolated plant DNA.

9. Plant RNA isolation

10. Gel electrophoresis to see the isolated plant RNA.

11. Quantification of DNA/RNA

12. Exercises relevant to topics such as *lac* operon, *trp* operon, etc.

13 Mitosis and Meiosis-Cell division stages

References:

1. Gerald Karp 2013. Cell and Molecular Biology: Concepts and Experiments. 7th

Edition, Wiley, NJ, USA.

2. Geoffrey M. Cooper & Robert E. Hausman 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc., Sunderland, USA.

3. Harvey Lodish, Arnold Berk, Chris A. Kaiser & Monty Krieger 2012 Molecular Cell Biology. 7th Edition, W. H. Freeman, NY, USA.

4. Jeff Hardin, Gregory Paul Bertoni & Lewis J. Kleinsmith 2011. Becker's World of the Cell. 8th Edition, Benjamin Cummings, San Francisco, California, USA.

5. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White & Jeremy S. Hyams 2011. Cell Biology: A Short Course Wiley-Blackwell, NJ, USA.

6. Bruce Alberts, Dennis Bray, Karen Hopkin & Alexander D Johnson 2009. Essential Cell Biology.3rd Edition, Garland Science, NY, USA.

7. James D. Watson, Tania A. Baker, Stephen P. Bell & Alexander Gann 2013. Molecular Biology of the Gene. 7th Edition, Benjamin Cummings, San Francisco, California, USA.

8. Burton E. Tropp 2012. Molecular Biology: Genes to Proteins. 4th Edition, Jones & Bartlett, Burlington, USA.

9. Jocelyn E. Krebs, Elliott S. Goldstein & Stephen T. Kilpatrick 2012. Lewin's GENES XI. Jones & Bartlett, Burlington, USA.

10. Robert F. Weaver 2011. Molecular Biology 5th Edition, McGraw-Hill, NY, USA.

11. Michael M. Cox, Jennifer Doudna & Michael O'Donnell 2011. Molecular Biology: Principles and Practice. W. H. Freeman, NY, USA.

12. Nancy Craig, Orna Cohen-Fix, Rachel Green and Carol Greider 2010. Molecular Biology: Principles of Genome Function. Oxford University Press, USA.

using aceto-orcein smear techniques.

5. Study of mitotic waves and synchronized cell division in *Tephrosia/Crotalaria* using Aceto-carmine squash techniques.

6. Study of induced chromosome aberrations (clastogenic & non-clastogenic) in *Allium*

sativum/Vicia faba.

7. Study of induced chromosome breakages in *Allium cepa* var. *aggregatum* using hydroxyquinoline-orcein technique.

8. Study of induced polyploidy in *Allium cepa* var. *cepa/ Hippeastrum* using colchicineorcein

References:

Celis, J. E. 1994. Cell Biology: A Laboratory Hand Book. Vol. 1-3 Academic press, Inc.

Barch, M. J. et al. 1997. The AGT Cytogenetics Laboratory Manual (3rd edn), Lippencott-Raven Publishers.

Jahier, J. 1996. Techniques of Plant Cytogenetics.Oxford & IBH Publishing Co. Pvt. Ltd.

Singh R. J. 1997. Plant Cytogenetics. CRC Press.

Sharma, A. K. & Sharma A. 1990. Chromosome Techniques – Theory & Practice. Butterworths & Co.

Rickwood, D. & Harris, J. R. 1996. Essential Techniques: Cell Biology. Promega.

Sharma, A. K. & Sharma A. 2001. Chromosome Painting – Principles, Strategies & Scope. Kluwer Academic Publishers.

Taylor G. R. 1997. Laboratory Methods for the Detection of Mutations & Polymorphisms in DNA. CRC Press.

Bonifacino, J. S. 2003. Short Protocols in Cell Biology. John Wiley & Sons Inc.

Lloyd, R. V. 2004. Morphology Methods: Cell and Molecular Biology Techniques. Humana Press.

PLANT PHYSIOLOGY AND BIOCHEMISTRY

48 hours Theory Credit -3 (3hrs/week)

Practical credit -1(2hrs/week)

Course code: MSPSC02C09

Course Objectives

This course aims to provide students with an understanding of the core topics and advanced integrated knowledge in plant biochemistry and physiology.

To learn the structure and function of essential biomolecules and their key

chemical and physical properties.

To understand the biochemical mechanisms underlying the metabolism of plants

To understand the biochemistry of value-added products and secondary metabolites from plants.

Course outcome

Upon completion of this course, students will be able to explain and demonstrate the structure, function and dispersal of the basic building blocks of life - the chemical components of living organisms especially plants

Course Content

Module I **12hrs**

Introduction to Biochemistry

Biochemistry and organization of cells - Molecular logic of life - Chemical unity and Biological diversity - Hierarchy of Molecular Organisation -Bioenergetics and Laws of thermodynamics. Subcellular fractionation, biological membranes; Ionization of water- weak acids and weak bases; pH scale, Buffers; properties of water, hydrogen bonding, polarity, Cohesion and adhesion. The concept of water potential. Water movement in cells and tissues. Soil-plant-atmosphere continuum. Bulk movement of water and substances across the membrane, The ascent of xylem water and the uptake of water by the roots, Aquaporins, stomatal regulation of transpiration, anti transpirants; Nutrition in plants;. Absorption of mineral ions – absorption of solutes. phloem transport. Sources and sinks. Mechanism of translocation.

Carbohydrate and Glycobiology: Structure and classification-Monosaccharides, Oligosaccharides and polysaccharides; Biological functions, Glycoproteins, Proteoglycans; Metabolism: Glycolysis, TCA cycle, Pentose phosphate pathway, oxidative phosphorylation; Gluconeogenesis; Cyanide insensitive respiration; Anaerobic respiration. Sucrose synthesis and breakdown, starch structure and metabolism

Plant cell wall polymers: structure elucidation, Degradation, Cellulose, Hemicellulose, Pectin, Lignin; Plant biomass applications: Bioenergy; Value-added products

Module II **12hrs**

Amino acids, Peptides and Proteins: Aminoacids and Peptides: Nomenclature, Structure, Classification, properties and Biological functions. Proteins: Conformation-Tertiary and Quaternary; Protein: Hierarchy of protein structure, motifs and domains, torsion angle and Ramachandran plot, Forces stabilizing protein structure. Protein synthesis; Protein folding; Post-translational modifications; molecular chaperones; Proteolysis; Protein isolation from plant tissues, Purification, quantification protein-ligand interaction; Metabolism: Biosynthesis of amino acids reductive amination, transamination. GDH and GOGAT pathway.

Enzymes: Classification, principles of catalysis, Mechanism of enzyme activity, Factors affecting enzyme activity, regulation, Michaelis-Menten equation & Kinetics- Derivation of Michaelis-Menten equation – Michaelis-Menten plot and Lineweaver Burke plot. Enzyme inhibition; Cofactors and Coenzymes.

Module III 12hrs

Photosynthesis: Light reaction- pigments, photosynthetic apparatus, photosynthetic electron transport, water oxidation and its molecular mechanism, photophosphorylation, pseudocyclic electron transport, Mehler reaction. Genetics of photosynthesis

Dark reaction: Carbon dioxide fixation in C3, C4 and CAM plants regulation of PCR cycle; photorespiration and its regulation, environmental factors affecting photosynthesis.

Nitrogen metabolism: Nitrogen nutrition, organic nitrogen, nitrogen fixation in legumes, nitrate and ammonia assimilation: Sulfur metabolism Interrelationship between

photosynthesis, respiration and nitrogen metabolism. Export of fixed nitrogen from nodules. Nitrogen nutrition – agricultural and ecological aspects. Genetics of N2 fixation

Nucleotides and Nucleic acids: Functions of nucleotides, nucleotide biosynthesis by de novo pathways and salvage pathways; Purine and Pyrimidine metabolism

Lipids: Classification of lipids; Occurrence and properties of fatty acids, Fatty acid metabolism-Oxidation of fatty acids- Biosynthesis of fatty acids. Glycolipid, Lipid biosynthesis: Membrane phospholipids, Triacylglycerols, Cholesterol, Steroids and Isoprenoids.

Module IV **12hrs**

Growth and development: growth differentiation and development. Genetic control and hormonal regulation of development. Seed germination. Physiology of hormones in plant development – auxins, gibberellins, cytokinins, abscisic acid and ethylene. Role of vitamins and nutrients in development. Plant growth regulators- Phytohormones- Auxin; cytokinin; Gibberellins; ethylene; ABA. polyamines; brassinosteroids, jasmonate; Phytochromes and light control; Mechanism of phytochrome and gene action. Cytochromes and blue light effect. physiology of flowering and fruiting; Seed dormancy and germination, senescence; Plant movements. Seed physiology

Photomorphogenesis: Phytochrome – chemistry and physiological effects.

