PONDICHERRY UNIVERSITY
PUDUCHERRY

M.Sc. BOTANY
(Choice Based Credit System)

Syllabus & Regulations
(2020-2021 onwards)

CBCS GUIDELINES FOR AFFILIATED COLLEGES FOR M.Sc. BOTANY PROGRAMME (ARTS & SCIENCE COLLEGES)

1. Objectives:

Choice Based Credit System (CBCS) at Post Graduate programmes, is aimed at

I. Offering Courses on **Credit mode** and enrich the quality of Teaching-Learning at Higher Education level.

II. Encouraging faculty to design and develop **newer Electives/ Soft Core Courses**.

III. Enabling **Students to make a choice** between different streams of Soft Core/ Elective courses

IV. Facilitating **credit transfer** from courses offered through SWAYAM / MOOCs platforms.

1.1. Eligibility:

Candidate for admission to M.Sc. Botany shall be required to have passed B.Sc. Botany/ Plant Science with 50 percentage of marks in non-CBCS syllabus pattern (or) Letter Grade of C with the Grade Point of 5 in CBCS syllabus pattern, in Part III (Main and Allied). Maximum age for the admission into M.Sc. Botany programme is 25.

2. Credit Based Courses:

- **Credits:** CBCS defines different courses offered in a PG Programme in terms of Credits.
- **Teacher Contact:** A Credit refers to the number of hours that a teacher contact is required per week for a given subject
- **Classification of Courses:** Based on contents of syllabus and level of difficulty of Teaching – learning process, credits are assigned. For example,

Credits	Nature of Course
4 Credits Course	Problem Solving/ Model Building/ Advanced Theory based subjects
2 Credits Course	Theory/ Laboratory based/ field study based subjects

2.1. Hard Core and Soft Core:

- **Hard core:** Subjects which are basic and essential to a programme are called Hard Core (Compulsory) courses.
- **Soft core:** Courses which are open for only a select group of students who opted for a specific specialization are called Soft Core/ Elective courses.
- **Specialization:** Soft Core courses are designed and offered by a team of teachers of a programme based on their specialization.
- **MOOCs:** Soft Core courses also include all those subjects offered by a department for the benefit of all Students of the College. For Example, courses on Environment Studies, Science for common man, Finance for Non Finance students, Basics of Business, Basics of Compute rProgramming, etc. These also include related subjects available in MOOCs and SWAYAM platforms.

2.2. Audit and Non-Audit Courses

- **Audit:** Audit courses refer to all those subjects for which Credits earned will be taken into consideration for the calculation of CGPA and declaration of results. Audit courses include Hard Core as well as Soft Core subjects. Regular classes will be conducted for all Audit courses.
- **Non–Audit:** Non – Audit course refers to courses/activities which shall be completed by the student, but the Credits earned are not considered in the calculation of CGPA. The non – Audit courses are to be completed by students at their own initiative. These include participation in Skill development workshops, NSS/NCC and Sports activities, participation in awareness camps conducted in adopted villages by the college. These also include completion of select courses through OOCs/SWAYAM platforms. A course completion certificate is needed from HOD or Faculty Coordinator.

3. Total Credits of a PG Programme:

The minimum number of credits that a student is expected to complete over a period of four semesters for M.Sc. Botany is given below.

Sl. No.	Programme	Hard Core	Soft Core	Total Credits
1.	M.Sc. Botany	60	12	72

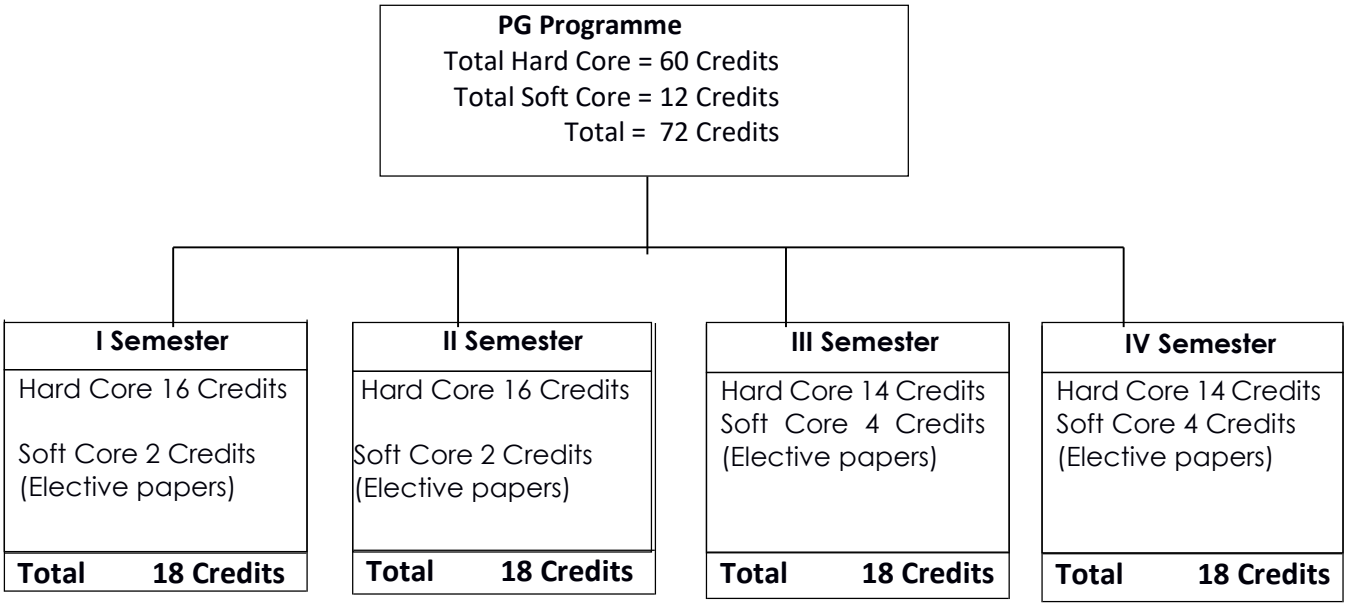
(Every Core subject is to be taught for prescribed number of hours. In addition to regular classroom teaching there should be at least 2 hours of Tutorials additionally. In case of Lab subject every 2 credit Lab requires 6 hours of Lab supervision. Accordingly Teacher workload to be calculated)

4. Course Design

- **UGC Model Curriculum:** All Hard Core courses are compulsory courses. Soft Core courses are Elective streams with internal choice. All courses are designed by a team of experts in a PG Board of studies (BOS) meeting based on latest UGC/AICTE Model Curriculum/ NET/CSIR/Civil Services syllabus.
- **Specialization subjects:** Soft Core Courses are designed based on Skill requirements of Employers/ Career objectives of students and market trends. Specializations of existing Faculty are also taken into consideration in designing Soft Core courses.
- **Lab based/ Field based subjects:** Four sets of elective Soft Core courses shall be designed by the BOS Each set is called Elective stream with six to eight Soft Core subjects in each. Soft Core subjects may include Theory subjects, Lab Practicals, Field study based subject, Internship based subjects, Project works, Seminars- cum-Viva subjects. All Soft Core courses outcomes, Detailed syllabus, Basic Text Books, Course Materials, Web based resources, Model Internal Assessment Test papers and End Semester model Question papers along with a Panel of Examiners who can set and evaluate Answer papers from other Universities for each subject.

4.1. Typical Course Design (for 72 Credits)

Post Graduate BOS in consultation with the Faculty working in PG Departments of affiliated colleges may design a Course Structure as follows



4.2. Breakup of Hard and Soft core:

PG Level Course structure thus contains a minimum of

11 Hard Core Theories = 11 x 4 = 44 Credits
1 Hard Core Project = 1 x 4 = 4 Credits
6 Hard Core Labs = 6 x 2 = 12 Credits
6 Soft Core Subjects (Theory) = 6 x 2 = 12 Credits
TOTAL = 72 Credits

4.3. Non – Audit Courses Winter/Summer Activities

Co-curricular and Extracurricular: In addition to the above Course structure of 72 Credits, every Post Graduate student is expected to complete 10Credits worth of Non- Audit Courses during Summer and Winter Vacation so as to become eligible to get his/her PG Degree from Pondicherry University. The tentative list of Non-Audit courses are as follows:

Sl. No.	Non-Audit Courses	Credits
1.	Skill Development/Soft skills workshops (one/two) (Min Duration : 15 days)	2
2.	Innovations and Entrepreneurship Development Workshops Industry – Interface, Incubation and Start-Up Programmes (Training for 15 days)	2
3.	Village Adoption/Awareness camps, SHG, Basic Literary Clubs (15 days)	2
4.	NSS/NCC Camp/Swatch Bharat/ Traffic Maintenance Activities/ Government schemes (2 weeks)	2
5.	Participation in Seminars / Conferences/ Inter collegiate Meets /Science Day Celebrations, etc (Any 4 events for 15 days)	2
6.	Completion of any one/two MOOCS/ SWAYAM Courses (30 hours)	2
		Any 10 Credits

Completion Certificate needed: A certificate of completion for each activity shall be issued by the HOD/Faculty Co-ordinator or Principal of the College which is needed to be submitted to Programme Committee, before the candidate is allowed to take up his final Semester exam.

4.4. Format for Course Structure of 2 Year M.Sc. BOTANY (CBCS) Programme offered at Affiliated Colleges

Bridge Course: Does not arise since a candidate with a degree other than B.Sc. Botany cannot study this programme.

Regular Courses

I Semester (Audit Courses)

Sl. No.	Course Code	Course Title	Nature	No. of Credits	No. of teaching hours
1.	411	Plant Diversity I (Algae, Fungi, Lichens)	Hard Core (Theory)	4	6*
2.	412	Plant Diversity II (Bryophytes, Pteridophytes, Gymnosperms & Paleobotany)	Hard Core (Theory)	4	6
3.	413	Cell and Molecular Biology	Hard Core (Theory)	4	6
4.	414	Practical I (Plant Diversity I)	Hard Core (Lab)	2	4
5.	415	Practical II (Plant Diversity II & Cell and Molecular Biology)	Hard Core (Lab)	2	4
6.	416	Pathogens and Pests of Crop Plants / Applications of Algae, Environment And Human Welfare/Campus Ecology/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
			Total	**18**	**30**

* Teaching hours including Seminar hour.

II Semester (Audit Courses)

Sl. No.	Course Code	Course Title	Nature	No. of Credits	No. of teaching hours
1.	421	Plant Morphogenesis	Hard Core (Theory)	4	6
2.	422	Taxonomy of Angiosperms	Hard Core (Theory)	4	6
3.	423	Ecology and Biodiversity Conservation	Hard Core (Theory)	4	6
4.	424	Practical- III (Plant Morphogenesis)	Hard Core (Lab)	2	4
5.	425	Practical- IV (Taxonomy of Angiosperms &Ecology and Biodiversity Conservation)	Hard Core (Lab)	2	4
6.	426	Evolutionary Biology/ Economic Botany/ Secondary Plant Products and Metabolic Engineering/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
			Total	**18**	**30**

III Semester (Audit Courses)

Sl. No.	Course Code	Course Title	Nature	No. of Credits	No. of teaching hours
1.	511	Plant Physiology and Biochemistry	Hard Core (Theory)	4	6
2.	512	Microbiology and Immunology	Hard Core (Theory)	4	6
3.	513	Instrumentation and Research Methodology	Hard Core (Theory)	4	6
4.	514	Practical V (Plant Physiology and Biochemistry & Microbiology and Immunology)	Hard Core (Lab)	2	4
5.	515	Biogeography/ Biodiversity and Conservation/ Air Pollution and Climate Change/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
6.	516	Medicinal Botany and Dietetics/ Ethnobotany/ Molecular Plant Breeding/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
Total				**18**	**30**

IV Semester (Audit Courses)

Sl. No.	Course Code	Course Title	Nature	No. of Credits	No. of teaching hours
1.	521	Project	Hard Core (Project)	4	6
2.	522	Genomics and Bioinformatics	Hard Core (Theory)	4	6
3.	523	Plant Biotechnology	Hard Core (Theory)	4	6
4.	524	Practical VI (Genomics and Bioinformatics & Plant Biotechnology)	Hard Core (Lab)	2	4
5.	525	Nanobiology/ *In Vitro* Technologies and Industrial Applications/Molecular Interactions of Plants with Microbes/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
6.	526	Plants and People/ Agricultural Ecology/ Systems Biology/ MOOCs/ SWAYAM	Soft Core (Theory)	2	4
			Total	**18**	**30**

Hard Core – 60 Credits
Soft Core – 12 Credits
Total: 72 Credits

ELECTIVE PAPERS

Each Student shall choose any of the choices given in each softcore paper mentioned in each semester.

5. Programme Committee:

a) CBCS Implementation: Every PG Programme shall have a 'Programme Committee'. It facilitates the implementation of CBCS. It supervises the Academic activities of the department. A Programme Committee meets at least two times in a semester.

b) Constitution of Programme Committee: All Faculty members in the Department who are offering Hard Core/Soft Core courses are the members of Programme Committee. Two Student Representatives, one each from I year and II year based on their Academic Merit are also co-opted to represent the students views on academic matters.

c) Principal's Nominee: Principal will nominate one faculty from sister departments of the same college, as his/ her nominee.

d) HOD is the Chairman: HOD is the Chairman of the Programme Committee. He keeps a record of minutes of meetings. Other records like allotment of Subjects, Time Table, schedule of Internal Assessment tests, Question papers, etc., are to be maintained by HOD.

e) Course Plan: Faculty are expected to prepare their Course plan, number of sessions of Teaching, Field Projects/ Lab Practical sessions, etc., and place before Programme Committee.

f) Credit Transfer: Credit Transfer from open source courses, method of evaluation for Internal Assessment tests, etc are to be finalized in Programme Committee.

g) Department Activities: Decisions relating to Conduct of special Lectures/ Seminars/ Conferences/ Workshops for the benefit of students, Students Meets, Science Day celebrations, Alumni meets etc., and the requirement of funds for equipments, annual tours are to be finalized in a Programme Committee meetings.

h) Soft Skill Workshops: Every PG Department should make arrangements for organising Skill-workshops for communication and development of Soft skills, Industry
Interface meets, Campus Placement meets. Smart class rooms are to be created for open source courses, organise Village camps for awareness meets on Government schemes, Climate change, Environment Protection, Girl child, Right to Education, Gender sensitization, etc.,

i) Academic Clubs: Colleges Should organize Research clubs, Technology clubs, Science Exhibitions, Innovation and Patent Workshops, Entrepreneurship Development, etc,

j) Membership in Professional Bodies: The PG Department should join as member in all Professional bodies and conduct at least one annual Seminar on contemporary Topics by inviting experts from professional associations.

k) Workload documentations: All the faculty members are expected to maintain documents relating to number of sessions of teaching (45 hours of direct contact Hours for a 3 credit subject and 60 hours for a 4 credit subject) in every semester

l) Students Attendance: Individual Faculty should also maintain the student's attendance for the sessions handled by them. A minimum 70% attendance is essential to allow a student to appear for the End semester Examination (The same rule is applicable for every Internal Assessment test as well). Students cannot register for subjects where they have shortage of attendance for end- semester exam.