Stress physiology: Abiotic and biotic stresses, morphological and cellular adaptation; molecular mechanism of stress tolerance and protection

Plant secondary metabolites: Classification; Isolation, Characterization**,** Biosynthetic pathways, Applications(Alkaloids, Phenols, Terpenoids, Flavanoids) ; Allelopathic substances

References:

Anderson, J. W. and Boardall, J. (1991) Molecular Activation of Plant cells- An

Introduction to Plant Biochemistry. Blackwell Scientific Publishers.

Beck, C. B. (2005). An Introduction to Plant Structure and Development. Cambridge

University Press.

Bewley, J. D. and Black E. (1994) Seeds: Physiology of Development and Germination. 2nd Edn. Plenum Publishing Corporation.

Bidwell, R.G. S. (1979) Plant Physiology. 2nd Edn. Macmillan Publishing Corporation.

Buchanan, B. B, Gruissem, W. and Jones, R. L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.

Devlin, R. M. and Witham, F. H. (1986). Plant Physiology. IVth Edn. CBS Publishers & Distributors.

Hopkins, W. G. (2004). Introduction to Plant Physiology. John Wiley & Sons Inc.

Karp G. (1996). Cell and Molecular Biology – Concepts and Experiments. John Wiley & Sons, Inc.

Mayer and Poljakoff- Mayber. (1989). The Germination of Seeds. IVth Edn. Pergmon Press.

Moore. T. C. (1981) Research Experience in Plant Physiology. A Laboratory Manual. Springer Verlag,

Noggle, G. R. and Fritz G. J. (1992). Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd.

Salisbury, F. B. and Ross C. W. (1992) Plant Physiology. 4th Edn. Wordsworth Publishing Corporation.

Steward, F. C. Plant Physiology – A Treatise. Vol. I to X. Academic. Press.

Stumpf, P. K. and Conn, E. E (1980). The Biochemistry of Plants: A Comprehensive Treatise. Academic Press.

Taiz, L. and Zeiger, E. (2002). Plant Physiology. The Benjamin Cummings Publishing Corporation Inc.

Wilkins, M. B. (1984). Advances in Plant Physiology. Longman Scientific & Technical.

Practical Credit -1 Course code: MSPSC02C11

1 Quantitative estimation of reducing sugar

2. Quantitative estimation of protein.

3. Isolation of enzyme (amylase/ xylanase) from germinating finger millet seeds and estimating crude enzyme activity.

4 Isolation of enzyme (amylase/ xylanase) from germinating finger millet seeds and estimating crude enzyme activity.

5 Cell wall profiling (hemicellulose composition/hydroxycinnamate) by HPLC

6 Enzyme kinetics- Determination of pH and temperature optimum, Michaelis constant (Km) and Vmax.

7 Estimation of total phenolics

8 Estimation of cell wall polysaccharide, cellulose, in selected grass species.

9 Isolation of intact organelles: chloroplasts and mitochondria.

10 Chlorophyll estimation

11 Assay of photosynthetic electron transport activity from isolated chloroplast using oxygraph

12. Determination of ascorbic acid content of the tissue.

References

Buchanan BB, Gruissem W, Jones RL 2000. Biochemistry and molecular biology of plants. L K International Pvt. Ltd.

Nelson DL, Michael M Coxe: 2008. Lehninger Principles of Biochemistry fifth edition, W. H. Freeman and Company

Nelson DL, Michael M Coxe 2016. Lehninger Principles of Biochemistry: seventh edition, W. H. Freeman and Company

TAIZ L and ZEIGER E. 2010 Plant Physiology. (5th Edition). Sinauer Associates, Inc., Sunderland, Massachusetts. ISBN: 978-0-87893-866-7.

Dey PM and Harborne J B. 1997. Plant Biochemistry. first edition, Academic Press

Bonner J and Warner JE. 1976. Plant Biochemistry: Third edition, Academic

press

Heldt HW and Piechulla B 2011. Plant Biochemistry: fourth edition, Academic Press

Nobel PS and Henry RJ 1996. Practical application of Plant

molecular biology. Chapman and Hall, London 9

Wink M 1999. Biochemistry of Plant Secondary Metabolism: Sheffield Academic Press, Volume 2

Dey PM and Harborne JB. 1997. Plant Biochemistry. Academic Press

Ekinci D. 2012. Biochemistry**,** volume 8, In tech

Finkelstein A. 1987. Water movement through lipid bilayers, pores and

plasma membranes: Theory and reality. Wiley, New York

Mengel, K. and Kirkby E.A. 1996. Principles of Plant Nutrition, Panama

Publishing Corporation, New Delhi, India,

Anderson, J. W. and Boardall, J. (1991) Molecular Activation of Plant cells- An

Introduction to Plant Biochemistry. Blackwell Scientific Publishers.

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University Press.

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2nd Edn. Plenum Publishing Corporation.

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Devlin, R. M. and Witham, F. H. (1986). Plant Physiology. IVth Edn. CBS Publishers &

Distributors.

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Sons, Inc.

Mayer and Poljakoff- Mayber. (1989). The Germination of Seeds. IVth Edn. Pergmon

Press.

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Springer Verlag,

Noggle, G. R. and Fritz G. J. (1992). Introductory Plant Physiology. Prentice-Hall of

India Pvt. Ltd.

Salisbury, F. B. and Ross C. W. (1992) Plant Physiology. 4th Edn. Wordsworth Publishing Corporation

DEVELOPMENTAL BIOLOGY OF PLANTS

Theory credit – 3 (3hrs/week) 48 hours

Course code: MSPSC02E03

Course objectives

This course aims to introduce students to the cellular and molecular processes that govern plant development.

Objectives of the course are to:

Make students familiar with the molecular and cellular basis of the processes that govern plant development. • Expose students to the most recent scientific advances in plant development.

Make students familiar with tools and methodologies commonly used in plant cell and developmental biology research

Course outcome

At the end of this course students will be able to: •

Approach complex biological questions related to the developmental biology of plants.

Correlate concepts across different disciplines of the plant sciences.

Understand and critically evaluate literature that forms the basis for current knowledge in plant developmental biology

Course content

Module I **12hrs**

Introduction to developmental biology of plants: Introduction to model plants used for development studies in plant system, advantages of each system with special emphasis on the model plant Arabidopsis **Basics:** Cell division and cell cycle, planes of cell division, cell autonomy, cell polarity, radial a/symmetry, pattern formation, abaxial/adaxial identity, cell lineage vs. cell position, meristem, determinant vs. indeterminant meristem. **Reproduction:** Male and female gametophyte development, genetic and hormonal regulation of reproduction, pollination and fertilization.

Module II **12hrs**

Seed Development and germination: Seed formation, cotyledon, endosperm and seed coat development. Seed dormancy and germination, hormonal regulation of seed dormancy, seedling development, Concept of vernalization and genetic regulation of vernalization.

Embryogenesis: Basic layout of dicot and monocot embryos, stages of embryo development, embryonic axis, cell division and pattern formation in embryo, genetic and hormonal regulation of embryo development, cell polarity in embryo.

Shoot development: Structure and function of shoot apical meristem (SAM), initiation and maintenance of SAM, regulation of meristem size, antagonism between SAM and lateral organs, genetic regulations, axial bud formation, shoot branching.

Module III **12hrs**

Leaf development: Emergence of leaf primordium from SAM, the abaxial and adaxial identity of leaf cells, leaf margin, trichrome, epidermis and stomatal development, theories of stomatal development, vascular differentiation.

Floral development: Transition from vegetative to reproductive stage, inflorescence meristem, floral whorls specification, ABC model and beyond, whorl boundary specification, asymmetric flower development, structure and development of monocot flowers.

Module IV **12hrs**

Fruit Development and ripening: Genetics and epigenetics of the ovary to fruit transition, the role of hormones in the regulation of ovary to fruit transition, fruit size genes and the control of fruit size in model crops such as Arabidopsis, Tomato, ripening of climacteric and non-

climacteric fruits; Various factors controlling fruit ripening, the role of hormones in fruit ripening. Manipulation of fruit ripening by altering various parameters. Endoreduplication and fruit development.

References:

1. Bhojwani SS & Bhatnagar SP. 2009. Embryology of angiosperms. Vikas Publication House.

2. Buchanan BB, Grussem W and Jones RL. 2015. Biochemistry and Molecular

Biology of plants. John Wiley & Sons Inc.

3. Davis PJ. 2004. Plant hormones: Biosynthesis, Signal Transduction, Action.

Kluwer Academic Publishers.

4. Raghavan V. 1997. Molecular Embryology of Angiosperms. Cambridge University Press.

5. Raghavan V. 2000. Developmental Biology of the Plants. Springer-Verlag, New York.

6. Raghavan V. 2006. Double Fertilization: Embryo and Endosperm

Development in Flowering Plants. Springer-Verlag Berlin Heidelberg.

7. Seymour GB, Tucker GA, Poole M & Giovannoni J. 2013. The Molecular

Biology and Biochemistry of Fruit Ripening. A John Wiley & Sons, Inc. Publication.

8. Srivastava LM. 2002. Plant Growth and Development: Hormones and Environment. Academic Press.

9. Taiz L and Zeiger E, Moller IM & Murphy A. 2015. Plant Physiology & Development. Sinauer Associate Inc. Publishers.

10. Taiz L and Zeiger E. 2013. Plant Physiology. Sinauer Associate Inc. Publishers.

11. The Arabidopsis Book, ASPB publication (available freely at www.aspb.org)

FOREST BOTANY AND PHYTOGEOGRAPHY

48 hours

Credit – 3 Theory (3hrs/week)

Course code: MSPSC02E04

Course objectives

This course aims to provide students with an understanding of the core topics in forest botany and phytogeography.

Course outcome

Upon completion of the course, the students will have a thorough understanding of the forests in India, the biodiversity associated, the conservation aspects associated etc. Also, they would familiarise themselves with the distribution of flora in the world, phytogeographical region and the methods of GIS used in phytogeography.

Course content

Module I **10hrs**

Forest Botany

General Introduction to Forest. Status of forests in India and their role. History of forestry development in India. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation. Physiographic factors - influence of altitude, latitude, aspect and lope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Theories of succession. Classification of forests - Forest types of India and their distribution. Definition, scope and objects of silviculture. Forests as potential carbon sinks- C sequestration; CDMs, Kyoto protocol, Paris Agreement. Forest certification.

Module II **14hrs**

Forest and Biodiversity. Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology, *Ex-situ* and *In situ* methods of conservation, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

Sustainable forest management and concept of the normal forest. Social forestry and its aims. Concepts of joint forest management -special features of JFM in various parts of the country and abroad. Social forestry and community forestry- concepts. National forest policies- Forest Utilisation- Introduction, methods of collection- Classification, management and importance of Non-Timber Forest Products (NTFP)

Module III **12 hrs**

Forest reproduction - flowering, fruiting and seeding behaviour. Regeneration of forests - objectives – ecology of regeneration- factors governing the choice of regeneration techniques. Natural, artificial and mixed regeneration. Natural regeneration - seed production, seed dispersal, germination and establishment. Artificial regeneration - an object of artificial regeneration - advantages. Preparation of planting material- field planting-site preparation-marking- boundary demarcation, fencing, alignment and staking-kinds of pit making-patterns of planting-stump, Thinning-kinds of thinning - improvement felling- salvage cuttings-pruning.

Importance of seed forestry- Seed production areas- seed orchards–plus tree – elite seed tree, isolated tree. Methods of seed collection. Fruit and seed handling - Seed storage- Seed dormancy- classification of types of dormancy. Treatments for breaking exogenous and endogenous dormancy. Seed testing - definition- ISTA rules. Germination testing-

Importance and scope of dendrology. Detailed study of the following major tree families - Magnoliaceae, Annonaceae, Guttiferae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae, Leguminosae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocynaceae, Bignoniaceae, Verbenaceae, Lauraceae, Euphorbiaceae and Moraceae. Brief description of the families-Bixaceae, Bombacaceae, Burseraceae and Rhamnaceae, Ebenaceae, Loganiaceae,

Myristicaceae, Proteaceae, Santalaceae, Casuarinaceae, Orchidaceae, Palmae, Graminae and Pinaceae.

Module IV **12hrs**

Phytogeography:

Aims and major approaches to the study of Phytogeography.

Descriptive Phytogeography: Types of plant distribution: Continuous distribution;

cosmopolitan, circumpolar, circumboreal or circum-austral, and pantropical;

Discontinuous distribution; Theory of land- bridge, theory of continental drift, theory of polar oscillations or Shifting of poles, glaciations. Centres of origin and diversity of plants; Methods of dispersal, migrations and isolation; Theories on the distribution of plants: theory of age and area, theory of tolerance. Factors influencing plant distribution; Floristic regions of the world: Vegetation Zones concerning latitudes and altitudes; a

brief account of the phytogeographical regions of India (recent classification by BSI); Endemics: Neo and relics. Geographical Information Systems: definition, fundamental concepts and components of GIS; developments and future trends in GIS.

References:

Balakathiresan, S. 1986. Essentials of forest management, Nataraj Publishers, D'Doon.

Champion, H. and Seth, S.K. 1968. *A revised survey of the forest types of India*. Delhi: Manager of Publications. https://dds.crl.edu/crldelivery/23005.

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. *Principles of Silviculture*, McGraw Hill, N.Y.

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Misra, K.C. 1974. *Manual of Plant Ecology*. Oxford &IBH Pub Co. New Delhi etc. 491p

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Lal, J. B. 2003. *Tropical Silviculture, New Imperatives: New Systems*, International Book Distributors, P.O. Box 4. Dehra Dun

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Schmidt, L. 2000. *Guide to Handling Tropical and Subtropical Forest Seed*. Danida

Singh, S.K. 1998. Handbook of Environment, Forest and Wildlife Protection laws in India. Natraj Publishers, Dehradun

Ramprakash, 1986. Forest Management, IBD, D'Doon.

Willan, R.L. 1985. *A Guide to Forest Seed Handling*. FAO Forestry Paper 20/2 FAO, Rome

Cronquist, A. 1988. The evolution and classification of flowering plants. New York

Botanical Garden Press.

Dahlgren, R. M. T., Clifford, H. T. & Yeo, P. F. 1985. The Families of Monocotyledons.

Springer-Verlag.

Davis, P. H. & Heywood, V. H. 1973. Principles of Angiosperm Taxonomy. Robert R

Krieger Publishing Co.

Douglas, E. & Soltis et al. 2005. Phylogeny and Evolution of Angiosperms. Sinauer

Associates Inc.

Harris J. G. & M. W. Harris. 2007. Plant Identification Terminology. Spring Lake

Publishing.

Hutchinson, J. 1959. The Families of Flowering plants. Oxford.28

Mc Neill, J. et al. 2006. International Code of Botanical Nomenclature (ICBN) (Vienna Code). A.R.G. Gautner Verlag K.G.

Janick, J. et al. 2002. International Code of Nomenclature of Cultivated Plants. International Society for Horticulture Science.

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Kitching, I. J.et al. 1998. Cladistics – the theory and practice of Parsimony Analysis. Oxford University Press.

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Sivarajan, V. V. 1991. Introduction to the Principles of Plant Taxonomy. Oxford & IBH Publishing Co. Pvt. Ltd.

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http://www.iapt-taxon.org/nomen/main.php

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Cox, C. B., Healey, I. N. & Moore, P. D. (1976). Biogeography. An Ecological and Evolutionary Approach. 2nd Edition. Blackwell Scientific Publications.

MacDonald, G. (2003). Biogeography: Introduction to Space, Time and Life. John Wiley & Sons, Inc.

Simmons, I. G. (1979). Biogeography: Natural and Cultural. Edward Arnold Ltd.

Whittaker, R. H. (Ed.) (1973). Ordination and Classification of Communities. In R. Tüxen (Ed. in Chief), Handbook of Vegetation Science. Part V. Dr W. Junk b.v.

LANDSCAPE ECOLOGY

Credit 3 Theory 3hrs/week

48 hours

Course code: MSPSC02E05

Course objectives

This course aims to provide students with an understanding of the core topics in landscape ecology

Course outcome

Upon completion of the course, the students will have a thorough understanding of the principles of landscape ecology, the structure, hierarchy, species diversity, etc. Also, they would familiarise themselves with the analysis of landscape data using software tools.

Course content

Module 1 **12 hours**

The link between landscape patterns and ecological processes at large spatial (landscape) scales. History and definition of landscape ecology, its relationship to other subfields of ecology, Causes of landscape pattern (abiotic, biotic, human land use and disturbance), Data for studying landscapes (GIS, remote sensing), Measuring landscape pattern (spatial statistics, landscape pattern analysis), Landscape disturbance dynamics, Conservation ecology. Landscape and Principles; - Landscape structure: -Hierarchical framework, Landscape metrics:

quantification and applications; Fractals; Influences of land use patterns on landscape integrity; Human disturbances and landscape structure: Landscape equilibrium

Module 2 **12 hours**

Landscape Ecology:

Landscape structure and Processes, Geographic Ecology: Isolation and Species Richness; Sampling Area and Number of species, Island Area and Species Richness, Island Isolation and Species richness, Theory of Island Biogeography; Equilibrium model of Island Biogeography, Concept of Metapopulation theory Spatial heterogeneity, landscape connectivity – Fragmentation – Landscape genetics Landscape elements:

Heterogeneity, scale, pattern–process relationships, hierarchy, disturbance, coupled ecological-social dynamics, and sustainability, Conservation planning, ecosystem management, Neutral models of landscape patterns

Module 3 **12 hours**

Scale concepts: Definition and theory, applications, types of scaling, scales of variation, Habitat assessment- Species Vulnerability.Landscape Pattern: Physical: biotic, Disturbance, Land use, populations, communities, Measuring landscape pattern, Analysis of pattern formation, Effects of landscape pattern on organisms, populations, communities and ecosystem processes, spatial pattern

Module 4 **12 hours**

Analysis of landscape data:

Spatial statistics & autocorrelation – Landscape management: issues, prospects, and case studies. Computation of landscape metrics and parameters using FRAGSTATS or any other software; lab exercise on analysis of landscape data using spatial statistics software (SAM, ArcGIS, etc); analysis of meta-populations using RAMAS GIS.