6. Evaluation:

1. **Total 100 marks**: All Audit courses are evaluated for 100 marks. The Internal Assessment component is for 40 per cent and End semester is for 60 per cent marks.

2. **Internals for Lab/Project Work:** In case of Practical Lab Exams/Fields study Reports/Project works/Viva Voce examinations there is 40% internal marks out of 100 marks, i.e., 40 marks for ICA- Internal Continuous Assessment and 60 marks for ESE- End Semester Exam (ICA marks are calculated by consolidating the marks earned by a student in each practical classes of a practical course for the entire period of a semester). The ESE shall comprise marks for Lab Record, Practical Exam, Viva voce, Herbarium. There shall be a mock test for all Lab courses.

3. **Break up of Internal Assessment marks**
   - Each Theory Course shall have the following Break-up of Internal Assessment Marks

Internal Assessment Tests (Two) 2x15	= 15 + 15	= 30 Marks
Seminar/Assignment/ Presentation/Viva and Attendance	= 5 + 5	= 10 Marks
	Total	= 40 marks

Below 75%	0
75-80%	1
80-85%	2
85-90%	3
90-95%	4
95-100%	5

4. **Internal Test Schedule:** Internal Assessment Tests for all subjects in a given semester are to be conducted Test at a time. Program Committee prepares the Internal Assessment schedule.

   - First Test series is to be conducted in first week of September, 2nd Test series in the second week of October and in third week of November, end-Semester examinations begin.
   - In case of even semester (2nd, 4th) the first Internal Assessment test series is in the 2nd week of February and second Internal Assessment test series is in the 3rd week of March and the end Semester exam will be during fourth week of April.
   - Internal Assessment Tests shall be conducted centrally for all the subjects in a particular week continuously for both first and second year students.
   - The faculty Co-ordinator and HOD will coordinate the paper setting work, room arrangements, invigilation, etc.

5. **Two Tests per day in case of internal assessment tests:** Usually, tests for 2 subjects shall be conducted in a given day i.e., 10.00 to 11.30 A.M Paper I, 2.00 to 3.30 P.M Paper II, etc. All Internal Assessment tests should be completed within 3 to 4 days. No class work during the Internal Assessment Test series.

6. **Evaluation in one week days:** The Internal Assessment test papers are to be evaluated within one week days and feedback to be given to students. All test papers should be preserved until end semester exams are conducted.

7. **Minimum 40%:** The Passing Minimum for Internal Assessment tests is 40% of 40 Marks.

8. **Re-test Facility:** A Re-test may be conducted for all those failed to secure 16 marks in IA. No retest will be allowed to those who are irregular, absent without any valid reasons and without any prior approval from all concerned Faculty and HOD.

9. **Consolidated IA Marks:** A Programme Committee meeting (without student representatives) shall be conducted to approve the Internal Assessment marks awarded by all Teachers before submitting to the University.

Range of Marks	**Letter Grade**	**Weightage in calculating CGPA**
91-100	O	10
81-90	A+	9
71-80	A	8
61-70	B+	7
56-60	B	6
50-55	C	5
Below 50	F	0
Failed due to shortage of Attendance	FA	0

6.1. End Semester Examinations:

- **Paper Setting by COE:** For all theory papers, the Controller of Examinations (CEO) of University will arrange for Question papers set by external examiners and also conducts the Examinations by appointing a chief superintendent in each college.
- **Lab/ Project Work Exams:** For all Practical exams/Project works/Viva, an External Examiner appointed by COE and an eligible Internal Faculty of the Department jointly evaluate the performance of students. The Controller of Examinations also appoints an external examiner for all Computer Lab subjects. He evaluates for 60marks
- **Passing Minimum Aggregate 50 Marks:** The Passing minimum in End-semester Examination is 40%. However, a student should get 50 marks when Internal Assessment and End – semester marks are put together.
- **Arrear Exam:** A student who failed to secure 50 marks in aggregate is eligible to take up a supplementary exam with, prior Registration to the said course in the following Semester. Students who failed due to shortage of attendance have to repeat the course.

6.2. Letter Grades and CGPA:

Controller of Examinations shall consolidate the Internal Assessment marks and marks secured in the End – semester examinations. He declares the Results both in letter grades and in Figures. The letter grades refer to the following distribution of marks.

6.3. CGPA:

Cumulative Grade Point Average (CGPA) will be calculated as a weighted average of number of credits that a course carries and the value of Grade point, averaged for all the subjects.

6.4. Declaration of Results

The Controller of Examinations (COE) of Pondicherry University is authorized to declare the Results of a programme. Pass classes are worked out as follows:

Pass Class

CGPA	Result
9.0 and above (in first attempt)	Distinction
7.0 and above	First class
5.00 to 6.99	Second class

Maximum time to complete a 2 year PG Programme is 4 years. University Gold medal will be declared not only based on Academic performance of a student but also weightage is given for his participation in curricular co-curricular and extension activities.

7. Role of Principals:

Overall Supervision: The Principal of the College/Director of PG Centre is authorized to resolve operational difficulties in implementing the CBCS. He is also empowered to supervise the quality of the teaching, standards of this evaluation of Internal Assessment tests and regulate students' attendance, maintain discipline, teacher's sincerity in handing classes, conducting remedial classes for weaker students/students with arrear subjects, etc.

Nomination of Faculty Coordinators: Principals are requested to nominate different faculty in each PG Department as Faculty Coordinators for Internal Assessment Tests, Skill Development, Village Adoption. Innovation and Entrepreneurship, NSS/NCC and other Outreach activities, Coordination of SWAYAM/ MOOCS Courses, Counselling of students to participate in Technical Seminars/ Hackathons, and Campus Placements. Each faculty may be given 2 hours of workload per week for coordinating the above said works

8. Power to resolve Grievances:
However, the Chairman Academic Council/ (Vice–Chancellor of Pondicherry University) has the ultimate authority to interpret, modify and relax any of the above said guidelines and the recommendations of a oversight Committee formed for the purpose of implementing CBCS smooth conduct of Academic programmes in affiliated colleges.

HARD CORE - PAPER 1
I Semester

PLANT DIVERSITY I
(ALGAE, FUNGI AND LICHENS)

Theory (Credits: 4)

Course Code: 411 **Lecture:60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To learn the diversity, structural organization and reproduction of lower organisms – algae, fungi, lichens and present these life form to be progenitors of higher forms life, especially the plants
- To introduce the students the economic value of Thallophytes and their utilization by humans

Course outcome:

On successful completion of the course students will be able to

- identify and classify algae and evaluate the significance in their habitats and in economic terms
- distinguish and classify fungi and assess their biotic significance
- recognize the economic importance of fungi would turn the attention of students to study it
- muster knowledge in spotting lichens and consider them and lower plants indispensable and important as organisms of extreme conditions in the biosphere..

ALGAE

Unit 1 Classification of Algae **12 Lectures**

Criteria for algal classification – Fritch's system of algal classification [In brief, general characters at class level only] – Modern trends in algal classification – chief algal divisions and their principal characters: Cyanophyta, Chlorophyta, Bacillariophyta, Phaeophyta and Rhodophyta. Thallus organization, Organells (chloroplast, pyrenoid eyespot, flagella and Gas vacuoles) & Life cycle patterns in algae.

Unit 2 Applications of Algae **12 Lectures**

- Nitrogen fixation by Cyanobacteria. Beneficial and detrimental aspects of algae: Biotechnological applications of algae. Bioluminescence – Algal bloom, Red tide, and Algal toxins. Algae as indicator of water pollution. Role of algae for carbon sequestration.

FUNGI

Unit 3 Classification of Fungi **12 Lectures**

Classification of fungi by Alexopolous (1995), recent trends and criteria used in classification (DNA BAR coding in fungi). Fungal mycelium and organization of hyphal apex, Fungal Nutrition(with reference to necrotrophs, biotrophs and symbionts), General account of Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes Basidiomycetes and Deuteromycetes with reference to *Plasmodiophora*, *Phytophthora*, *Rhizopus*,*Aspergillus*, *Puccinia*, *Colletotrichum* and *Cystopus.*

Unit 4 Reproduction and Economic uses of Fungi **12 Lectures**

Reproduction in fungi; Hormonal control of sexual reproduction; Patterns of Life cycle in fungi; Fungal Cytology: Heterothallism, heterokaryosis, parasexuality. Economic importance of fungi – Mycotoxins, and mycotoxicoses, antibiotics, edible mushrooms. Mycorrhiza –types and significance.

LICHEN

Unit 5 Nature and Classification of Lichen **12 Lectures**

Lichens- Nature of the relationship between algae and fungi in Lichens - Habit and habitat – Classification of Lichens. Fine structure of lichen thallus – Internal structure– Special structures: Clyphellae, Cephalodia, Soredia, Isidia and Rhizinae. Reproduction: Asexual reproduction: Fragmentation, Isidia and Soredia – Sexual reproduction – Apothecia of lichen. Economic importance of lichens. Lichen as pollution indicators.

Suggested Readings

Text Books

1. Ahamadjan V. 1973. *The Lichens*. Academic press. New Delhi.
2. Gangulee H.C. and Kar A.K. 2011. College Botany (Vol. II). New Central BookAgency. Calcutta.
3. Gibson J.P. and Gibson T.R. 2007. Plant Diversity (Hopkins W.G (Editor). Chelsea House Publishers, New York.
4. Kumar H.D. 1999. Introductory Phycology (2nded.). Affiliated East-West Press Pvt. Ltd. Delhi.
5. Nash III T.H. 2008. Lichen Biology(2nded.). Cambridge University Press, Cambridge.
6. Pandey S.N. and Trivedi P.S. 2013. A textbook of Botany (Vol-I), Vikash Publishing House Pvt. Ltd., New Delhi.
7. Rai M. and Kovics G. (editors). 2010. Progress in Mycology**.** Scientific Publishers (India). Jodhpur.
8. Raven P.H., Johnson G.B., Losos J.B. and Singer S.R., 2005. Biology. Tata McGraw Hill. New Delhi.
9. Sethi I.K. and Walia S.K. 2011. Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd. New Delhi.

Reference Books

1. Alexopoulos C.J., Mims C.W. and Blackwell M. 2002. Introductory Mycology (4thed.). John Wiley and Sons (Asia), Singapore.
2.Bellinger E.G. and Sigee D.C. 2010. Freshwater Algae- Identification and Use as Bioindicators. John Wiley & Sons, Ltd, UK.
3. Lee R.E. 2008. Phycology (4thed.). Cambridge University Press, Cambridge.
4. Round F.E.1986. The Biology of Algae. Cambridge University Press, Cambridge.

HARD CORE –PAPER 2
I Semester

PLANT DIVERSITY II
(BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Theory (Credits: 4)

Course Code: 412 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To learn the diversity, structural organization and reproduction and evolution of organs of Bryophytes, Pteridophytes & Gymnosperms as a perquisite intended towards the extensive colonisation land by flowering plants.
- To learn the preserved vestiges of plant life of the geological past and get a grasp changes faced on global climate and environment.

Course outcome:

On successful completion of the course students will be able to

- locate the trivial non-vascular embryophytes, the bryophytes and could identify them as amphibians of plant kingdom
- classify and identity these first successful land plants as forerunners of Pteridophytes,
- comprehensively review the structural and functional elaboration of free-sporing vascular plants, and
- Comprehensively study the strategies involved in the greening of world and infer the evolution of seed plants
- study the to identify Gymnosperms and interpret the morphological features as key to structural evolution and ecological adaptations,
- examine fossils and could trace the origin and evolution of various groups of plants.

BRYOPHYTES

Unit 1 Classification, Anatomy and Cytology of Bryophytes **12 Lectures**

Classification of bryophytes by Rothmaler (1951) (In brief, general characters at class level only). Origin of Bryophytes including fossil evidence - Morphological variations, Anatomical and Cytological studies of Gametophytes and Sporophytes with reference to Hepaticopsida, Anthocerotopsida & Bryopsida- Dehiscence of capsule and dispersal of spores. Evolution of gametophytes and sporophytes –Affinities of Bryophytes - Progressive sterilization of the sporogenous tissue – Ecology of bryophytes(Pollution indicators and monitoring) – Economic importance of Bryophytes.

PTERIDOPHYTES

Unit 2 Classification of Pteridophytes **12 Lectures**

Classification (G.M. Smith) of Pteridophytes – General aspects of the Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Origin of Pteridophytes: Telome theory; Origin of leaves; sporophylls & roots; Stelar system in Pteridophytes; Zimmermen's telome theory. Comparative account of the important characters of the Psilotopsida, Eligulopsida and Ligulopsida.

Unit 3 Experimental studies in Pteridophytes **12 Lectures**

Life cycle and biology of *Equisetum*, sexuality and advances in homosporous & heterosporous ferns, Heterothallism, regulatory role of light, hormonal control of antheridial and archegonial differentiation. Experimental studies on the development of gametophyte – regeneration of gametophyte reproductive physiology in relevance to genetics. Sporophytes in Pteridophytes- Heterospory and seed habit in Pteridophytes- Economic importance of Pteridophytes.

GYMNOSPERMS

Unit 4 Classification and Characters of Gymnosperms **12 Lectures**

Classification of Gymnosperms by K. R. Sporne. General characters of the following orders: Psilophytales, Lepidodendrales, Sphenophyllales and Coenopteridales. Evolutionary tendencies among Gymnosperms – Comparative account of important characters of *Cycadopsida, Coniferopsida and Gnetopsida*. Primary and secondary structures of wood in cycads and conifers. Organization of male and female cones. Development of male and female gametophytes and embryogeny of class Coniferopsida. Experimental studies and economic importance of Gymnosperms.