References

1. Swanson, F.J., T.K. Kratz, N. Caine, and R.G. Woodmansee. 1988. Landform effects on ecosystem patterns and processes. Bioscience 38:92-98.
2. Landscape ecology (journal)
3. Landscape Ecology by Richard T.T. Forman and Michel Godron; Published by John Wiley & Sons, New York

WETLAND ECOLOGY

Credit – 3 Theory 3hrs/week

Course code: MSPSC02E06

Course objectives

This course aims to provide students with an understanding of the core topics in wetland ecology

Course outcome

Upon completion of the course, the students will have a thorough understanding of the wetland ecosystems of the world, the biodiversity associated, the conservation aspects associated etc. Also, they would familiarise with the mapping of wetlands, wetland surveys to measure floral and faunal diversity

Course content

Module 1 **12 hours**

Wetlands: definition, concepts, and functions – Wetland hydrology – Seasonality – Wetland nutrient cycles and buffers – Classification, inventory, and delineation of wetlands, Cultural attitudes toward wetlands. Types of wetlands: Coastal wetlands – Inland wetlands - Freshwater Swamps, Coastal marshes, Mangrove swamps, "Vital" ecosystem – Wetland flora and fauna – Wetland communities, zonation, and succession and composition of species, microbiology and soils, biogeochemistry (C & N cycles) (P and other nutrients) , plant communities, ecosystems

Module 2 **12 hours**

Carbon sequestration in wetlands – Biological adaptations to wetland ecosystems, degradation, the adaption of species, mapping of wetlands, estimation of primary productivity, wetland surveys to measure floral and faunal diversity Climate change and wetlands, microbiology and soils, biogeochemistry,

Module 3 **12 hours**

Primary productivity of wetlands– Biodiversity and ecosystem values of wetlands – Valuation of wetland ecosystem functions and services – Human impacts and management of wetlands – Factors influencing wetland properties: hydrology, fertility, disturbance, competition, and sedimentation.Wetland restoration – Methods, Active and passive restoration, Rehabilitation, the impact of restoration Water Quality, Treatment Wetlands, Invasive species management

Module 4 **12 hours**

Wetland conservation and management –Conventions and Treaties – International agencies in wetland conservation – Indian legal framework for wetland management.

Field exercise in wetland mapping, water and sediment sampling, sampling of benthic fauna and planktons; lab analysis of water and sediment properties; estimation of primary productivity; quantification of benthic fauna and planktons; wetland surveys to measure floral and faunal diversity

References

Austin, M.P and T.M. Smith. 1989.A new model for the continuum concept.

Batzer, D.P. and R.R. Sharitz (eds). 2006. Ecology of freshwater and estuarine wetlands

Carter, R. W. G. 1988. Coastal Environments: an introduction to the physical, ecological and cultural systems of coastlines. Academic Press, London, UK. 617 pp.

Keddy, P.A. Wetland ecology: Principles and conservation. Cambridge University Press, Cambridge, UK. 614 pp.

Lodge, T.E. 2010. The Everglades Handbook: Understanding the ecosystem. CRC Press, Boca Raton, FL 392 pp.

McVoy CW, Park WA, Obeysekera J, VanArman JA, Dreschel TW. 2011. Landscapes and hydrology of the pre-drainage Everglades. University Press of Florida

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands, 2th Edition. John Wiley & Sons, Hoboken, NJ. 722 pp.

Mitsch, W. J., J.G. Gosselink, C.J. Anderson, L. Zhang. Wetland ecosystems. 2009. John Wiley & Sons, Hoboken, NJ. 295 pp.

Pittman, Craig and Matthew Waite. 2009. Paving Paradise: Florida's vanishing wetlands and the failure of No Net Loss. University Press of Florida, Gainesville, FL. 351 pp.

Rydin, H. and J. Jeglum. 2006. The biology of peatlands. Oxford University Press. Oxford, UK. 343 pp. Tomlinson, P. B. 1986. The botany of mangroves. Cambridge University Press, Cambridge UK. 419 pp. Viliesis, Ann. 1997. Discovering the unknown landscape: a history of America's wetlands. Island Press, Washington, DC. 433 pp.

SEMESTER III

PLANT BIOTECHNOLOGY AND TISSUE CULTURE

48 hours

Theory- Credit 3(3hrs/week)

Practical-Credit -1(2 hrs/week)

Course Code: MSPSC03C12

Course objectives

To familiarize with plant tissue culture techniques, plant transformation and genetic engineering techniques

Course outcome

After completion of the course, the students will get in-depth knowledge both theoretically and practically about plant cell culture and manipulation techniques.

Course content

Module I **14hrs**

Introduction to cell and tissue culture-Tissue culture media (composition, preparation) -growth hormones- Pathways of regeneration- Initiation and maintenance of callus and cell suspension culture-organogenesis- embryogenesis-Micropropagation: various stages of micropropagation, importance, subculture, hardening, vitrification, Germplasm conservation slow growth and Cryopreservation. Somatic embryogenesis- pathways –conditions- importance. Callus pathway and Somaclonal variations.

Module II **12hrs**

Haploid plant production, Importance of haploid plants. Androgenesis: pre-treatment of anther/pollen grains, callus induction and shoot regeneration, androgenic embryos, their development. Merits and demerits of anther culture. Microspore culture, Protocol, Advantages of microspore culture over anther culture. *In vitro* gynogenesis, Ovary/ovule/flower bud culture, embryo culture, Protoplast isolation culture and fusion- methods- somatic hybrids and cybrids. Production of haploids, triploids and endosperm culture.

Protoplast isolation, culture, methods of fusion, somatic hybrids, selection methods cybrids, applications

Module III **12hrs**

Production of secondary metabolites from plant cell cultures - Processes for enhancing the production of secondary metabolites- Technology of plant cell culture for production of chemicals- Bioreactor systems and models for mass cultivation of plant cells.

Recombinant DNA Technology: Tools in genetic engineering; prokaryotic and eukaryotic

vectors; shuttle-, expression-, dominant selectable-, amplifiable-, integrating-, broad host range vectors; positive and negative selection; enzymes involved; gene cloning & gene farming; single cell protein, shotgun cloning, gene library; comparison of cloning vectors. Plant Transformation Technology- *Agrobacterium*-mediated gene transfer- Agrobacterium based vectors - viral vectors and their application. Direct gene transfer methods- chemical methods, electroporation, microinjection, particle bombardment.

Module IV **12hrs**

Plant Genetic Engineering (Biotic Stress) Herbicide resistance- Insect resistance- Disease resistance- virus resistance. (Abiotic Stress - Abiotic stress tolerance -Drought, temperature and salt tolerance.
Molecular Farming & Industrial Products- Application of Plant biotechnology for the production of quality oil- Industrial enzymes paper-biodegradable plastics-antigens (edible vaccine) and plantibodies. Metabolic engineering for plant secondary metabolites. Molecular Techniques: DNA markers & DNA probes, DNA Sequencing Methods (Maxam & Gilbert, Sanger et al., capillary), RNA Sequencing, colony hybridisation, dot & slot blot (Southern, Northern, Western, South-Western & North-Western), RFLP, RAPD, STS & PCR (Variants in PCR), Real-time quantitative PCR, PCR, LCR), DNA- & RNA fingerprinting, genomic library, cDNA library & gene bank; chromosome walking ;protein sequencing-MALDI.

References:

Lewin B (2009). Genes IX. Humana Press.

Flynne WG (2008). Biotechnology and Bioengineering. Nova Science Publishers

Lipps, G. (2008). Plasmids: Current Research and Future Trends. Caister Academic Press.

Torr, J. D. (2006). Genetic Engineering-Current Controversies. Greenhaven Press.

Engdahl, S. (2006). Genetic Engineering-Contemporary Issues. Greenhaven Press, San Diego, USA.

Magnien, E. & De Nettancourt, D. (1985). Genetic Engineering of Plants and Micro-Organisms Important for Agriculture. Springer Verlag.

Fox, M. W. (2000). Beyond Evolution: The Genetically Altered Future of Plants, Animals, the Earth ... and Humans. Lyons Press.

Ho, R. J. Y. & Gibaldi, M. (2003) Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs. Wiley-VCH

Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier,1990.

Bhojwani, S. S. and Razdan, M. K. 2004. Plant Tissue culture: Theory and Practice. Elsevier.

Crispeels, M.J. and Sadava, D.E. 2003. Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition).

Cunningham, C. and Porter, A.J.R. 1997. Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press.

Doods, J. H. and Roberts, L. W. 1985. Experiments in Plant Tissue culture, Cambridge University Press.

George, E. F. 1993-96. Plant propagation by Tissue culture-2 vols. Exegetics Ltd.23

Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and

Biotechnology, CRC Press.