PALEOBOTANY

Unit 5 Fossils and Geological Time Scale **12 Lectures**

Plate tectonics- Wagner's theory of continental drift - Mega and microfossils - Geological time table – Salientfeatures of Paleozoic Pteridospermae and Mesozoic Pteridospermae. Affinities of the Cordaitales, Resemblances with Cycads, Ginkgoales and Pteridosperms. A detailed study of external, internal morphology and reproduction in the following fossils – *Asteroxylonmackiei, Lepidocarpon lomaxi, Lyginopteris oldhamia,Cordaites*and Pentoxylon. Contributions of Indian Paleobotonist- Birbal Sahni.

Suggested Readings

Text Books

1. Bhatnagar S.P. and Moitra A. 1996. Gymnosperms. New Age International (P) Ltd Publishers. New Delhi.
2. Gibson J.P. and Gibson T.R. 2007. Plant Diversity (Hopkins W.G (Editor). Chelsea House Publishers, New York.
3. Goffinet B. and Shaw A.J. 2009.Bryophyte Biology (2nded.).Cambridge University Press. Cambridge.
4. Pandey B.P. 2012. College Botany (Vol. II). S. Chand & Company Pvt. Ltd. New Delhi.
5. Parihar N.S. 1991.An Introduction to Embryophyta (Vol.I). Bryophyta. Central Book Depot, Allahabad.
6. Rashid A. 1999. An Introduction to Pteridophyta: Diversity, Development, Differentiation(2nd revised ed.). Vikas Publishing House Pvt Ltd. New Delhi.
7. Sambamurty A.V.SS. 2005. *A text book of Bryophytes, Pteridophytes, Gymnospermsand Paleobotany* I.K. International Pvt. Ltd. New Delhi.
8. Sporne K.R. 1991. *The Morphology of Pteridophytes*. B.I. Publishing Pvt. Ltd. Bombay.
9. Sporne K.R. 1974. *Morphology of Gymnosperms*. Hutchnson University Library. London.
10. Vashishta B.R. 1995. Botany for degree students: Bryophyta. S.Chand & Company Ltd. New Delhi.
11. Vashishta P.C., Sinha A.K. and Kumar A. 2010. Pteridophyta. S. Chand & Company Pvt. Ltd. New Delhi.

Reference Books

1. Arnold C.A. 2008. An Introduction to Palaeobotany. Read Books. New York.
2. Stewart W.N. and Rathwell G.W. 1993. *Palaeobotany and the evolution of Plants*. Cambridge University press.
3. Taylor T.N. and Taylor E.L. 2009. Paleobotany: The Biology and Evolution of Fossil Plants (2nded.). Academic Press, Amsterdam.
4. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.

HARD CORE –PAPER 3
I Semester

CELL AND MOLECULAR BIOLOGY

Theory (Credits: 4)

Course Code: 413 **Lecture:60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course is to understand the basic theoretical concepts and techniques of Cell Biology and Molecular Biology with special reference to plants.
- It will facilitate the students to develop an understanding of sub-cellular structural details of plant cells.
- This paper shall introduce the constructs on molecular details of the different plant cells enable them to identify the area of interest for research.

Course outcome:

On successful completion of the course students will be able to

- probe and unravel the mysteries of plant life at microscopic and nano scale dimensions
- handle modern microscopic and molecular tools with confidence.
- hire appropriate tools/ techniques identify and characterize the roles played by each plant cell organelle.
- Infer and interpret events like cell division and it molecular mechanism so as to appreciate and manipulate normal and abnormal cell and tissue growth
- Know the functions of nuclear genome and would realize the importance in coordinating cell and organelle functions

CELL BIOLOGY

Unit 1 Introduction to Modern Tools and Techniques of Cell Biology **12 Lectures**

Light and Electron microscopy, techniques supplementing microscopy (cytochemistry and techniques like microprobe analysis, X-ray diffraction), Cell fractionation and visualization/characterization of various cell fractions.

Unit 2 Cell Components and their Functions **12 Lectures**

Dynamic structure, functions and biogenesis of cell wall and plasma membrane; new insights in structure and function of cytoplasmic cell organelles and biopolymers; nucleus; its components, chromatin structure in eukaryotes, condensation and packaging of DNA in prokaryotes, their dynamic state and role in gene regulation and C-value paradox; structure and function of plant cytoskeletal genes and gene products; protein sorting and intracellular trafficking.

Unit 3 Cell Signaling **12 Lectures**

Signal transduction: receptors and G-proteins and signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants.

Unit 4 Cell Multiplication and Turnover **12 Lectures**

Mitosis and meiosis, their regulation, steps in cell cycle regulation and control of cell cycle (Cyclins and CdkS) and apoptosis; Gene structure, regulation and expression in eukaryotes: Gene and promoter architecture, cistrons, regulatory sequences, enhancers and their mechanism of action, DNA replication; transcription - RNA polymerases, transcription factors, Introns, RNA splicing, alternative splicing, RNA stability - cap structure and function, polyadenylation; translation, posttranslational modifications.

Unit 5 Organellar Genomes **12 Lectures**

Endosymbiotic theory -Organization and function of mitochondrial and chloroplast genomes, diversity and evolution of organelle genomes.

An over view of chloroplast and mitochondrial functions in cellular energetic - ATP synthase - Chloroplast protein targeting to different compartments, mitochondrial DNA and male sterility, transfer of genes and gene products between nucleus and organelles.

Suggested Readings

CELL BIOLOGY

Text Books

1. Gupta P.K. 2005. *A textbook of Cell and Molecular Biology*, RastogiPublications, Meerut.
2. Gupta P.K. 2005. *Cytogenetics*, Rastogi Publications, Meerut.
3. De Robertis E.D.P. and De Robertis E.M.P. 2010. Cell and Molecular Biology(8th edition), Lea and Febiger, Philadelphia, USA.
4. Kumar H.D. 1993. *Molecular Biology and Biotechnology*, Vikas Publishing House, New Delhi
5. Gupta P.K. 2005. *Genetics.* Rastogi Publications. Meerut.
6. Watson J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press.

Reference Books

1. Alberts B., Johnson A.D., Lewis J., Morgan D., Raff M.. 2018. Molecular Biology of the Cell, Academic Press, Garland Science.
2. Krebs J. E., Goldstein E. S. and Kilpatrick S. T. 2011. *Lewin's Genes X* (10thed.),Jones and Bartlett Publishers.

MOLECULAR BIOLOGY

Text Books

1. Allison L.A. 2007. Fundamental Molecular Biology. Blackwell Publishing. U.S.A.
2. Gupta P.K. 2005. *A textbook of Cell and Molecular Biology*, Rastogi Publications, Meerut
3. Henry R.J. 1997. *Practical applications of Plant Molecular Biology*, Chapman & Hall, London, UK.
4. Friefelder D. 1987. Molecular Biology (2nded.). Narosa Publishing House. New Delhi.
5. Kumar H.D.1993. *Molecular Biology and Biotechnology*, Vikas Publishing House, New Delhi.
6. Sheeler P. and Bianchi D.E. 2006. Cell and Molecular Biology (3rd edition). Wiley India (P.) Ltd. New Delhi.
7. Verma P.S. and Agarwal V.K. 2009. Molecular Biology. S.Chand & Company Ltd. New Delhi.
8. Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. and Losick R. 2004.

Reference Books

1. Bruce Alberts, 2008. *Molecular Biology of the Cell*(5thed.), Garland Science
2. Becker W.M., Kleinsmith L.J., Hardin J. and Bertoni G. P. 2009. The World of theCell (7thed.). Pearson Benjamin Cummings Publishing. San Francisco.
3. Cooper G.M. and Hausman R.E. 2009. The Cell: A Molecular Approach (5thed). ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology (8thed.). Lippincott Williams and Wilkins. Philadelphia.
5. Karp G. 2010. Cell and Molecular Biology: Concepts and Experiments (6thed.). John Wiley & Sons. Inc. New York.
6. Lodish H., Berk A., Kreiger C. A. Scott, M. P. A. Bretscher H., Ploegh P., Matsudaira.2008. *Molecular Cell Biology*(6thed.), W.H. Freeman.
7. Old R.W. and Primrose S.B. 2006. *Principles of Gene Manipulation (7th edition)*. Blackwell Scientific Publications, Oxford, UK.
   (Ebook: https://pdfs.semanticscholar.org/4263/86452b4eaac2f77324b6f70bfa78f7de70a7.pdf)
8. Smith- Keatry P. 1991. Molecular Genetics, MacMillan Publication Co. Ltd. London.

HARD CORE –PAPER 4
I Semester

PRACTICAL – I (PLANT DIVERSITY I)

Practical (Credits: 2)

Course Code: 414 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To make the learner locate and identify cryptogams and fungi
- investigate the internal and external features of lower plants through a rounded hands-on experience

Course outcome:

- **On successful completion of the course students will turn** competent in identifying the lower life forms and primitive plant species by its morphological features and reproductive structures and shall effectively ad positively handle them in use for human welfare.

SUGGESTED LABORATORY EXERCISES

Algae

Study of the morphology and internal structure of the algae with particular reference to the following forms, including locally available forms: *Oscillatoria, Spirulina, Anabaena, Microcystis, Scytonema, Tolypothrix, Westiellopsis, Cylindrospermum, Chlorella, Desmids, Ulva, Caulerpa, Halimeda, Diatoms, Padina, Dictyota, Sargassum, Gracilaria*.

Isolation and culture of algae from fresh and marine water

Fungi

Isolation and identification of fungi from bread, soil, seed and dung. Identification ofthe following genera – *Rhizopus, Pilobolus, Penicillium, Trichoderma, Fusarium, Curvularia and Alternaria*. Sectioning of – *Agaricus, Polyporus, Peziza* & *Xylaria*

Lichens

Usnea, Parmelia thallus and Lichen Apothecium for sectioning.

Suggested Readings

1. Kumar H.D. 1988. *Introductory Phycology*. Affiliated East-West Press Ltd, New Delhi.
2. Round F.E.1986. *The Biology of Algae*. Cambridge University Press, Cambridge.
3. Alexopoulus C.J., Mims C.W. and Blackwel M. 1996. *Introductory Mycology*, JohnWiley &Sons Inc.
4. Ahamadjan V. 1973. *The Lichens*. Academic Press. New Delhi.
5. Aneja, K.R. 1993. *Experimens in Microbiology*, Plant Pathology and Tissue Culture. New Age International Publishers.

HARD CORE –PAPER 5
I Semester

PRACTICAL – II (PLANT DIVERSITY II & CELL AND MOLECULAR BIOLOGY)

Practical (Credits: 2)

Course Code: 415 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To understand the morphological features of plant amphibians and primitive vascular terrestrial plants
- To understand the growth, development of plant organs, somatic and reproductive cell division processes.
- To inculcate the structure and functions of the cell and project it as a fundamental unit of life

Course outcome:

On successful completion of the course students will be able to

- identify major groups of bryophytes, pteridophytes and gymnosperms and know their academic and applied utility.
- take up fossil collections to compare external and internal features of present day pteridophytes & gymnosperms and draw insights on past and present ecological crisis
- The student will be able to identify the type of organelles and determine their functions that they may see the cell system as self contained entity.

SUGGESTED LABORATORY EXERCISES

Bryophytes

Morphological and Anatomical studies of the following specimens – *Marchantia, Targionia, Reboulia, Dumortiera, Pallavicinia. Porella, Anthoceros, Polytrichum*and *Sphagnum.*

Pteridophytes

Study of morphology, anatomy and reproductive structures of *Psilotum, Lycopodium, Selaginella, Equisetum, Isoetes, Lygodium, Gleichenia, Pteris, Ophioglossum, Ceratopteris, Marsilea, Azolla* and *Adiantum.*

Gymnnosperms

Study of morphology, anatomy and reproductive structures of *Cycas, Pinus, Araucaria, Ginkgo biloba, Podocarpus, Gnetum, Cupressus, Thuja.*

Paleobotany

Study of important fossil forms from slides and specimens- *Asteroxylon mackiei, Lepidocarpon lomaxi, Lyginopteris oldhamia, Cordaites*and Pentoxylon.

Cell and Molecular Biology

1. Isolation and purification of nuclei and their staining with Feulgen stain or DAPI.
2. Isolation of mitochondria and their visualization with Janus green B
3. Isolation of chloroplasts
4. Comparing the effect of some physical and chemical factors on the efficiency of photosynthetic electron transport.
5. Study of different stages of mitosis in onion root tip tissues
6. Study of different stages of meiosis in anther.
7. To study the effect of inhibitors and uncouplers on the activity of succinic dehydrogenase, a marker enzyme of mitochondria.
8. Isolation of RNA, quantification and visualization on gel.
   In situ visualization of microfilaments and microtubules by fluorescent labeling.
9. *In silico* analysis (sequence comparison) of mitochondrial and chloroplast genes for identification of the loci for interspecific discrimination.

10. Multiple sequence alignment and ontology based database searches on selected plant cytoskeletal genes to deciphering the molecular phylogeny of cytoskeleton genes.
11. Immunostaining of nuclei, chloroplast and/or mitochondria.
12. Feulgen staining of nucleic acids in onion root tissues
13. Induction of polyploidy using colchicines

Suggested Readings

PLANT DIVERSITY II

1. Agrawal A. A text book of Botany (vol.III) (Diversity of Pteridophytes Gymnosperms & paleobotany) Theory & Practical. KNRN Publications, Meerut, U.P.
2. Sambamurty A.V.SS. 2005. *A Text Book of Bryophytes, Pteridophytes, Gymnospermsand Paleobotany*. I.K. International Pvt. Ltd. New Delhi.
3. Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd. Bombay.
4. Sporne,K.R. 1974. Morphology of Gymnosperms. Hytchnson Univ. Library. London.
5. Vasishta B.R., Sinha A.K. and Anil Kumar. 2005. Pteridophyta. S. Chand & Co. Ltd. New Delhi.c

CELL BIOLOGY

1. George M Malacinski . 2015. Freifelders Essentials Of Molecular Biology (4th ed.). Jones & Bartlett.
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
4. Gupta, P.K. 2018. *Cytogenetics*, Rastogi Publications, Meerut.
5. Gupta, P.K. 2012. Cell Biology and *Genetics*. Rastogi Publications. Meerut.
6. Kumar, H.D. 2007. *Molecular Biology and Biotechnology*, Vikas Publishing House, New Delhi.
7. Krebs J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning, ISBN-13: 978-1284104493, ISBN-10: 1284104494.

MOLECULAR BIOLOGY

1. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
2. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual. 3. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
4. Henry, RJ 1997, *Practical applications of plant molecular biology*, Chapman & Hall, London.
5. Kumar H.D. 2007. Molecular Biology and Biotechnology (2nd ed.), Vikas Publishing House, New Delhi
6. Krebs J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.
7. Malacinski G.M. 2008. Freifelder's Essentials of Molecular Biology (4th ed.), Narosa Publishing House, New Delhi.
8. Primrose S.B. and Twyman R.M. 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing, U.K.
9. Schuler M.A. and Zielinski R.E. 2012. Methods in Plant Molecular Biology. Academic Press.

SOFT CORE –PAPER 1
I Semester

PATHOGENS AND PESTS OF CROP PLANTS

Theory (Credits: 2)

Course Code: 416 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To provide an exposure on the nature of diseases to crop plants.
- To introduce the type of pathogens of plants.

Course outcome:

On successful completion of the course students will be able to

- recognize and identify diseases using systems and find ways means to adopt control measures.
- identify bacteria diseases and draw inferences on etymology and control
- study fungal diseases interns of their causes , control and management
- distinguish diseases and disorders caused by insects and nematodes and deal with them appropriately

Unit 1 Plant pathogen: Viruses **12 Lectures**

General characteristics of plant pathogenic viruses with reference to the initiation, cause, control and spread of viral diseases, and deal with host specificity control mechanisms concerning genetics, chemical treatments and genetic engineering.

Unit 2 Plant pathogen: Bacteria **12 Lectures**

General characteristics of plant pathogenic Bacteria with reference to the following:
Life cycles, Nature of disease(s) and damage caused, Host range, Control mechanisms based on genetics, chemical treatments, biological control in the context of analyzing the disease triangle

Unit 3 Plant pathogen: Fungi **12 Lectures**

General characteristics of phtyopathogenic Fungi pondering on life cycles of the germ, Nature of damage caused on host dealing with control strategies based on genetics, mechanicals, chemical and biological control and work hesitance mechanism

Unit 4 Plant pathogen: Insects and Nematodes **12 Lectures**

General characteristics of plant pathogenic Insects and Nematodes with reference to the loss incurred in productivity and study the life cycles of pests, nature of disease(s), damage caused on host and explore the mechanism and management of select diseases

Unit 5 Case studies of pathogens **12 Lectures**

Case studies of economically important causative agents with specific references to case studies on:

1. Plant-virus interactions with emphasis on potyviruses and horticultural crops.
2. Plant-bacterial interactions with emphasis on *Erwinia* sp. and potatoes.
3. Plant-fungus interactions with emphasis on *Magnaporthe* sp. and rice.
4. Plant-nematode interactions with emphasis on *Meloidogyne* sp. and tomato.
5. Plant-Insect interactions with emphasis on *Pieris* sp. and crucifers.

Suggested Readings

Text Books

1. Agrios G.N. 2005. Plant Pathology, 5th edition. Vikas publications. New Delhi
2. Buchanan B., Gruissem G. and Jones R. 2000. Biochemistry and Molecular Biology ofPlants, American Society of Plant Physiologists, USA.
3. Roberts D.A. Boothroyd C.W.1984. Fundamentals of Plant Pathology (2nd edition). CBCS Publishers & Distributors, Delhi.
4. Sethi I.K. and Walia S.K. 2011.Text book of Fungi & Their Allies, MacMillan PublishersPvt. Ltd. New Delhi.

Reference Books

1. Burns R. (editor). 2009. Plant Pathology- Techniques and Protocols. Humana Press, LLC.
2. Talbot N.J. (editor). 2004. Plant–Pathogen Interactions. In: Annual Plant Reviews. Blackwell Publishing Ltd., UK.

SOFT CORE –PAPER 1
I Semester

APPLIATIONS OF ALGAE, ENVIRONMENT AND HUMAN WELFARE

Theory (Credits: 2)

Course Code: 416 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course is to provide a good working knowledge on organization, reproduction, classification and industrial applications of algae with reference their environment.
- Also introduces the concept on algal cultures in laboratory and biofuel production.
- The students would be introduced with the role of algae in combating global warming.

Course outcome:

- Students would be able to identify different algal forms by their external morphology.
- Students could compare different algal groups based on their genetic makeup.
- Many algal products and bioactive compounds could be isolated by the students.
- Algal cells can be cultured through tissue culture and aquaculture procedures.
- Algal cells could be used as biofuel producers and agent to reduce global warming.

Unit 1 Diversity and distribution of the algae **8 Lectures**

Thallus organization, cell structure and reproduction in various groups. *Chlamydomonas* and *Porphyra* as model experimental systems.

Unit 2 Classification of Algae **14 Lectures**

Molecular taxonomy – recent developments in algal classification, emerging trends in molecular phylogeny and inter relationship of principal groups of algae: Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.

Unit 3 Industrial Phycology **14 Lectures**

Products, processes and applications, seaweeds polysaccharides: Agar, Carrageenan and Alginates. Bioactive compounds from algae: Bio-fertilizers; Algae in bioengineering, photo-bioreactors and raceway ponds.

Unit 4 Algal Biotechnology **12 Lectures**

Historical perspectives, algal culturing techniques in the laboratory, tissue and cell culture studies in seaweeds, cryopreservation, aquaculture (micro and macroalgae cultivation), bioremediation.

Unit 5 Recent developments and future of algal biotechnology **12 Lectures**

Algal biofuels – algal biodiesel, bio-ethanol and biological hydrogen production; Algae in global warming – carbon capture by algae.

Suggested Readings

Text Books

1. Cole K.M. and Sheath RG. 1990. Biology of the Red Algae. Cambridge University Press, Cambridge.
2. Fritsch F.E. 1945. The Structure and Reproduction of Algae. Vol. II. Cambridge University Press. Cambridge, London.
3. Isabella A. Abbott, George J. and Hollenberg. 1993. Marine Algae of California. Stanford University Press. USA.
4. Lee R.E. 1989. Phycology (vol. II). Cambridge Univ. Press. Cambridge, USA.
5. Sahoo D. and Qasim S.Z. (Editors), 2002. Sustainable Aquaculture. APH Publishing Corporation, New Delhi, India.
6. South G.R. and Whittick A. 1987. Introduction to Phycology. Blackwell Scientific Publications. London.

Reference Books

1. Andersen R.A. 2005. Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
2. Lee R.E. 2008. Phycology (4thed.). Cambridge University Press, Cambridge.

Journals

Journal of Applied Phycology
Journal of Phycology
European Journal ofPhycology
Phycologia
Botanica Marina.

SOFT CORE –PAPER 1
I Semester

CAMPUS ECOLOGY

Theory (Credits: 2)

Course Code: 416 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To present course aimed at giving quality education on the basics of ecosystem, in order to give a clean atmosphere within the campus.
- To offer information and inspire learner with the information on uniqueness of the flora and fauna in the campus will tickle the young mind with a vision towards the biodiversity of the campus ecosystem .
- To impress upon the student the need to be egocentric that after the completion of the course students will be able to understand, appreciate and conserve the nature.

Course outcome:

On successful completion of the course students will be able to

- appreciate the history and establishment of the campus which is an important heritage marvel and the origin.
- understand the biodiversity abode with reference to changes in seasonal variations of the flora, fauna and the risks related to spread of exotic plants
- realize the ecoclimatic conditions prevailing in a campus in the context of preserving the serenity of the campus, and proactively take part in efforts taken by the administration to maintain the ecological harmony mainly concentrating on water crisis and conservation.
- comprehend the reason behind the importance cleanliness of the campus by way of solid waste disposal and also to ensure the campus upkeep.

Unit 1 Understanding the campus **12 Lectures**

Origin and history – departments – etymology – building designs – architecture – various facilities – organizational set up – satellite campus – origin and history – beneficiaries.

Unit 2 Biodiversity **12 Lectures**

Flora and fauna – seasonal variations – exotic plants and weeds – horticultural species – arboretum – species of birds and animals – importance of flora and fauna

Unit 3 Ecoclimate **12 Lectures**

Serenity of the campus – ecological factors – rainfall – temperature – altitude – impact of plants – campus as an ecosystem – litter fall – rain water harvesting – water crisis and conservation.

Unit 4 Waste regulation **12 Lectures**

Waste disposal – litter *vs* solid waste – basics of solid waste management – pollution (air, water and environment) – ecological ethics – importance of diversity – atmospheric cleanliness – future scope.

Unit 5 Eco-watching **12 Lectures**

Tree cover – qualitative and quantitative analysis: belt transect (density, abundance and frequency) – basics of bird watching – unique trees and animals – litter drop method – basics of aerobiology.

Suggested Readings

Text Books

1. Odum E. and Barrett G.W. 2005. Fundamentals of ecology. Cenage Learning India Private Limited.
2. Sharma, P. D. 2017. Ecology and Environment. Rastogi Publications.
3. Cokulraj, Uma, and Kadavul K. 2016. Flora of Tagore Arts College. B.Sc. Dissertation submitted to Pondicherry University.

Reference Books

1. Anonymous 2005. The American college Commemoratory publication SCILET
2. Bor N. L.and Raizada M.B. 2000 Some Beautiful Indian Climbers and Shrubs, Bombay Natural History Society. Bombay
3. Mc Cann, C. 1966. 100 Beautiful trees of India – A descriptive and pictorial handbook. D.B. Taraporevala Sons & Co Private Ltd, Bombay.
4. Sahni K C. 1998. The Book of Indian Trees. Bombay Natural History Society. Bombay.
5. Santapau H. 1966. Common trees, India land and the people, National book Trust India New Delhi.

HARD CORE –PAPER 6
II Semester

PLANT MORPHOGENESIS

Theory (Credits: 4)

Course Code: 421 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course is to inculcate in students the appreciation of architectural marvel of plants and to explore the various developmental stages involved in it.
- The types of building blocks and the engineering mechanisms involved in tissue assembly and organ development would be unraveled.
- The vegetative growth and the reproductive ability of the immobile entity as plants would be studied at the experimental level.

Course outcome:

On successful completion of the course students will be able to

- look at plant development from holistic view point and appreciate plans and the processes involved
- know the types of tissues and find the importance of their form and functions in constituting the plant body.
- probe the growth of plant cells and organs and identify the principles involved coordination specially with reference to plant growth substances.
- profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.

Unit 1 Organization of land plants **12 Lectures**

Exomorphic design – internal morphology and histological diversity – unique and general attributes of plant growth – plant structure viewed in terms of functions – cell as a building block – developmental potential of zygote, shoot and root meristem – embryogenic, somatic and reproductive phases of plant development.

Unit 2 Developmental anatomy **12 Lectures**

Uniqueness of meristematic cell – Shoot Apical Meristem (SAM)– theories and contemporary views– parenchyma as a filler and feeder – wall thickening and cytological variations in collenchyma and sclerenchyma – axial and appendicular structures – shoots – leaf differentiation and leaf expansion – plastochron –phyllotaxy – mechanism of axial and radial growth – polarity – histogenesis – lateral meristem (vascular and cork cambium) – xylem – phloem – secondary growth and anomaly – environmental control – special structures (velamen, hydathodes and laticifers).

Unit 3 Growth and Development **12 Lectures**

Mechanics of cell cycle and cell division – Growth curve and relative growth rate (RGR) – growth pattern – Plant Growth Regulators: bioassay and biosynthesis – mode of action of classical hormones, Brasinosteriods, Jasmonic Acid –Phytochromes and Photoperiodism – Biological Clock – Plant Movements – Biochemical and Hormonal Integration – Signal Transduction – Genetic Control – Growth Measurement – Aging – Senescence, Abscission – Dormancy – Programmed Cell Death(PCD).

Unit 4 Reproductive Biology **12 Lectures**

Organization of floral meristem – protective and generative organs of a flower – floral evocation – Control of florogenesis: ABC model –microsporogenesis and pollen development – megasporogenesis and female gametophytes – genic and cytoplasmic male sterility – Floral and extrafloral nectories –Protection and pollination behavior – pollen – pistil interactions and sexual incompatibility– syngamy, post-fertilization changes (embryo, seed, fruit development).

Unit 5 Experimental morphogenesis **12 Lectures**

Plant growing structures – controlled and precision farming. Nursery practices – propagation through cutting, layering, grafting – Seed science – traditional and hybrid seed production – grain filling – parthenocarpy and applications (seedless, shelf - life) – commercial dimensions of flower, seed, fruit and grain production – Case studies on rubber, tea 'banji' removal and Jasmine production.

Suggested Readings

Text Books

1. Burgess J. 1985. An Introduction to plant cell development. Cambridge University Press. ISBN 0 5213 0273 0.
2. Evert R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of The Plant Body: Their Structure, Function, and Development (3rd edition). John Wiley & Sons, Inc., Hoboken, New Jersey.
4. Fahn A 1989. Plant Anatomy. Pergamone Press.
5. Johri B. M. 1982. Experimental Embryology of Vascular Plants – Springer – Verlag. 6. Suárez M.F. and Bozhkov P.V. 2008. Plant Embryogenesis. Humana Press, LLC.

Reference Books

1. Lyndon R. F. 1990 Plant development: The cellular basis Unwin Hyman Publication. ISBN00458 1032 X.
2. Maheshwari P. 1985. An introduction to the embryology of angiosperms, Tata McGraw Hill.
3. Raghavan V. 1986. Embryogenesis in Angiosperms, Cambridge University Press, 4. Raghavan V. 1997. Molecular Basis for Plant Development, Cambridge University Press.
5. Wardlaw C. W. 1952. Plant Morphogenesis. Mac Millan & Co Ltd. London.

HARD CORE –PAPER 7
II Semester

TAXONOMY OF ANGIOSPERMS

Theory (Credits: 4)

Course Code: 422 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To introduce a help students understand the fundamental concepts of plant Ecology
- To enhance the knowledge of the students in wide array of plant and their interaction with the environment.

Course outcome:

On successful completion of the course students will be able to

- understand the underlying mechanism of using floral and somatic traits as vqlid basis for classifying plants
- identify and name the plants and this would lead to documentation of floral wealth
- Distinguish Dicot and Monocot families with specific examples and engage themselves scientifically evaluating nature and planet earth's treasures.