Gresshoff, P.M. 1994. Plant Genome Analysis: Current Topics in Plant Molecular

Biology. CRC Press.

Narayanaswamy, S. 1994. Plant cell and Tissue culture. Tata McGraw Hill Ltd.

De, K. K. 1995. Plant Tissue Culture. New Central Book Agency.Hammond, J., McGarvey, P., Yusibov,V. 1999. Plant Biotechnology: New Products and Applications, Springer Verlag.

Potrykus I.and G. Spangenberg, G. 1997. Gene Transfer to Plants (Springer Lab Manual),

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Razdan, M. K. 1995. An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd.

Slater, A., Scott, N.W. and Fowler, M. R. 2008. Plant biotechnology: the genetic manipulation of plants. Oxford University Press.

Smith, R. 2000. Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic

Press.

Bhojwani, S.S. and Bhatnagar, S.S. The embryology of Angiosperms. Vikas Publications, New Delhi. Maheswari, P. An introduction to Embryology of Angiosperms, McGraw Hill.

Tissue culture Practical

Course code: MSPSC03C15

Preparation of stock solutions: different media - Preparation of solid and liquid media.

Inoculation technique: Culture of different explants. Introduction of callus and organogenesis.

Anther, ovary, embryo culture; Meristem culture. Cryopreservation -Production of synthetic seed. *In vitro* fertilization Plant transformation experiments, GUS/ GFP detection

References:

Bhojwani, S.S. and Razdan, M.K. 1983. Plant Tissue culture: Theory and Practice.

Elsevier.

Doods, J.H. and Roberts, L.W. 1985. Experiments in Plant Tissue culture, Cambridge

University Press.

George, E.F. 1993-96. Plant propagation by Tissue culture-2 vols. Exegetics Ltd.

Narayanaswamy, S. 1994. Plant cell and Tissue culture. Tata McGraw Hill Ltd.

De, K.K. 1995. Plant Tissue Culture. New Central Book Agency.

Razdan, M.K. 1995. An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd.

Plant Biotechnology – Practical

Course code: MSPSC03C15

1. Genomic DNA isolation by CTAB method from plant tissues
2. Isolation of bacterial genomic DNA.
3. Molecular weight determination of DNA by Agarose gel electrophoresis

4. Restriction fragment analysis of DNA.

5. Plasmid DNA isolation.

6. Estimation of DNA concentration by Spectrophotometric method.

7. Estimation of RNA concentration by Spectrophotometric method.

8. Lac induction by X-Gal method.

References

Ausubel, F. M. *et al*. (2002) Short protocols in Molecular Biology. Vol. 1, 2 John Wiley & Sons.

Wilson, J. & Hunt, T. (2007) Molecular Biology of the Cell - Problems Book: 5th Edition. Garland Science.

Lodish, H. (2007). Students Solutions Manual for Molecular Cell Biology. W. H. Freeman Co. Innis, M. A., Gelfand, D. H. & Sninsky, J. J. (1999). PCR Applications: Protocols for functional Genomics. Academic Press.

Mitra, S. (1996) Genetic Engineering. Macmillan India Ltd.

Reed, R. *et al*. (2007) Practical Skills in Biomolecular Sciences. Benjamin Cummings

BIOINFORMATICS

48 hours

Theory Credit: 3(3hrs/week)

Practical -1(3hrs/week)

Course Code: MSPSC03C13

Course Objectives:

1. Get knowledge about biological databases and understand sequence alignment methods.

2. Understand methods in genomics and proteomics.

3.Understand the molecular level interactions and molecular modelling.

4.Understand the method of structure-based drug design and gain basic knowledge of systems biology.

Course Outcome:

The students shall be able to

1. Access different biological databases, retrieve protein and nucleic acid sequences and perform sequence alignment.

2.Explain different methods used in genome and proteome analysis.

3.Explain different molecular interactions, techniques of molecular modelling, protein structure prediction

4.Explain the method of structure-based drug design and basic concept of systems biology

Course Content

Module I **12 hrs**

DATABASES & TOOLS: Introduction to Bioinformatics, Need for informatics toolsand exercises, Significance of databases towards informatics projects. The nucleotide and protein sequence databases: GenBank, DDBJ, EMBL, PIR, Primary and Secondary Databases; Format of databases, Gene bank flat file. Protein Data Bank (PDB) flat-file; FASTA Format, PIR Format; Structure file formats, PDBSUM, PDB Lite, MMDB, SCOP, Pfam; Database of structure viewers. Specialized databases: NCBI, Pubmed, OMIM, Medical databases, KEGG, EST databases; Overview of other popular tools for bioinformatics exercises.

SEQUENCE ALIGNMENT AND DATABASE SEARCHES: Introduction, The evolutionary basis of sequence alignment, the Modular Nature of proteins, Optional Alignment Methods, Substitution scores, substitution matrices, PAM, BLOSUM, Gap penalties, Statistical significance of Alignments, Database similarity searching, FASTA, BLAST, Low-Complexity Regions, Repetitive Elements. Practical Aspect of Multiple Sequence Alignment, Progressive Alignment Methods, CLUSTALW

PHYLOGENETIC ANALYSIS: Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Building the Data Model (Alignment), Determining the Substitution Model, Tree - Building Methods, Searching for Trees, Rooting Trees, Evaluating Trees and Data, Phylogenetic software (CLUSTALW, PHYLIP etc), Conceptual numericals.

Module II 12hrs PREDICTIVE METHODS: Predictive Methods using Nucleotide sequences: Framework, Masking repetitive DNA, Database searches, Codon Bias Detection, Detecting Functional Sites in the DNA (promoters, transcription factor binding sites, translation initiation sites), Integrated Gene Parsing, finding RNA Genes, Web-based tools

(GENSCAN, GRAIL, GENEFINDER). Predictive Methods using Protein sequences: Protein Identity based on composition, Physical properties Based on sequence, secondary structure and folding classes, specialized structures or features, tertiary structure. Related web-based software (JPRED, PROSEC, NNPREDICT, and SOPMA)

PLASMID MAPPING AND PRIMER DESIGN: Restriction mapping, Utilities, DNAstrider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web-based tools(MAP, REBASE); Primer design – the need for tools, Primer design programs and software(PRIMER3). Conceptual numericals.

Module III **12hrs**

GENOME BIOINFORMATICS: Sequencing methods (qualitative), Bioinformatics tools and automation in Genome Sequencing, analysis of Raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in the detection of Polymorphisms, SNPs and their relevance, Bioinformatics tools in microarray data analysis, tools for comparative genomics.

MOLECULAR VISUALIZATION: Generation or Retrieval, Structure Visualization, Conformation Generation. Graphical representation of molecular structures: small molecules (low molecular weight – peptides, nucleotides, disaccharides, simple drugs molecules) and macromolecules (high molecular weight molecules - proteins, DNA, RNA, membranes). Usages of visualization software available in the public domain like VMD, Rasmol, Pymol, Spdb Viewer, Chime, Cn3D.Rotameric Structures of Proteins (Conformational Flexibility), Canonical DNA Forms (DNA Sequence Effects). Systematic methods of exploring conformational space.

Module IV **12 hours**

IN SILICO MODELING & DRUG DESIGN: Scope and applications of in silico modelling in modern biology. Comparative modelling, Constructing an initial model, refining the model, manipulating the model, molecule superposition and structural alignment, concept of energy minimization, different types of interactions and formulation of force fields. Basic MD algorithm, its limitations, treatment of long-range forces. Molecular modelling in drug

discovery, deriving bioactive conformations, molecular docking, quantitative structure-activity relationship (QSAR), deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Ligand – Receptor Interactions: Docking, Calculation of Molecular Properties using Energy Calculations (no derivation). Conceptual numericals.

References:

1. Bioinformatics – Andreas D Baxevanis. Wiley Interscience, 1998.

2. Bioinformatics –David W Mount, Cold spring harbor, 2001.

3. Introduction to Bioinformatics – Arthur Lesk, Oxford, 2006.

4. Bioinformatics – Stuart M Brown, NYU Medical Center, NY USA. 2000.

5. Fundamental Concepts of Bioinformatics – D E Krane & M L Raymer, Pearson, 2006.

6. Structural Bioinformatics – PE Bourne and H Weissig, Wiley – Liss, 2003.

7. Computational methods for macromolecular sequence analysis – R F Doolittle. Academic Press, 1996.

8. Computational Methods in Molecular Biology – S.L.Salzberg, D B Searls, S Kasif, Elsevier, 1998.

9. Bioinformatics, Methods And Applications – Genomics, Proteomics And Drug Discovery – S C Rastogi, N Mendiratta & P Rastogi, PHI, 2006.

10. The Molecular Modeling Perspective in Drug Design – N Claude Cohen – Academic Press, 1996.

11. Analytical Tools for DNA, Genes & Genomes: – Arseni Markoff, New Age, 2007.

12. Introduction to Bioinformatics – Anna Tramontano Taylor & Francis. (2007)

13. Bioinformatics – Des Higgins & Willie Taylor – Oxford. (2005)

14. Discovering Genomics, Proteomics and Bioinformatics – A M Campbell and L J Heyer, Pearson education, 2007.

Practicals

Course code: MSPSC03C15

1. Exercises on Windows, Linux, UNIX, Networking, Internet search & Graphics.

2. Usage of Software for identification - Accessing existing databases on the World-wide Web; Software for identification of species;

3. Usage of software to elucidate the structure of biomolecules, docking of molecules & molecular designing/modelling; Analytical software related to Genomics and proteomics.

4. Usage of similarity, homology and alignment software; Software of Microarray analysis – design, processing and analysis.

References:

1. Bioinformatics – Andreas D Baxevanis. Wiley Interscience, 1998.

2. Bioinformatics –David W Mount, Cold spring harbor, 2001.

3. Introduction to Bioinformatics – Arthur Lesk, Oxford, 2006.

4. Bioinformatics – Stuart M Brown, NYU Medical Center, NY USA. 2000.

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10. The Molecular Modeling Perspective in Drug Design – N Claude Cohen – Academic Press, 1996.

11. Analytical Tools for DNA, Genes & Genomes: – Arseni Markoff, New Age, 2007.\

12. Introduction to Bioinformatics – Anna Tramontano Taylor & Francis. (2007)

13. Bioinformatics – Des Higgins & Willie Taylor – Oxford. (2005)

14. Discovering Genomics, Proteomics and Bioinformatics – A M Campbel and L J Heyer, Pearson education, 2007.

ETHNO BOTANY AND ETHNO PHARMACOLOGY

48 hours

Credit: 4 Theory 3hrs/ week;

Practical 3 hrs/week

MSPSC03C14

Course Objectives

The course aims to introduce students to the science of how people use plants in different cultures and societies (ethnobotany), with emphasis on current research and issues. The objectives of this course are to: Introduce students to the basic concepts of ethnobotany with emphasis on plant-human interactions. Make students familiar with scientific methods of plant 34 collections, including identification and curation and ethnobotanical methods of collecting plant-use information from indigenous people and how this information contributes to our understanding of the usage of plants for various purposes.

Course Outcome

After the completion of this course, students will be able to: Collect and identify plants using standard methods. Practice standard ethnobotanical survey techniques. Field collection and identification methods. Recognize regionally important plant families. •Explore the general principles of ethnobotany, including its history and importance in traditional and modern culture across continents.

Course Content

Module 1 **12 hours**

Introduction - relevance, scope and status. Classification, International, National and Regional (Kerala State) Contributions (J.W.Harshberger, R.E.Schultes, E.K.Janakiammal, S.K.Jain, K.S.Manilal, V.V Sivarajan & P.Pushpangadan). Centres of Ethnobotanical studies in India, AICRPE-All India Coordinated Research Project on Ethnobiology, FRLHT- Foundation for the Revitalisation of Local Health Traditions. Contributions of AICRPE and FRLHT to ethnobiology of India. Study in brief about Tribal/Folk communities of Kerala State focussing on Anthropology, Customs and Beliefs & Archaeological Ethnobotany. (Koraga, Kurichiya, Adiyan, Paniya, Cholanaikan, Kadar, Kurumba, Kuruman, Kani, Ulladan). Role of ethnomedicine and its scope in modern times. Role of Ethnobotany in conservation and sustainable development

Module II **12 hours**

Methods in the ethnobotanical study: General ethnobotanical techniques-Anthropological field methods. Quantitative approach (Open-ended and semi-structured interviews, 'Hands on' learning of traditional techniques) and Qualitative approach (Structured interviews and questionnaires, Free-listing, Pile sorting and preference ranking: triadic and paired, Systematic surveys -e.g., of transects or hectare plots); Quantification and verification: Free-listing, Preference ranking. Direct matrix ranking. Utilization surveys. Interview techniques and elicitation methods: Choosing participants. Linguistic and other symbolic analyses - Symbolic and Empirical analysis of Myths and Folklore; Plant labels and cultural significance.

Plant collection and taxonomy: Nature and uses of voucher specimens, Plant identification. Classification. The plant used in ethnomedicine- e.g.: *Trichopus zeylanicus, Ocimum sanctum, Aegle marmelos, Janakia arayalpatra, Phyllanthus niruri, Cissampelos pareira.* Preparation and their uses.

Archaeobotanical data: Observation of archaeobotanical remains and collection of data. Pieces of evidence from specialized archaeological contexts. Dating methods and data presentation. Specialist ethnobotanical methods: Nature and applications of specialist methods - Languages and linguistics. Art, history, Agricultural science. Ecology, Phytochemistry, Pharmacognosy, Molecular biology, Applied anthropology, Environmental economics. Ethical analysis and law. Communication and education. Information systems.

Practical applications of Ethnobotanical data: External benefits - National and Global interests in ethnobotany: Ethno-directed sampling in Biodiversity Prospecting: Plant derived drugs used in orthodox medical practice; Traditional Plant management and Environmental conservation; Traditional germplasm management: in situ and ex-situ conservation; Local benefits: Cultural survival and community development:

Ethnomedicine and Primary health care; Renewable plant products: Sustainable source of income; Protecting local resources. Commercialization and conservation: Sustainable development - Economic growth and resource conservation. Documentation and analysis of ethnobotanical data.

Module III (12 hours)

Ethnopharmacology

Introduction, scope and relevance. A brief account of Phytochemistry, pharmacodynamics and pharmacokinetics. Difference between herbal/botanicals and pharmaceutical medicine. Classification and sources of crude drugs. Quality, safety and efficacy of herbal medicines/ nutraceuticals. Role of ethnopharmacology in drug development.

Basic definition and types of toxicology, Regulatory guidelines for conducting toxicity studies as per OECD, Alternative methods to animal toxicity testing. Biopiracy, Intellectual Property Rights(IPR). Ethnopharmacology and IPR issue. The integrated drug development programme, technology transfer and commercialization of Traditional medicine.

Biological screening of herbal drugs- introduction and need for phytopharmacological screening. *In vitro* Screening methods used for herbal drugs: Antimicrobial screening of herbal drugs, Screening for anticancer activity, Screening for antioxidant activity, Screening for antiurolytheticactivity. *In vivo* Screening methods used for herbal drugs: Screening for anti-inflammation and analgesic activity, Screening for antiulcer activity, Screening for antidiuretic activity, Screening for liver-related disorders. Database on pharmaceutical uses of plants

Module IV Indigenous/Traditional Knowledge (12 hours)

Plants used by ethnic groups as food, medicines (Ethnomedicine), beverages, fodder, fibre, resins, oils, fragrances and other uses. NWFP(Non-Wood Forest Produces), animal products, minerals, artefacts, and rituals, used by Tribal and Folk Communities of Kerala. Traditional/indigenous knowledge and its importance. Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development.

References:

Chaudhuri, Rai, H. N., Guha, A., Roychowdhury, E. & Pal, D. C. 1980. Ethnobotanical uses of Herbaria-II. J. Econ. Tax. Bot. 1:163-168.

Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of herbaria. Bull. Bot. Surv. India19:256-261.

Faulks, P.J. 1958. An Introduction to Ethnobotany. Moredale Publications Ltd., London.

Ford, R. I.(Ed.). 1978. The Nature and Status of Ethnobotany. Anthropological Paper

no.67. Museum of Anthrop., Univ. of Michigan.

Harshberger, J. W. 1896. The Purpose of Ethnobotany. Bot. Gazette 31 : 146-154.

Jain, S. K. & Rao, R. R. 1983. Ethnobotany in India-An Overview. Botanical Survey of India.

Jain, S. K. (Ed.). 1981. Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co.

Jain, S. K. 1964. The role of a Botanist in folklore Research. Folklore 5:145-150

Jain, S. K. 1967a. Ethnobotany – Its scope and study. Indian Museum Bull. 2:39-43.

Jain, S. K. 1995. A Manual of Ethnobotany. Scientific Publishers.

Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. & Das, D.1984.

Bibliography of Ethnobotany. Botanical Survey of India.

Ranfrew, Jane. 1973. Paleoethnobotany. Columbia University Press.

Practicals: 36hrs **(3hrs/week)**

Ethnobotany (18 hrs) MSPSC03C16

1. Field trip to tribal settlement to survey, document and frame hypothesis on the people-plant relationship.

2. Review of a Peoples Biodiversity Register (PBR) in collaboration with BMC of a local self-government.

3. Collection, processing and preservation of ethnobotanical specimens in the institutional repository.

4. Identify and document plant parts used in the preparation of crude drugs/herbal formulations

Ethnopharmacology (18 hrs)

1. Patent Searching of herbal molecules.

2. Testing of Antimicrobial activity of herbal drug of by disc diffusion method.

3. Estimation of antioxidant activity of the herbal drug.

4. Testing of cytotoxicity of herbal drug.

5. Determination of biochemical parameter in blood and tissue samples of liver function, lipid profile, kidney function, evaluation of antioxidant enzymes, (SOD, CAT ,GSH) in liver tissue, evaluation of haematological parameters, histopathological studies **(optional)**

REFERENCES

1. Traditional plant medicines as sources of new drugs. P J Houghton in Pharmacognosy Trease and Evan's.16 Ed .2009

2. Cunningham, A. B. (2001). Applied Ethnobotany. Earthscan Publishers Ltd. London & Sterling, VA, USA Cotton, C.M. (1996).