Unit 1Plant Nomenclature **12Lectures**

Plant Species concept, Taxonomical Hierarchy, Salient features of ICBN, Typification, Priority, Homonyms and Tautonyms. Taxonomic evidences: Morphology, Anatomy, Palynology, Embryology, Cytology, Phyto-chemistry, Genome analysis and nucleic acid hybridization.
Advanced Morphology: Origin and evolution of flower- Co- evolution of flower and pollinator; origin and evolution of polypetalae, sympetalae, stamens and carpels; Staminodia. Nectaries; types and evolution of ovaries, placenta.

Unit 2 Classification of Angiosperms **12 Lectures**

System of angiosperm classification: phonetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification; Artificial (Linnaeus), Natural (Bentham and Hooker), Phylogenetic(Hutchinson) and Modern (Cronquist) systems, relevance of taxonomy to conservation.

Unit 3 Polypetalae Families **12 Lectures**

Study of the following Polypetalae families and their economic importance: Nymphaeaceae, Papaveraceae, Brassicaceae, Caryophyllaceae, Tiliaceae, Menispermaceae, Portulacaceae, Meliaceae, Rosaceae, Myrtaceae, Passifloraceae, Apiaceae, Sapindaceae, Vitaceae.

Unit 4 Gamopetalae Families **12 Lectures**

Investigation of the following Gamopetalae families and their economic importance: Sapotaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Acanthaceae, Scrophulariaceae, Pedaliaceae, Verbanaceae.

Unit 5 Monochlamydeae and Monocotyledonae **12 Lectures**

Evolution and study of selected Monochlamydeae & Monocotyledonae families and theireconomic importance of Moraceae, Nyctaginaceae, Loranthaceae, Casuarinaceae, Aristolochiaceae, Amarillidaceae, Orchidaceae, Commelinaceae, Araceae, and Cyperaceae, and study their economic and ecological importance.

Suggested Readings

Text Books

1. Cole A. J. 1969. *Numerical Taxonomy*, Academic Press, London.
2. Davis P. H. and Heywood, V.H. 1973. *Principles of Angiosperms Taxonomy*. Robert E. Kreiger Pub. Co. New York.
3. Grant V. 1971. *Plant Speciation*. Columbia University Press, New York.
4. Harrison H.J. 1971. *New Concept in Flowering Plant Taxonomy*. English Language Book Soc. & Edward Arnold Pub. Ltd., London.
5. Henry A.N, M. Chandrabose. 1980. *An aid to International code of Botanical Nomenclature*. Today & Tomorrow's Printers and Publishers. New Delhi.
6. Jain S.K. and Rao R.R. 1977. *A Handbook of Field and Herbarium Methods*. Today & Tomorrow's Printers and Publishers. New Delhi.
7. Jones S.B.Jr. and Luchsinger A.E. 1986. *Plant Biosystematics* (2nded.).McGrew Hill Co., New York.
8. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
9. Lawrence G.H.M. 1951. Taxonomy of Vascular Plants. Oxford & IBH Co. Pvt. Ltd. New Delhi.
10. Pandey B.P. 2005. Taxonomy of Angiosperms. S.Chand & Company Pvt. Ltd. New Delhi.
11. Pandey B.P. 2010. Modern Practical Botany (Vol. II). S.Chand & Company Ltd. New Delhi.
12. Pandey B.P. 2012. College Botany (Vol. II). S.Chand & Company Pvt. Ltd. New Delhi.
13. Singh G. 2012. Plant Systematics: Theory and Practice (3rded.). Oxford & IBH Pvt. Ltd. New Delhi.
14. Sivarajan V.V. 1991. *Introduction to the principle of plant Taxonomy*. Oxford IBH Publication Pvt Ltd, New Delhi.
15. Solbrig O.T. 1970. *Principles and Methods of Plant Biosystematics*. The MacMillan Co-Coller-MacMillan Ltd., London.
17. Subramaniam, N.S. 1996. *Laboratory Manual of Plant Taxonomy*. Vikas Publishing House Pvt. Ltd., New Delhi.

Reference Books

1. Grant, W.F. 1984. *Plant Biosystematics*. Academic Press, London.
2. Henry R.J. 2005. Plant Diversity and Evolution: Genotypic and Phenotypic Variation in Higher Plants. CABI Publishing, CAB International, UK.
3. Heywood, V.H. and Moore, D.M. 1984. *Current Concept in Plant Taxonomy*, Academic Press, London.
4. Hutchinson, J. 1973. *The Families of Flowering Plants*. 3rd Edition. Oxford University Press. Oxford.
5. Mathews, K.M. 1983. *Flora of a Tamil Nadu Carnatic Vol I-VI*. Rapinat Herbarium, Trichy.
6. Nordenstam,B., El Gazaly, G. and kassas, M. 2000. *Plant Systematics* for 21stCentury. Portland Press Ltd., London.
7. Rendle A.B. 1967, Classification of flowering plants, Cambridge University Press , Cambridge.
8. Simpson M.G. 2006. *Plant Systematics.* Elsevier Academic Press. San Diego, CA,U.S.A.
9. Takhtajan, A.L. 1997. *Diversity and Classification of Flowering Plants*. ColumbiaUniversity Press, New York.
10. Gamble JS (1935), Flora of Presidency of Madras, London.

HARD CORE –PAPER 8
II Semester

ECOLOGY AND BIODIVERSITY CONSERVATION
Theory (Credits: 4)

Course Code: 423 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To examine and understand the basic concepts of plant ecology as e scientific study of environment
- To enhance the knowledge of the students and equip them in assessing and protecting invaluable components of nature and the interactions in environment.

Course outcome:

On successful completion of the course students will be able to

- Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species.
- Students will spot the sources and pollution and seek remedies to mitigate and rectify them.
- Guard various plant resources that they may be effectively and sustainably utilized for human welfare.

Unit 1 Vegetation organization and Development **12 Lectures**

Plant Community concepts and their characteristics, ecological succession, nutrient cycling, structure and function of ecosystem, biogeochemical cycle of C, N, P & S, population & the environment, ecads and ecotypes.

Unit 2 Vegetation pattern and Biological diversity **12 Lectures**

Major biomes and vegetation, soil, concept of biodiversity, IUCN categories of threat, speciation and extinction, inventory, hot spots, endemism, plant introductions, biodiversity and ecosystem, local plant diversity and its socio– economic importance.

Unit 3 Ecological Pollution and Management **12 Lectures**

Air Pollution, Water Pollution & Soil Pollution(sources, effects on plants and ecosystem, control measures), Climatic change, Green House Effect: Green House Gases, Global warming, Ozone layer depletion, UV radiation and their impacts on vegetation, Environmental Impact Assessment, Ecosystem restoration, Sustainable development.

Unit 4 Plant resources **12 Lectures**

Plant resources – Global and national scenario (terrestrial and marine),various utility values of plant resources (food, fodder, timber, medicinal, aromatic, oil, ornamental, ethical, aesthetic and option values), Ecosystems in India with rich biological diversity (mangroves, coral reefs, wetlands and sub-tropical forests) and threats to these resources (natural and manmade).

Unit 5 Conservation and Management of Biodiversity **12 Lectures**

Need for conserving the biodiversity, International and National aid, policies and legal assistance, detailed account on *In-situ* and *Ex-situ* conservation methods.

Suggested Readings

Text Books

1. Ambasht R. S. 1990. A Text Book of Ecology. Students Friends Publications,Varanasi.
2. Berlatsky (2013) Biodiversity – Global Viewpoints. Gale Cengage Publishers.
3. Krishnamurthy K.V. 2004. An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
4. Sharma P.D. 2011. Ecology and Environment. Rastogi Publications, Meerut.
5. Singh J.S., Singh S.P. and Gupta S.R. 2014. Ecology, Environmental Science and Conservation. 4th Edition. S. Chand & Company Pvt. Ltd.
6. Stiling P. 2015. Ecology: Global Insights & Investigations (2nd edition). McGraw-Hill international edition.

Reference Books

1. Odum E.P. and Barrett G.W. 2018. Fundamentals of Ecology. JayPee Brothers Medical Publishers.

HARD CORE –PAPER 9
II Semester

PRACTICAL – III (PLANT MORPHOGENESIS)

Practical (Credits: 2)

Course Code: 424 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

To make learners understand the morphological features and help them appreciate the designs of plant growth and development

To enable students understand the nitty-gritty of the development of plant organs and productive process conferring them their reliance in plant evolution

Course outcome:

On successful completion of the course students will be able to

- identify the plant a composite being with a fine- tuned arrangement of development and functions
- scientifically study contributions of cells, tissues and organs in the making somatic structures and flowers in a plant

Suggested Laboratory Exercises

1. Morphology and adaptations of flowering plant.
2. Growth pattern.
3. Internal morphology of the monocot and dicot root and shoot.
4. Investigation of secondary growth and wood anatomy.
5. Anomalous secondary growth in selected plants.
6. Study on leaf: Anatomy, Trichomes, Phyllotaxy and Stomatal apparatus.
7. Plant organs of special purpose – Floral, extra floral nectaries, laticifers.
8. Observation on primary, secondary meristems and nodal anatomy.
9. Maceration techniques and study of plant tissues.
10. Types and variations in inflorescences and flowers, floral modification.
11. Organization of anther and pollen(pollen wall patterns, pollen germination)
12. Study on ovary, ovules and their modification.
13. Isolation of plant embryos and embryonal tissues.
14. Group work: a. Vegetative propagation techniques: Budding, Layering, Cuttage and Graftage: b. Microtomy and permanent slide preparations.
15. Submission:a. A minimum of 5 double stained permanent sections. b. Record and \ observation note book.Wax blocks and slides mounted with wax ribbons.
16. Group report on a ontogenetic change in selected plant.

Suggested Readings

1. Esau K. 1977. Anatomy of seed plants. Wiley Eastern, Publ. ISBN 0 4712 45208.
2. Esau K. 2002. Plant anatomy, John Wiley and Sons. ISBN 9 8141 2649 7.
3. Fahn A. 1989. Plant Anatomy. Mac Millan Pub. New York. ISBN 008 028030 7
4. Johri B.M. 1982. Experimental Embryology of Vascular Plants – Springer – Verlag, Nerlin. ISBN 3 5401 0334 1.
5. Maheshwari P. 1985. An introduction to the embryology of angiosperms, Tata McGraw Hill, ISBN 0 0709 9434 X.
6. Raghavan V., 1986 Embryogenesis in angiosperms, Cambridge University Press.

HARD CORE –PAPER 10
II Semester

Practical- IV (TAXONOMY OF ANGIOSPERMS &ECOLOGY AND BIODIVERSITY CONSERVATION)

Practical (Credits: 2)

Course Code: 425 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course will provide practical knowledge on how to prepare herbarium.
- The lab exercise will facilitate the students to understand the characters of plant species.
- Students will be given an opportunity to study a plant of his/her choice in detail that the patterns and designs of plant morphogenesis is followed and understood closely

Course outcome:

On successful completion of the course students will be able to

- to independent identify and study plants at family, genus and species level.
- get motivated to recognize and classify plants and preserve them as resources for posterity
- study the plant communities at different localities of known and unknown destinations.

Suggested Laboratory Exercises

TAXONOMY OF ANGIOSPERMS

1. Description of specimens from representative, locally available families.
2. Description of various species of a genus; location of key characters and preparation of keys to generic level. Location of key characters and use of keys at family level. Training in using floras and herbaria for identification of specimens described in the class.
3. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
4. Comparison of different species of a genus and different genera of a family to calculate similarity coefficient and preparations of dendrograms.
5. A study tour under the supervision of lecturers to a place of botanical interest.

Note: The students are required to prepare and submit a brief account of the field survey and ***30*** herbarium sheets of wild plants.

ECOLOGY AND BIODIVERSITY CONSERVATION

1. To calculate mean, variance, deviation, standard error, students t- test, Chi squire testfor comparing two variables related to ecological data.
2. To find out relationship between two ecological variables using Correlation co-efficient and Regression equation.
3. To determine Minimum Size/ number of Quadrat required for the vegetation analysis in a given area. To estimate biomass in grassland ecosystem.
5. To study the Community by quadrat method by determining frequency, density, abundance and importance Value Index
6. To determine soil moisture, porosity and bulk density and water holding capacity ofsoil collected from varying depth at different locations.
7. To estimate chlorophyll content in SO_2 fumigated and unfumigated plant leaves.
8. To estimate dissolved oxygen content in water samples collected from different sources.
9. To perform simple test for tannins/alkaloid/oil/Starch /Protein.
9. Primary productivity measurement using Light and Dark Bottle method.
10. Field visit to any of the protected habitat or ecosystem with rich biological diversity to assess and document the values and threats.
11. Scientific visit to institutes which are involved in conserving biological diversity to learn the conservation strategies.

Suggested Readings

TAXONOMY OF ANGIOSPERMS

1. Hutchinson, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press Oxford.
2. Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.

ECOLOGY AND BIODIVERSITY CONSERVATION

1. Groombridge B. (editor). 1987. Global Biodiversity: Status of Earths Living resources, Chapman & Hall, London.
2. Odum E.P. and Barrett G.W. 2018. Fundamentals of Ecology. JayPee Brothers Medical Publishers.
3. Sharma P. D.1988 Elements of Ecology, Rastogi Publications, Meerut.
4. Sharma P.D. 2011. Ecology and Environment. Rastogi Publications, Meerut.
5. Umar U and Asija M. 1997 Biodiversity: Principles and Conservation (2nd edition), Agrobios, Jodhpur.

SOFT CORE –PAPER 2
II Semester

EVOLUTIONARY BIOLOGY

Theory (Credits: 2)

Course Code: 526 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

This course will introduce the concept of evolutionary theories with examples to the students.

It will provide the knowledge on how organisms evolved in this earth during the past.

Course outcome:

On successful completion of the course students will be able to

- draw insights from the past to predict the trends and dangers of the present
- appreciate evolution of pants animals and other biota in their niches, and see earth as potential ad fertile ground of opportunities confronted with vulnerability threats and risks

Unit 1 Introduction **12 Lectures**

An overview of origin and evolution of life - chemical and structural changes- the abiogenesis and biogenesis debate - Evolutionary Biology pre and post Darwin era. History and land marks in evolutionary biology – the idea of extinction and speciation.

Unit 2 Biological diversity **12 Lectures**

Species and classification. Phylogenetic trees, reading and using trees. Geological fundamentals. Phylogeny and the fossil record. Evolutionary trends. Rates of evolution. The geography of life. Major patterns of distribution. Historical biogeography, phylogeography. Genetic diversity: Genes,genomes, mutations, karyotypes. Sources of phenotypic variation. Genetic variation in populations.

Unit 3 Microevolution **12 Lectures**

Genetic drift, sampling, coalescence. Founder effects. Neutral theory of molecular evolution. Natural selection. Adaptation in action. Experimental studies. Levels of selection. Genetical theory of natural selection. Fitness, modes and models of selection. Evolution of phenotypic traits, Conflict and co-operation. Species and speciation. Reproductive success. Co-evolution.

Unit 4 Macroevolution **12 Lectures**

Inferring phylogenies. Gene trees, species trees. Patterns of evolutionary change. Adaptive radiation. Evolution and development.

Unit 5 Biodiversity **12 Lectures**

Centers of origin and crop development – invasive species and dangers monocroping- values of biodiversity - Estimating changes and loss in biodiversity. Taxonomic diversity through the Phanerozoic. The future of biodiversity and conservation measures.

Suggested Readings

Text Books

1. Douglas J. Futuyma. 1998. Evolutionary Biology (3rd Edition), Sinauer Associates.
2. Mark Ridley. 2003. Evolution (3rd ed.), Blackwell.
3. Roderic D. M. Page, Edward C. and Holmes. 1998. Molecular Evolution: A Phylogenetic Approach, Blackwell.
4. Scott R, Freeman and Jon C. Herron. 2003. Evolutionary Analysis, Prentice Hall.
5. Taylor T.N. and Taylor E.L. 2009. Paleobotany: The Biology and Evolution of Fossil Plants (2nd edition). Academic Press, Amsterdam.

Reference Books

1. David Briggs and Stuart Max Walters.1997. Plant Variation and Evolution, Cambridge University Press.
2. Pontarotti P. (editor). 2010. Evolutionary Biology –Concepts, Molecular and Morphological Evolution. Springer-Verlag, Berlin Heidelberg.

SOFT CORE –PAPER 2
II Semester

ECONOMIC BOTANY

Theory (Credits: 2)

Course Code: 526 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

This course will introduce potential plants of livelihood and commercial interests. Intending to apprise students on utility value of selected speices , it will seek to prsnt the market and commercial value.

It will also offer an idea on the processes concerning the cultivation of economically useful plants.

Course outcome:

On successful completion of the course students will be able to

- Identify and recognize potential of food crops namely cereals, millets, pulses, sugar yielding plants, spices, condiments, tubers, fruits and medicinal plants
- Venture into cultivation, process and harvest economically useful plants
- Gain confidence in pursuing entrepreneurial projects.

Unit 1 Cereals and Millets **12 Lectures**

Detailed study of occurrence, mode of cultivation, process, product, biochemical and nutritional values of the following crop plants with their botanical details of Cereals and Millets: Rice, Maize.

Unit 2 Pulses and Sugar yielding plants **12 Lectures**

Detailed study of occurrence, mode of cultivation, process, product, biochemical and nutritional values of the following crop plants with their botanical details of Pulses: Soya bean, Winged bean, Sword bean; Sugar yielding plants: Sugarcane, Sugar beet.

Unit 3 Plantation crops, Spices and Condiments **12 Lectures**

Detailed study of occurrence, mode of cultivation, process, product, biochemical and nutritional values of the following crop plants with their botanical details of Plantation crops: Coconut, Cocoa, Coffee and Tea; Spices and condiments: Pepper, Ginger, Turmeric, Cardamom, Nutmeg.

Unit 4 Tuber crops, Fruits and Vegetables **12 Lectures**

Detailed study of occurrence, mode of cultivation, process, product, biochemical and nutritional values of the following crop plants with their botanical details of Tuber crops: Potato, Sweet potato and Tapioca; Fruits: Mango, Banana, Citrus, Guava, Grapes and Cashew nut; Vegetables: Tomato, Brinjal, Cucumber, Ash gourds and Bitter gourd.

Unit 5 Medicinal plants, Narcotics and Timber yielding plants **12 Lectures**

Detailed study of occurrence, mode of cultivation, process, product, biochemical and nutritional values of the following crop plants with their botanical details of Medicinal plants: Sarpagandha, *Belladonna*, Cinchona, *Vinca, Glycirrhiza*; Narcotics: *Cannabis,* Opium; Timber yielding plants: Rose wood, Teak Wood.

Suggested Readings

Text books

1. Arora P.K. and Nayar E.K. 1984. Wild relatives of Crop plants in India, NBPGR Sci. Monograph No. 7 CSIR, The useful plants of India, Publication and Information Directorate, CSIR, New Delhi
2. Harris J.G. and Harris M.W. 2001. Plant Identification Terminology: An Illustrated Glossary (2nd edition). Spring Lake Publishing, Utah.
3. Judd W.S., Campbell C.S., Kellog E.A. and Stevens P.F. 1999. Plant Systematics. Sinauer Associates, Inc., Massachusetts, USA
4. Kochar L.S. 1981. Economic Botany in the Tropics, Macmillan
5. Singh G. 2010. Plant Systematics: An Integrated Approach (3rded.). Science Publishers, USA.

Reference Books

1. Hill A.F. 1952, Economic Botany, Tata McGraw Hill
2. Hooker J.D. 1879. Flora of British India. Reeve &Co., London
3. Hutchinson J. 1959. Families of flowering plants, Cambridge University Press
4. Lawrence G.H.M. 1955. An Introduction to plant Taxonomy, Central Book Depot
5. Sen S. 1992. Economic Botany, New Central Book Agency, Calcutta
6. 1Sivarajan V.V. 1999. Principles of plat Taxonomy, Oxford and IBH Publishing Co.
7. Stace C. 1985. Plant Taxonomy and Biosystematics, London.
8. Takhtajan A.L. 1969 Flowering plants. Origin and Dispersal, Oliver and Boyed.

SOFT CORE –PAPER 2
II Semester

SECONDARY PLANT PRODUCTS AND METABOLIC ENGINEERING

Theory (Credits: 2)

Course Code: 426 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course will introduce basic concepts on plant secondary metabolites.
- This course will provide knowledge on herbal insecticides, alternate sweeteners, plant poisons, polyamines and their metabolic engineering.

Course outcome:

On successful completion of the course students will be able to

- identify different plant chemicals which have applications and utility
- enlist phytochemicals and secondary metabolites of market and commercial significance
- design and develop their own business prepositions such as theo in the preparation of herbal insecticides.

Unit 1 Introduction to Secondary Metabolites **12 Lectures**

Introduction to Secondary Plant Products: Pathways andfunctions. Structure and biosynthesis of Nitrogenous compounds: alkaloids, seed proteins; Isoprenoids: terpenoids, carotenoids and steroids.

Unit 2 Phenolics, Flavours,Volatiles and Colourants **12 Lectures**

Phenolics: cinnamates, coumarins, benzoates, Flavonoids, lignans, lignins, Tannins.
Occurrence, biological and economic importance of Flavor substances, volatiles and colourants.

Unit 3 Herbal Insecticides and Alternate Sweeteners **12 Lectures**

Medicinal plants Insecticidal compounds; Non-saccariferoussweeteners.

Unit 4 Plant Poisons, Polyamines **12 Lectures**

Plant toxins/poisons;Polyamines and non-protein amino-acids.

Unit 5 Metabolic Engineering **12 Lectures**

Metabolic Pathway Engineering plant phenolics and alternate sweeteners.

Suggested Readings

Text Books

1. Bob Buchanan, Gruissen W. and Jones R.L. 2015. Biochemistry and Molecular Biology of Plants (2nd edition). Wiley.
2. Dey P.M. and Haroborne. J.B. 2000. Plant Biochemistry (Indian Edition), Academic Press.

Reference Books

1. Leland J. Cseke. 2006. Natural Products from Plants, CRC Press.
2. Peter B. Kaufman et al. 1999. Natural Products from Plants. CRC Press LLC
3. N.J. Walton, Diane E. Brown. 1999. Chemicals from Plants: Perspectives on Plant Secondary Products. Imperial College Press and World Scientific Publishing Co. Ltd.

HARD CORE –PAPER 11
III Semester

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Theory (Credits: 4)

Course Code: 511 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

1. To understand the physiological processes in plants.
2. To understand the structure and function of the Bio-molecules.

Course outcome:

On successful completion of the course students will be able to

- determine the functions of different organs of plants.
- interpret the functional significance of molecules and metabolites which back plant processes.

PLANT PHYSIOLOGY

Unit 1 Plant water relations **12 Lectures**

Water absorption system in Plants – Mechanism of Ascent of Sap. Kinds of transpiration, Difference between Transpiration, Evaporation, Guttation and Exudation. Mechanism of stomatal movement.

Mechanism of mineral absorption: Passive (Diffusion, Ion Exchange, Donnan Equilibrium and Mass Flow Hypothesis) and Active (Carrier Concept and Electro-Chemical) Theory. Difference between Chlorosis and Etiolation. Mechanism of Phloem translocation: Pressure flow mechanism, phloem loading and unloading. Root –Microbe interaction in facilitating nutrient uptake.

Unit 2 Photosynthesis **12 Lectures**

Organization of Photosystem I and II, Quantosomes, Light Harvesting Chlorophyll Protein I (LHCPI)&Light Harvesting Chlorophyll Protein II (LHCPII), OEC, Absorption Spectrum, Action spectrum, Reddrop and Emerson effect. Fluorescence and Phosphorescene. – Hill reaction – Noncyclicand Cyclic Electron Transport, Photophosphorylation – C_3 and C_4 pathways, Kranz Anatomy of Leaves of C_4 plants, Difference between C_3 and C_4 cycle. CAM pathway. Photorespiration and its significance.

Mechanism of Aerobic respiration: Glycolysis and Krebs Cycle, Chemiosmotic theory, Oxidative phosphorylation, Cyanide Resistant Pathway. Difference between Oxidative and Photo phosphorylation. Factors affecting Photosynthesis and Respiration.

Unit 3 Plant Hormones and Signal Transduction **12 Lectures**

Physiological role and mechanism of action of Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene. Photoperiodism and Vernalization. Response of plants to salt, drought, freezing, heat, oxidative and UV stresses-mechanism of stress resistance. Circadian rhythm in plants. Signal transduction: receptors and G-Proteins, phospholipid signaling, calcium- calmodulin cascade, Seed dormancy – Hormonal regulation of dormancy and germination. Physiology of fruit ripening.

BIOCHEMISTRY

Unit 4 Carbohydrates, Lipids and Nitrate Assimilation **12 Lectures**

Structure of Monosaccharides, Oligosaccharides and Polysaccharides(Starch and Cellulose). Plant lipids: Fatty acids, Phospholipids, structure of Ergosterol and Cholesterol. Oxidation of fatty acids. General characters and classification of Vitamins and Alkaloids. Structure of Chlorophyll, Carotenoids, phycobilins, anthocyanins and betacyanins. Structure and properties of Cutins, Suberines and Waxes.

Symbiotic and asymbiotic nitrogen fixation. Nitrate assimilation.

Unit 5 Proteins and Enzymes **12 Lectures**

Protein and non-protein amino acids – reductive amination and transamination – glutamate pathway; biosynthesis of amino acids.

Molecular configuration and conformation of proteins – primary, secondary, tertiary and quaternary structures (Ramachandran Plot) – properties and types of proteins –simple, complex and derived proteins.

Enzymes: Classification, kinetics, mechanism of enzyme action – enzyme inhibition, enzyme regulation-allosteric enzymes-isoenzymes-coenzymes-ribozymes.

Suggested Readings

Text Books

1. Battacharya D. 1999. Experiments in Plant Physiology- A Laboratory Manual. NarosaPublishing House. New Delhi.
2. Kumar,A, and Purohit, S.S. 2005. *Plant Physiology* , Agrobios (India), Jodhpur.
3. Mukherji,S. and Ghosh,A.K. 2005. *Plant Physiology*. First Central Edition, New Central
4. Narayanan L.M., Meyyan R.P., Nallasingam K., Prasanna Kumar S., Arumugam N.And Fatima D. 2014. Biochemistry. Saras Publication. Nagercoil, Tamil Nadu.
5. Salisbury F.B. and Ross C.W. 1986. Plant Physiology (3rd edition.). CBS Publishers & Distributors. New Delhi.
6. Taiz L. and Zeiger E. 2010. Plant Physiology (5th edition). Sinauer Associates Inc. U.S.A.

Reference Books

1. Bob B. Buchnan, Whilhelm Gruissem and Russel L. Jones. 2015. *Biochemistry and Molecular Biology of Plants*. I.K. International Pvt. Ltd. New Delhi.
2. Berg. J.M., Tymoczko, J.L. and Stryer, L. 2006. *Biochemistry* (6thed.), Freemanand co. New York.
3. Lea, P.l.J..and Leegood, R.C. 2001. *Plant Biochemistry and Molecular Biology*. JohnWiley and sons, New Yorlk.
4. Hopkins W.G. and Huner N.P. 2009. Introduction to Plant Physiology (4th ed.). JohnWiley & Sons. U.S.A.
5. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. 2000. Harper's Illustrated Biochemistry (26thed.). McGraw-Hill Company Inc. U.S.A.
6. Nelson D.L. and Cox M.M. 2017. Lehningers Principles of Biochemistry (7thed.).W.H.Freeman. London.
7. Rodwell V.W., Bender D., Botham K.M., Kennelly P.J. and Weil P.A. 2015.HarpersIllustrated Biochemistry (30thed.). The McGraw-Hill Education. USA.

HARD CORE –PAPER 12
III Semester

MICROBIOLOGY AND IMMUNOLOGY

Theory (Credits: 4)

Course Code: 512 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

1. This course is introduced to make the students understand and appreciate the fundamental principles of basic and applied microbiology.
2. To provide students with knowledge on how the immune system works and understand immune response made in humans to foreign antigens including microbial pathogens.

Course Outcome:

On successful completion of the course students will be able to

- know about microbes and their life to draw inspirations to hire them in applications
- gain an understanding and foundation in immunological processes and use and interpret their significance in daily walks of life.