3. Ethnobotany-Principles and application. John Wiley& Sons Ltd., West Sussex, England

4. In vivo and in vitro assays Glimpses of ethnopharmacology 1994 Eds. P Pushpangadan ,V George and U.Nyman

5. Faulks, P.J. (1958). An introduction to Ethnobotany, Moredale Publ. London

6. Jain, S. K. (1981). Glimpses of Indian Ethnobotany. Oxford & IBH publishing Co. Pvt. Ltd., New Delhi

7. Jain, S. K. (1989). Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow 12

8. Jain, S. K. (1995). A manual of Ethnobotany. Scientific Publishers, Jodhpur

9. Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. and Das, D. (1984). Bibliography of Ethnobotany. Botanical Survey of India, Howrah

10. Jain S.K.(1997). Contribution to Indian Ethnobotany, Sci. Publ. Jodhpur

11. Jose Boban K. (1998). Tribal Ethnomedicine: Continuity and change. APH publishing corporation 5, Ansari Road, Darya Ganj, New Delhi

12. Phytochemical Methods. Harborne JB. 1984.Chapman and Hall, London

13. Mathur, P. R. G. (1977). The tribal situation in Kerala. Kerala Historical Society, Trivandrum

14. Shashi, S. S.(1995). Tribes of Kerala (Encyclopedia of Indian tribes Series-8). Anmol Publication Pvt. Ltd. Ansari Road, Daryagang, New Delhi

15. Snehalatha and Jain, S. K. (1998). Historical Archive in Ethnobotany. Institute of Ethnobotany, NBRI, Lucknow

16. Medical Pharmacology, Padmaja Udaykumar. Sixth Edition, CBS Publishers & Distributors Pvt Ltd

CONSERVATION BIOLOGY WITH EMPHASIS ON TRIBAL COMMUNITIES AND BIO CONSERVATION PRACTICES

48 hours

Credit -3

Theory 3hrs/week

Course code: MSPSC03E07

Course Objectives:

The course aims to introduce students to conservation biology with an emphasis on current research and issues. The objectives of this course are to: Introduce students to the basic concepts of conservation biology with emphasis on tribal communities and bio conservation practices of the western ghats.

Course Outcome

After the completion of this course, students will have a thorough understanding of the different conservation approaches – the climate change scenario- ecological restoration-ethnomedicinal practices and traditional wisdom.

Course content:

Module I **(12 hours)**

Introduction to Conservation Biology, Conservation and its approaches. Biodiversity – levels, measurement, documentation and valuation. Extinctions - causes of extinction – overexploitation, habitat destruction, Predicting extinction risk of species. Species invasions, – large- and large-scale patterns and issues. Management of IAS. Biotic responses to climate change, global climate change and extinction, conservation management tools

Module II **(12 hours)**

Demographic issues, Population viability analysis, ecological restoration. Consequences of small populations. Minimum viable populations and the extinction debt. Rarity - demography and genetics. Minimum viable population concept. Choosing conservation priority areas.

Module III **(12 hours)**

Conservation management tools & issues - Single species care & costs. Establishing new populations. Habitat maintenance. Restoration, captive breeding, cryogenesis, re-introductions, cloning. Conservation policy around the world. Legislations in India and Kerala. International conservation agreements. Conservation Genetics, Management and conservation of genetic variation in natural populations. Ex-situ and In-situ conservation. Designing conservation reserve, Management to meet conservation goal; Control of invasive species, scales of management

Module IV **(12 hours)**

Ethics and conservation. Human Evolution. The structure and nature of the traditional Indian social system. Tribes and aborigines- an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Kerala. Appraisal of tribal development - problems of tribal identity and integration in the mainstream. Relation between tribes and forests- Forests

as the means of livelihood - changes consequent to government control of forests. Forest management and tribal welfare- management conflicts and way forward. Role of government in tribal welfare. Indigenous knowledge and tribal development, Ethnomedicinal practices and traditional wisdom, Biopiracy of medicinal plants, Bio imperialism and bioprospecting.

References:

Marvier, M. and Kareiva, P.M. (2011). Conservation Science: Balancing the Needs of People and Nature. Roberts and Company

Bawa, K.S., Primack, R.B. and Oomen, M.A. (2011). Conservation Biology. A primer for South

Asia. Universities Press, Hyderabad, India. 589 pp.

Furer-Haimendorf, C.V. (1985). Tribes of India - the struggle for survival. OUP. New Delhi

Hasnain, N. (2007). Tribal India. New Royal Book Company

Hasnain, N. (2011). Indian Anthropology. Palaka Prakashan

Hunter, M.L. (1996). Fundamentals of Conservation Biology. Blackwell

Hunter, L.M. and Gibbs, J.P. (2006). Fundamentals of Conservation Biology, 3rd Edition.

Wiley-Blackwell Publications, New Jersey, USA. 516 pp.

Pielou, E.C. (1975). Ecological Diversity. Wiley Inter-science Pub.

Primack, R.B. (1993). Essentials of Conservation Biology. Soiner, MA.

Sharma, R.N. and Bakshi, S. (1984). Tribes and tribal development. Uppal Publ. House, New Delhi

Sharma, R. N., Sharma, R.K. (1997). Anthropology. Atlantic Publishers & Distributors.

Thakur, D. (1986). Socio-economic development of tribes in India. Deep and Deep Publications,New D

48 hours

Credits 3; Theory 3 hrs

Course code: MSPSC03E08

Course Objectives

To educate postgraduate students on grand challenges and important questions in Plant Science

To educate and stimulate discussions on trending topics in Plant Science

To encourage students to think and read beyond the limits of the program

Course Outcome

On completion, the students are aware of pressing challenges and recent advances in the field of Plant Science

Course Content

Module I **12hrs**

Nano-biotechnology: definition and concepts and applications; Cellular Nanostructures; Nanopores; Biomolecular motors; Criteria for suitability of nanostructures for biological applications, Colloidal nanostructures; Nanovesicles; Nanospheres; Nanocapsules. Nano biosensors, Nano pesticides and nano herbicides, Nano bio farming, use of carbon nanotubes in biotechnology, nano additives in food, Nanoparticles for diagnostics and imaging.

Module II **12hrs**

Global climate change: carbon pollution and human activities that promote global warming, Impacts on global flora, the impact of climate change on pollination, predictions, Plant responses to climate change. Approaches to adapt and mitigate climate change, ensuring food security and protecting biodiversity, restoration of ecosystems and re-engineering.case studies and discussion of recent research articles

Module III **12hrs**

Precision genome engineering: sequence-specific nucleases, ZFN, TALEN, CRISPR/cas9 and their use in chromatin modification and epigenetic regulation, transcriptional repression, transcriptional activation, gene editing and genome editing.

Module IV **12 hrs**

Organic farming: methods and approaches, sustainable intensification offarming, why farm organically.Nutraceuticals: classification, health benefits, nutritional therapy, global demand, regulations.

Text Books:

1. David S.Goodsell 2004. Bionanotechnology: Lessons from Nature. Wiley Publishers.

2. Aluko, R. 2012. Functional foods and nutraceuticals: springer.

3. Latest research articles/review articles relevant to the topic

BIOPROCESS TECHNOLOGY

48 hours

Credits 3; Theory 3 hrs/ week

Course code: MSPSC03E09

Course Objectives

To educate postgraduate students about bioprocess technology, the process, setting up and applications

Course Outcome

On completion, the students would have a thorough understanding of fermentation technologies and their applications in plant science.

Course Content

Module I **12 hours**

Introduction to Industrial Bioprocess: A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

Overview of Fermentation Processes: Overview of fermentation industry, general requirements of fermentation processes, the basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Processing – down and upstreams.

Module II **12 hours**

Raw Materials and Media Design for Fermentation Process: Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods Production of Primary Metabolites: A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,);amino acids (glutamic acid, phenylalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.).

Module III **12 hours**

Production of Secondary Metabolites: Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

Production of biopesticides, bio fertilisers, bio preservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc.,), single-cell protein.

Module IV **12 hours**

Production of recombinant proteins having therapeutic and diagnostic applications; production of vaccines and monoclonal antibodies. Products of plant and animal cell culture.

References:

Ratledge C. & Kristiansen B. (eds). Basic Biotechnology. Cambridge University Press.

Josh R. M. Biosafety and Bioethics. Isha Books.

Josh R. M. Biosensors. Isha Books.

Achrekar J. Concepts in Biotechnology. Dominant Publishers and Distributors.

Vashisth P. Environmental Biotechnology. Dominant Publishers and Distributors.

Pandey A., Webb C., Soccol C. & Larnche C. Enzyme Technology. Springer.

Khan I. A. & Khanum (eds). Fundamentals of Molecular Biology Genetic engineering Biotechnology. Ukaaz Publications.