Unit 1 Bacteria and Cyanobacteria **14 Lectures**

Outline classification based on Bergey's manual of systematic bacteriology (9th edition), Morphology and ultrastructure of bacterial cell. Methods of genetic transfers in bacteria – transformation, conjugation, transduction and sexduction. General account of Mycoplasma and Actinomycetes. Salient features and biological importance of Cyanobacteria. General account, ultra structure, nutrition, biology and economic importance of Archaebacteria, Molecular adaptation to extreme environment (thermophiles and halophiles).

Unit 2 Viruses **10 Lectures**

General Characteristics, Structure of Virus, Classification (LHI System), Bacteriophage: Structure of T4 phage, Life cycles of temperate and lytic bacteriophages, Transmission of plant viruses, Structure and multiplication of TMV, Introduction to viroids, prions and interferon.

Unit 3 Microbial nutrition, growth and Applied Microbiology **12 Lectures**

Nutritional types of microbes, Microbial growth kinetics, Environmental factors affecting growth, Bacterial chemotaxis and quorum sensing, Industrial microbes (isolation and strain improvement).

Microbial fermentation- upstream and downstream processing, Fermented products- milk products, alcoholic beverages, organic acids and amino acids, Single cell protein, Microbes and bioremediation.

Unit 4 Immunology I **12 Lectures**

Overview of the immune system, Innate and adaptive immune system - External defenses, Cells, organs and molecules involved in innate and adaptive immunity, Antigens, Antigenicity and Immunogenicity, Humoral and cell-mediated immunity, Primary and secondary immune response, B and T cell epitopes, Structure and function of antibody molecules, Generation of antibody diversity, Monoclonal antibodies.

Unit 5 Immunology II **12 Lectures**

Antigen-antibody interactions, Major Histocompatibility Complex (MHC) molecules, Antigen processing and presentation, Activation and differentiation of B and T cells, B and T cell receptors, the Complement system, Toll-like receptors, Cell-mediated effector functions, Inflammation, Hypersensitivity and autoimmunity, Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, Congenital and acquired immunodeficiency diseases, Vaccines.

Suggested Readings:

MICROBIOLOGY

Text Books

1. Wiley J.M., Sherwood L.M. Woolverton C.J. 2008. *Prescott, Harley and Klein's Microbiology*, McGraw-Hill. 7th Edition
2. Singh R.P. 2018. *Microbiology*, Kalyani Publication, New Delhi.
3. Dube, R.C. and D.K.Maheshwari. 1999. *A text Book of Microbiology*, S.Chand & Co. Ltd.
4. Pelczar Jr. M.J., Chan E.C.S. and Krieg N.R. 2009. Microbiology: Application Based Approach. Tata McGraw-Hill Education. New Delhi.

Reference books

1. R. Y. Stanier, E. A. Adelberg, J. L. Ingraham. 2007. *General Microbiology*, MacMillan Press, 5th edition.
2. Pommerville JC. 2013. *Alcamo's Fundamentals of Microbiology*, Jones and Barnet Learning, 10th edition.
3. Tortora G.J., Funke B.R. and Case C.L. 2010. Microbiology: An Introduction (10thed.). Pearson Benjamin Cummings. U.S.A.
4. Madigan M.T. et al. *Brock Biology of Microorganisms*. 2010. Benjamin-Cummings Pub Co, 13th edition

IMMUNOLOGY

Text Books

1. Abbas A.K., Lichtman A.H. and Pillai S. 2017. *Basic Immunology*. Elsevier India.
2. KindtT., GoldsbyR., OsborneB. A. 2006. *Kuby Immunology*, W. H. Freeman, 6th ed
3. MurphyK. 2011. Janeway's *Immunobiology,* Garland Science, 8th ed.
4. Ramesh SR. 2017. *Immunology*. McGraw Hill Education India Pvt Ltd. 1st ed

Reference Books

1. DelvesJ., Martin S., Burton D. and Roitt I.M. 2011. *Roitt's Essential Immunology*(12thed). Wiley-Blackwell.
2. Khanna R. 2011. *Immunology*. Oxford Higher Education.

HARD CORE –PAPER 13
III Semester

INSTRUMENTATION AND RESEARCH METHODOLOGY

Theory (Credits: 4)

Course Code: 513 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To make students realize importance of research in knowledge acquisition
- To train students to adapt to research methodology followed in the contemporary research
- To equip students to scientifically collect, analyze and interpret data that they generate through their personal enquires.
- To give an exposure to students on the types of field research different methods of data analysis
- To provide an overview on modern instrumentation that they would help students gain confidence to instantly commence research career and/or start entrepreneurial ventures.

Course outcome:

On successful completion of the course students will be able to

- Appropriately use instruments for specific research analysis.
- Independently design and execute experiments, collect information and handle the data collected during research studies.
- design their research studies using their own personal and community interests.

Unit 1 Analytical and Separation techniques **12 Lectures**

Concept and working principle of pH meter–principle and protocols of centrifugation (differential, density gradient and ultra); Chromatography (TLC, Column, GLC, HPLC, HPTLC) - Electrophoresis (Agarose Gel Electrophoresis, PAGE).

Unit 2 Biophysical Methods **12 Lectures**

Spectroscopy (Visible/UV, IR, AAS) - Molecular structure analysis (mass spectrometry, X-ray diffraction, NMR) FTIR, MALDI-ToF, - detection using isotopes (measurement, radiolabelling, autoradiography), -Flow Cytometry.

Unit 3 Materials and methods in Field study **12 Lectures**

Qualitative and quantitative parameters: plant study – (density, frequency, abundance, basal area, canopy cover and standing biomass by quadrat, transect and point frame methods); Meteorological studies (rain gauge, anemometer, windpane, psychrometer barometer, altimeter, thermometer, Stoke's sunshine recorder)- Aquatic studies (Secchi's disc, turbidometer)- field photography(DSLR, Aerial)and remote sensing(GPS,GIS, toposheet).

Unit 4 Data Handling **12 Lectures**

Proposal of research- Hypothesis validation- Sampling (nature, design, size). Data sources (primary and secondary, electronic, library, database)- techniques in data collection (observation- interview- questionnaire- feed back- opinion poll) - quantification- classification- tabulation- diagrams(pictogram- cartogram- graphs- charts)- measures of central tendency (mean, median and mode) -standard deviation - Percentages and Ratios – *f-test* and *t-tests* ANOVA, AMOVA)-Data interpretation.

Unit 5 Research design and Validation **12 Lectures**

Types of research publication (article, dissertation, research paper, peer- reviewed publication) **-** standards in publications- impact factor (SCOPUS and h-index)– plagiarism- thesis guidelines (Title of the paper, declaration, certificates, acknowledgement, contents, abbreviations, measurements, introduction, review of literature, rationale, plan of work, methodology, results, discussion, conclusion, summary, bibliography and appendices)– Presentation (oral and poster).

Suggested Readings

Text Books

1. Datta A. K. 2006. Basic Biostatistics & Its Applications. New Central Book Agency.
2. Jeyaraman J. 1998. Laboratory Manual in Biochemistry, New Age International Publishers Ltd.
3. Kothari C. R. 2004. Research methodology: Methods and techniques. New Age International.
4. Mahajan B. K. 2002. Methods in biostatistics. Jaypee Brothers Publishers.
5. Nautiyal S., Bhaskar, K., and Khan, Y. D. 2016. Biodiversity of Semiarid Landscape. Springer International Publishing.
6. Palanivelu P. 2009. Analytical biochemistry and separation techniques –A laboratory manual for B.Sc. and M.Sc. students, 21st Century Publications. Madurai.

Reference Books

1. Habib M.M., Pathik B. B. and Maryam H. 2014. Research methodology-contemporary practices: guidelines for academic researchers. Cambridge Scholars Publishing.

HARD CORE –PAPER 14
III Semester

PRACTICAL V (PLANT PHYSIOLOGY AND BIOCHEMISTRY & MICROBIOLOGY AND IMMUNOLOGY)

Practical (Credits 2)

Course Code: 514 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

The objective of this lab course is to make the students understand the various techniques of basic and applied microbiology and Plant Physiology. They will have exposure towards various immunological processes. They will visit leading laboratories and institutes to get exposed to various developments that take place in microbiology, immunology and plant physiology.

Course outcome:

On successful completion of the course students will be able to

- isolate and identify microbes and know about importance and relevance
- emerge as stake holders with a knowledge to make various industrial products such as wine, alcohol, citric acid and single cell protein under lab conditions. Students will be able to perform different experiments of immunological significance.

Suggested Laboratory Exercises

PLANT PHYSIOLOGY

1. Water potential by gravimetric and falling drop methods.
2. Osmotic potential by Plasmolytic method.
3. Quantitative estimation of total chlorophyll content and carotenoid contents inleaves.
4. Absorption spectrum of chlorophyll pigments by spectrophotometric method.

Differentiation of C3 and C4 plants by starch test.

5. Determination of nitrogen content in roots and root nodules.
6. Effect of temp., substrate conc., pH and inhibitor conc. on nitrate reductase activity.
7. UV-B effect on nitrate reductase.

BIOCHEMISTRY

1. Preparation of titration curve and pKa value determination.
2. Determination of isoionic pH of amino acid.
3. Determination of isoelectric pH of Protein.
4. Estimation of Protein, free amino acids, carbohydrate contents in plant sources.
5. Estimation of Vitamin C in fruits – titrimetric method.
6. Paper chromatographic identification of plant pigments, sugars and amino acids.

MICROBIOLOGY

1. Sterilization techniques viz. moist heat, dry heat, chemical and radiation.
2. Preparation of culture media: Basic & substituted.
3. Isolation and purification of microorganisms.
4. Quantification of soil microbes by plating technique.
5. Motility of bacteria by hanging drop method.
6. Staining: simple staining and Gram staining.
7. Micrometry: determination of dimensions of yeast, *Lactobacillus*, Cyanobacteria, fungal spores.

8. Spectrophotometric determination of bacterial density.
9. Preparation of genomic DNA from Bacteria.
10. Mass production of cyanobacteria – improvised method.
11. Fermentation and wine production.
12. Immbolization of algal cells using calcium alginate.
13. Aseptic procedures.
14. Production of citric acid using *Aspergillus niger*– Solid state fermentation and submerged fermentation.

IMMUNOLOGY

1. Technique of Ouchterlony double diffusion (the reaction pattern of an antigen with a set of antibodies).
2. Blood typing by agglutination.
3. Dot ELISA test for the detection of antigen and antibody.
4. Sandwich ELISA test.

Suggested Readings

PLANT PHYSIOLOGY and BIOCHEMISTRY

1. Kumar A, and Purohit S.S.2005. *Plant Physiology* , Agrobios (India), Jodhpur.
2. Mukherji S. and GhoshA.K. 2005. *Plant Physiology*. First Central Edition, New Central Book Agency (P) Ltd.,Kolkata.
3. Taiz L.and Zeiger E. 2010. *Plant Physiology*, 5th edition, Sinauer Associates.

MICROBIOLOGY

1. Aneja K.R. 1993. *Experimental in Microbiology, Plant Pathology & Tissue Culture*, Wiswa Prakashan, New Delhi.
2. Dube R.C. and D.K. Maheshwari. 2000. *Practical Microbiology*, S.Chand & Co. Ltd. Sunder
3. Rajan S. 2001. *Tools and Techniques of Microbiology*, Anmol Publication. New Delhi.

IMMUNOLOGY

1. T. Kindt R. Goldsby B. A. Osborne. 2006. *Kuby Immunology*, W. H. Freeman, 6th ed
2. Kenneth Murphy. 2011. Janeway's *Immunobiology* (8th edition), Garland Science.
3. Ramesh SR. 2017. *Immunology*. McGraw Hill Education India Pvt Ltd. 1sted

SOFT CORE –PAPER 3
III Semester

BIOGEOGRAPHY

Theory (Credits: 2)

Course Code: 515 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

The objective is to provide students with a general understanding of the current and historical components of biogeography, especially considering it's ecological, analytical, and conservation aspects.

The course will have a dual focus on identifying principles and concepts of the distribution of plants and animals worldwide.

Course Outcome:

On successful completion of the course students will be able to

- understand and participate in discussions regarding various aspects of biogeography on a broad as well as micro scale.
- Identify, examine and assess the scientific literature relating to biogeography.

Unit 1 Concepts in Biogeography **12 Lectures**

Introduction and history of biogeography - development of concepts (Linnaeus, Humboldt, Darwin, Wallace, Croizat), evolution and plate tectonics, ecological niche concepts, species distributions- species-area relationship, neutral theory, equilibrium.

Unit 2 Biodiversity Hotspots **12 Lectures**

Eco-regions and major biomes, biogeographical zones in India, biodiversity hotspots, patterns of biodiversity- local gradients to global biodiversity hotspots, extinction hotspots, alpha & beta diversity, latitudinal gradient, altitude.

(A study tour of maximum one week duration to a place of biogeographical interest within/outside the state is compulsory to understand the patterns of biodiversity (Submission of brief report. The duration for the study tour can be extended for the students studying in Andaman and Nicobar islands).

Unit 3 Life Patterns on Earth **12 Lectures**

Distribution of life (plants & animals) on earth- role of biological processes (predation, competition, mutualism, parasitism and mimicry) in the distribution of life, Role of physical and biological disturbances (fire, wind, floods and pathogens) in the distribution of life on earth.

Unit 4 Plant Conservation **12 Lectures**

Conservation biogeography and its importance, mega-extinctions and climate change, biogeographical patterns of endangered species, species richness and distribution of habitats in relation to the human density patterns.

Unit 5 Island Biogeography **12 Lectures**

Theory of island biogeography, variety of island habitats, characteristics of island flora and fauna, endemism, nestedness, biogeography of human infectious diseases.

Suggested Readings

Text Books

1. Huggett R.J. 2004. *Fundamentals of Biogeography*, Routledge
2. Mathur H.S. 1998. *Essentials of Biogeography*, Pointer Publisher, Jaipur
3. Husain M. 1994. *Biogeography*, Anmol Publication, New Delhi.

Reference Books

1. MacDonald G.M. 2003. *Biogeography: Space, Time and Life*. John Wiley & Sons
2. Lomolino M.V, Riddle BR and Brown JH. 2006.*Biogeography*, 4th Edition. Sinaur.
3. Cox C.D. and Moore P.D. 1993. *Biogeography: An Ecological and Evolutionary Approach* (5th edition), Blackwell.

SOFT CORE –PAPER 3
III Semester

BIODIVERSITY AND CONSERVATION

Theory (Credits: 2)

Course Code: 515 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

To inform students and make them understand the importance of vegetations.
To introduce the concepts relating to the understanding biodiversity and provide insights on its management
To provide knowledge hiring modern approaches in comprehending facts about past and present vegetation and discuss issues related.