Lewin B. Genes. Pearson Educational International.

Nelson D. L. & Cox M. M.. Lehninger Principles of Biochemistry, WH Freeman and Company.

Sambrook J. & Russel D. W. Molecular Cloning. Cold Springer Harbor Lab Press NY.

Roussos S., Soccol C.R., Pandey A. & Angur C. New Horizons in Biotechnology. Kluwer Academic Publications.

Alberghina C (ed). Protein Engineering in Industrial Biotechnology. Harwood Academic Publications.

Das H. K. Text Book of Biotechnology. Wiley Dreamtech India P.Ltd.

METHODS IN PLANT BIOLOGY

48 hours

Credits 3; Theory 3 hrs;

Course code: MSPSC03E10

Course Objectives:

AIM: This course aims to make the learners understand the important methods and innovative research used in plant biology and rules in scientific writing. This will help the master students in carrying out their dissertation work and preparing their thesis.

Objectives: To study the important methods applied in different research areas and

their technological advances. To expose students to scientific writing and make them

understand how the research findings can be documented and communicated

scientifically.

Course Outcome: This course enables the students to plan and work on a research topic/problem by selecting the most appropriate method/s relevant to their topic and communicate scientifically in a thesis or manuscript.

Course Content:

Module I **12hrs**

Microscopy: Light microscope- Bright-field microscope, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Laser dissection microscope, confocal microscopy Stereomicroscope, Transmission and scanning electron microscopy.

Spectroscopy, Principles and application: Beer and Lambert law, Colorimetry and spectrophotometry, Flame photometry and Atomic absorption spectrophotometry; Infrared spectroscopy- FTIR, NIR; Raman Spectroscopy; Nuclear Magnetic Resonance (NMR). Mass spectrometry**:** Basic principle and application; ESI-MS; MALDI-TOF;

LC-MS; GC-MS; MS-MS

Chromatography, Principles and application: Paper chromatography, Thin layer chromatography (TLC); Column chromatography: gel filtration, adsorption, partition, affinity, ion exchange; HPLC; HPTLC; Gas chromatography.

Module II **10hrs**

Anatomical and general plant biotechnological methods: Stain and Staining procedures, double staining, localization of pectin, suberin, phenols etc.; Centrifugation-Principles and application: types of centrifuges; Tracer techniques; Bioreactors, Fermenter.

Module III **12hrs**

Flow cytometry Methods: Principles of flow Cytometry, Nuclear DNA content measurement, Flow Cytometry and Ploidy: Applications in Systematics, Ecology and Evolutionary Biology, Genome Size Estimation, Analysis of endopolyploidy**.**

Structural biology and protein interactions: Cryo-electron microscopy, X-ray crystallography, Protein NMR, and X-ray scattering; yeast two-hybrid assay, split protein assays, co-immunoprecipitation and affinity purification. Protein Localization: Reporter genes, florescent protein tagging, immunostaining.

Module IV **14hrs**

Biostatistics: Quantitative methods in biology- introduction -Methods of data collection- primary and secondary data- census and sampling methods. Tabulation and presentation of numerical data- diagrammatic and graphical presentation. Measures of central tendencies- mean, median and mode. Skewness and kurtosis. Measures of variations- range, quartile deviation, mean deviation- variance and standard deviation. Standard error and Coefficient of variation.Tests of significance- z, t and $\chi 2$ tests. Analysis of variance. Analysis of variance - (ANOVA) - One way and two way, Correlation and regression analysis.Experimental designs. Introduction to various statistical software.

Scientific writing: Review of literature; Content writing; preparing journal manuscripts;

Text Books:

1. Steven E Ruzin. 1999. Plant microtechnique and microscopy: Oxford University Press

2. Walter F. 1980. The Microtome Manual of the Technique of Preparation and of Section Cutting. Germany; Ernst Leitz Wetzlar GMBH

3. Banwell C N, McGraw-Hill: 1966, Fundamentals of molecular spectroscopy: Vol 1, Science

4. Snyder LR, Kirkland JJ, Dolan JW. 2009. Introduction to Modern Liquid Chromatography: Third Edition

5. Kirakosyan A, Kaufman PB. 2009 Recent Advances in Plant Biotechnology: Springer, Boston, MA

6. Chawla HS. 2009, Introduction to Plant biotechnology, third edition, Science Publishers

7. Harris RK, Roderick E. Wasylishen, Duer MJ. 2009 NMR Crystallography, Wiley, first edition,

8. Daniel M. Bollag, Michael D. Rozycki and Stuart J. Edelstein, Protein Methods by 2 ed. Wiley Publishers

9. Bailey NTJ. 1969. Statistical Methods in Biology Published by The English Universities press L

10. Dolezel J, Greilhuber J and Suda J. 2005. Flow Cytometry with Plant Cells: Analysis of Genes, Chromosomes and Genomes. Wiley-VCH Publishers

BIOMASS AND BIOENERGY

48 hours

Credits -3 3 hrs/week

Course code: MSPSC03E11

Course Objectives:

This course aims to make the learners understand how plant biomass can be utilized to generate bioenergy

Objectives To understand the current International and national status of biofuel production

To know the structure of cell wall polymers and their conversion to biofuel by efficient pre-treatment methods

To discuss the major bottlenecks in the biofuel productions from plants

Course Outcome

The course has great scope in the current scenario of a search for a sustainable energy resource. The learners will understand how plant biomass can be utilized for biofuel production cost-effectively.

Course content:

Module I **12 hours**

Fundamental concepts in understanding biofuel/bioenergy production- Various biofuels/bioenergy from biomass. Bioenergy current status: National and international; Biofuel generations (first, second, third and fourth), Recent advances in second-generation biofuel production and its advantages, Feedstocks.- Important bioenergy crops, agri-residues, oilseeds.

Module II **12 hours**

Plant cell walls: Renewable energy resource of biofuel; Derivation of cell walls and wall architecture- Cellulose, Hemicelluloses, Pectic polysaccharides, Hydroxycinnamates, mixed linked glucans, proteins and glycoproteins, Lignin, Value-added products from lignin suberin,

cutin, waxes; Recalcitrance of cell wall. Cell wall profiling: Compositional analysis of cell wall using different biochemical and analytic methods such as HPLC, GC, FTIR etc.

Biosynthesis of cell wall polymers-General mechanism of polymer assembly. Glycosyltransferases and polysaccharide synthases, regulation of polysaccharide synthesis; Wall polymers: Extraction and fractionation

Module III **12 hours**

Cell wall degradation- Biomass pretreatment; different pretreatment methods-Physical, Chemical, Biological, Recent advances in cost-effective pretreatment methods; Microbial source for cell wall degrading enzymes: Cellulolytic, Xylanolytic and Ligninolytic microbes and their identification.

Saccharification and fermentation: Estimation of the saccharification efficiency of the pretreated biomass; Factors affecting saccharification, Simultaneous saccharification and Fermentation.

Module IV **12 hours**

Modification/ engineering of the plant cell wall for better fuel production: Hemicellulose and Lignin engineering

Environmental and economic aspects: Environmental impacts of biofuel production; Value-added processing of biofuel residues and co-product

Policies and regulations on biofuel production; biofuel policies, underlying drivers, technical standardisation

References:

1. Goldstein WE. 2016. The Science of Ethanol: CRC Press;

2. Fry SC. 2001. The Growing Plant Cell Wall: Chemical and Metabolic

Analysis The Blackburn Press

3. Hayashi T. 2006. The Science and Lore of the Plant Cell Wall: Biosynthesis,

Structure and Function Brown Walker Press

4. Linskens HF and Jackson, JF. 2011. Plant Cell Wall Analysis. Springer;

Softcover reprint of the original 1st ed. 1996 edition

5. Ahluwalia VK 2018. Renewable Energy In India; Impacts and Responses for

the Built Environment. Booh Shores, second edition

6. Singh RS and Pandey A. 2017. Biofuels Production and future Prospectives.

Edgard gnansounou, crc press

7. Shoukat S. 2011. Progress In Biomass and Bioenergy Production: vol , IntechOpen

8. Khanna M and Zilberman D. 2017. Handbook of Bioenergy Economics and Policy: Springer

9. Marco Aurelio Dos Santos Bernardes. 2011. Biofuel production:; Recent Developments and Prospects: vol 8, IntechOpen

10. Lima MAP, Policastro Natalense AP. 2012. Bioethanol: Intech,

11. Albersheim P, Darvill A, Roberts K, Sederoff R and Staehelin A. 2010. Plant

Cell Walls. Garland Science; 1 edition

12. Li Y and S.K. Khanal SK. 2016. Bioenergy: Principles and Applications. ISBN 9781118568316 (paper) / 9781118568378 (epub). Wiley Blackwell

13. Vairavan K, Thukkaiyannan P, Paramathma M Venkatachalam P, Sampathrajan A. 2007. Biofuel Crops: Cultivation and Management (Jatropha, Sweet Sorghum and Sugarbeet) Published by Agrobios.