Course outcome:

On successful completion of the course students will be able to

- Draw a holistic idea on biodiversity management and adapt mechanisms to preserve biodiversity
- Involve, participate and make meaningful and practical decisions concerning them ration utilization and presentation this valued inheritance
- To purse conservation efforts in such way that the sensitivities and sensibilities can be sharpened and seasoned to preserve the livability on face of earth against the overdrive to exploit.

Unit 1 Introduction **12 Lectures**

Definition, concepts and types of biodiversity, origin of new genetic material, isolation and origin of new species, Isolation mechanisms, Values of biodiversity, Ecosystem services, Mega-biodiversity centres, Hotspots, Endemism.

Unit 2 Status of Plants **12 Lectures**

IUCN- general account, categories of threat, Major drivers of biodiversity loss: demography pressures, over exploitation, deforestation, water dams and river valley projects, mines, grazing of grasslands. Biodiversity databases-Red data, Blue data and Green Book and community biodiversity registers. Coral Reefs – importance (role in ocean ecosystem) & conservation measures.

Unit 3 *Ex-situ* Conservation **12 Lectures**

Ex-situ Conservation: Principles, seed banks, pollen storage, tissue culture, germplasm bank, vegetative propagation, cultivation involving local and tribal communities, botanical gardens.

Unit 4 *In-situ* **12 Lectures**

In-situ Conservation: principles, biosphere reserves, protected areas network, national parks, sacred groves and wildlife sanctuaries. Indian case studies on conservation strategies (Project Tiger).

Unit 5 Global Biodiversity **12 Lectures**

Global biodiversity information system – species 2000 and Tree of life – Millennium goals and charters – overview of the UNEP/GEF biodiversity data management project (BDM), CBD-general account, NBA.

Suggested Readings

Text Books

1. Primack, Richard B., and Sher A. 2016. Introduction to Conservation Biology. Sinauer Associates, Incorporated, Publishers.
2. Berlatsky. 2013. Biodiversity – Global Viewpoints. Gale Cengage Publishers.
3. Mittelbach G.G. 2012. Community Ecology. Sinauer Associates, Inc.
4. Krishnamurthy K.V. 2003. An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
5. Singh J.S., Singh S.P. and Gupta S.R. 2014. Ecology, Environmental Science and Conservation (4th edition). S. Chand & Company Pvt. Ltd.
6. Primack R. B. 2012. A Primer of Conservation Biology (5th edition). Sinauer Associates is an imprint of Oxford University Press.
7. Magurran A.E., McGill B.J. 2011. Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press.
8. Jase Fitzgerald . 2017. Biodiversity: An Introduction. Larsen and Keller Education.
9. Stiling P. 2015. Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill international edition.

Reference Books

1. Groombridge B. (editor). 1994. *Global Biodiversity: Status of Earths Living resources*, Chapman & Hall, London.

SOFT CORE –PAPER 3
III Semester

AIR POLLUTION AND CLIMATE CHANGE

Theory (Credits: 2)

Course Code: 515 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

This course will introduce concepts influencing and governing various strata and factors of environment, especially on that which pertains to air and atmosphere

It intends provide a realistic picture on ongoing changes in climatic factors, resource utilization and the impact of environmental

The experience gained in the study will help students to reflect and debate pollution and pollution control measures.

Course outcome:

On successful completion of the course students will be able to

- assess the facets of pollution in the different various environment and their inter-connectedness.
- Suggest and bring out recommendations on sustainable schemes of development that will ensure minimal adversary
- Offer solutions to deal with vexing problems and adopt specific control measures for environmental pollution in every possible way to restore and preserve the living conditions.

Unit 1 Atmosphere and Climate **12 Lectures**

Atmospheric composition and climate; Gaseous and particulate pollutants, emission trends and scenarios; climate change, drivers of climate change, greenhouse gas emission scenarios; indoor air pollution.

Unit 2 Elements of Air Pollution **12 Lectures**

Sulphur derivatives: Sources and cycling of sulphur, effects on plants, human health and ecosystems, mechanism of toxicity, resistance and buffering, sulphur metabolism, threshold and injury. Nitrogen derivatives: Formation and sources; deposition, uptake, metabolism, critical load; effects on plants, human health and ecosystems. Fluoride derivatives: Sources and cycling, bioaccumulation, threshold and injury; effects on plants, human health and ecosystems.

Unit 3 Effect of Oxidants **12 Lectures**

Oxidants: Formation and sources, photochemical smog; effects on plants and human health, mechanism of toxicity, resistance, critical load. Stratospheric ozone depletion: Phenomenon, causes, irradiation scenarios; effects of enhanced UV-Bon plants, microbes and human health, biological action spectra.

Unit 4 Green House Effect **12 Lectures**

Greenhouse effects: Process; consequences, global warming, sea level rise, albedo, oceanic influences, agriculture, natural vegetation; effects of increased CO_2 on plants; effect on humans. Acid rain: Formation, dispersion and deposition, trends; consequences on soil fertility, rivers and lakes; effects on plants, leaf injury, buffering, reproduction; forest decline; effects on fisheries.

Unit 5 Biomonitoring and Role of Plants in Air Pollution Control **12 Lectures**

Biomonitoring of air pollution: Concept, active and passive monitoring; bioindicator parameters; air pollution tolerance indices; control of air pollution by plants, green belt design.

Suggested Readings

Text Books

1. Ayres J., Maynard R. and Richards R. 2006. Air Pollution Reviews Vol. 3: Air Pollution and Health. Imperial College Press. London.
   (Ebook: https://epdf.pub/queue/air-pollution-and-health-air-pollution-reviews.html)
2. Boubel R.W., Fox D.L., Turner D.B. and Stern A. C. 1994. Fundamentals of Air Pollution (3rd edition). Academic Press, San Diego.
   (Ebook: https://epdf.pub/fundamentals-of-air-pollution3faefc7af052f48603605ea4b7fc604666521.html)
3. Neelin J.D. 2011. Climate Change and Climate Modeling. Cambridge University Press. Cambridge.
   (Ebook: https://epdf.pub/queue/climate-change-and-climate-modeling.html)
4. Sharma P. D.1988. Elements of Ecology, Rastogi Publications, Meerut.
5. Sharma P.D. 2011. Ecology and Environment. Rastogi Publications, Meerut.
6. Letcher T.M. (editor). 2009. Climate Change: Observed Impacts on Planet Earth . Elsevier, Amsterdam.
   (Ebook: https://epdf.pub/queue/climate-change3e413515009d0d47767aab87e6427a3133932.html)
7. Borrego C. A. and Brebbia C. A. (editors). 2007. Air Pollution XV. WIT Press, Southampton, Boston.
   (Ebook: https://epdf.pub/queue/air-pollution-xv.html)

Reference Books

1. Odum E.P. and Barrett G.W. 2018. Fundamentals of Ecology. JayPee Brothers Medical Publishers.

SOFT CORE –PAPER 4
III Semester

MEDICINAL BOTANY AND DIETETICS

Theory (Credits: 2)

Course Code: 516 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

To promote good health by teaching the students about diet and nutrition.
To educate the science of nutrition in preventing development of disease.
To educate on the nutritional standards and specifications for the healthy person and patient to ensure prevention of mortality due to malnourishment.

Course outcome:

On successful completion of the course students will be able to

- Use the knowledge gained in deciding upon their food milieu and feeding habits
- Design food recipes working on the nutritive value of diet prescribed for different age groups
- Acquire knowledge about healthy food for normal person and patient and help the fight against hunger, mortality and malnutrition.

MEDICINAL BOTANY

Unit 1 Plant of Medicinal Interest **12 Lectures**

Study of the following plants with reference to their Habitat, Habit, Systematic position, Morphology of their useful parts and uses of: *Tinospora cordifolia* (Root), *Acorus calamus*(Rhizome), *Tylophora asthmatica* (leaf), *Terminalia chebula* (fruit), *Plantago ovata* (seed)and *Holarrhena antidysenterica* (bark).

Unit 2 Plant Oils and their uses **12 Lectures**

Source, properties and medicinal uses of some plant oils resources -Olive oil, Castor oil, Neem oil, Mentha oil and Lavender oil.

Unit 3 Indian Flora and Food **12 Lectures**

Therapeutic value of Indian plant foods- (a) rice (b) wheat; (c) green gram, black gram, soya bean (d) lemon, banana, Guava, (e) Ginger, Turmeric, Coriander, Garlic, Cumin and Clove.

DIETETICS

Unit 4 Plant Nutraceuticals **12 Lectures**

Definition and sources of plant nutraceuticals. Study of plant foods (food as medicine) in the treatment of some selected diseases – anorexia, arthritis, constipation, diarrhoea, diabetes, psoriasis, hypertension and memory loss.

Unit 5 Plant Antioxidants **12 Lectures**

Plant foods as Antioxidants - Definition - types, PUFA, Probiotics, Prebiotics, Dietary fibers, Omega-3 fatty acids. Cosmeceuticals – Definition, Retinoic acid.

Suggested Readings

Text Books

1. Bhattachariya S.K. 2004. Handbook on medicinal plants, pointer publishers Jaipur.
2. Farooqi A. and Sreeramu B.S. 2001. Cultivation of medicinal and aromatic Crops, Universities Press.
3. John Shi. 2006. Functional Food Ingredients and Nutraceuticals Processing Technology, CRC Taylor and Francis Publishers.
4. Lagua R. T. and Claudio V.S. 1995. Nutrition and diet therapy Reference dictionary (4th edition), Jones & Barlett Learning.
5. Purohit K. K. and Gokhale. 1999. Pharmacognacy, Nirali Publications.
6. Srilakshmi B. 2007. Dietetics, New Age International publishers.
7. Srivatsava A.K. 2006. Medicinal plants, International Book Distributors, Dehradun.
8. Yoganarashimman S.N., 2000. Medicinal Plants India, Vol.2 Tamil Nadu, Inderline Publishing Private Ltd., Bangalore.

Reference Books

1. Joshi S.G. 2000. Medicinal plants, Oxford and IBH Company Private Ltd., New Delhi.
2. Raymond J.L. 2003. Krause's Food, Nutrition and Diet therapy. Saunders Publishers.
3. Thomas B. and Bishop J. 2007. Manual of Dietetic Practice (Jone Gandy, Editor), 4thedition, Wiley Blackwell Publishing, Oxford, UK.
4. Vattem D.A. and Maitin V. 2016. Functional foods, Nutraceuticals and Natural Products. DEStech Publications, INC.

SOFT CORE –PAPER 4
III Semester

ETHNOBOTANY

Theory (Credits: 2)

Course Code: 516 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

To introduce and appreciate India as land and home of multiple identities with diverse culture, tradition and lifestyles

To bring the native wisdom to the mainstream not only our nation to gain from the indigenous knowledge but also and acknowledge the services of theses privileged and pursue benefit sharing with the communities that had been safe guarding the same

To appraise learners on the steps needed to safeguard our rights in the copy right and intellectual property right regime.

Course outcome:

On successful completion of the course students will be able to

- Explore use of plants for by people as practiced by ethnic communities dwelling in various regions of union territory.
- understand and document information on hitherto unknown use of the plants,
- make advocacies on copy right and ownership to help the ethnic people for what is due to them
- present the traditional knowledge and use of plants for various purposes to stream line the use for the larger benefit of the nation.

Unit 1 History and Traditional Systems of Medicine **12 Lectures**

Introduction, historical background, scope and objectives; Ethnobotany as an interdisciplinary science, brief outline on traditional systems of medicine-Ayurveda, Siddha, , Naturopathy, Unani and Homeopathy; the relevance of ethnobotany in present context; Major and minor ethnic groups or Tribals of India and their life styles.

Unit 2 Methodologies of Ethnobotanical Studies **12 Lectures**

Field work; herbarium; Ancient Literature; Archaeological findings; Temples and sacred places; Anatomical and Histochemical methods; Some general principles of phytochemical analysis.

Unit 3 Role of Ethnobotany in Modern Medicine **12 Lectures**

Medico-ethnobotanical sources in India; Plant secondary metabolites of medical importance; source, description of the products, chemical constituents, active principles and therapeutic uses of the following:

i. Carbohydrates- Ispaghula (*Plantago ovata*)
ii. Glycosides- Senna (*Cassia* sp.)
iii. Tannins- *Acacia sp.*
iv. Fixed oils-Ground nut oil (*Arachis hypogea*)
v. Volatile oils- Clove
vi. Resins-*Asfoetida*
vii. Alkaloid-*Cinchona,*
viii. Steroids-*Solanum*

Unit 4 Conservation of Plant Genetic Resources **12 Lectures**

Role of ethnic group in conservation of plant genetic resources; rare, endangered and threatened (RET) taxa; forest management (Participatory forest management), sharing of wealth concept with examples from India.

Unit 5 Ethnobotany and Legal Aspects **12 Lectures**

Ethnobotany as a tool to protect interests of ethnic group; Biopiracy, Intellectual Property Rights ; Issues pertaining to Traditional Knowledge Patent, Indian initiatives for Traditional Knowledge protection; Challenges in the promotion of alternative and complementary medicines.

Suggested Readings

Text Books

1. Colton C.M. 1997.Ethnobotany – Principles and applications. John Wiley and Sons. Lichester.
2. Gonsalves J. 2010. Economic Botany and Ethnobotany. International Scientific Publishing Academy. New Delhi.
3. Kocchar S.L. 2009. Economic Botany in The Tropics (3rded.), MacMillan Publishers India Ltd. New Delhi.
4. Jain S.K. 1995. Manual of Ethnobotany. Scientific Publishers. Jodhpur.
5. Jain S.K. (ed.). 1981. Glimpses of Indian Ethnobotany. Oxford and IBH. New Delhi.
6. Jain S.K. 1990. Contributions of Indian Ethnobotany. Scientific Publishers. Jodhpur.
7. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
8. Pooja. 2005. Economic Botany. Discovery Publishing House. New Delhi.
9. Pullaiah T. and Krishnamurthy K.V. and Bahadur B. 2017. Ethnobotany of India: The Indo-Gangetic Region and Central India (Vol. 5). Apple Academic Press. USA.
10. Rama Ro N. and Henry A.N. 1996. The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
11. Sambamurthy A.V.S.S. and Subramanyam N.S. 1989.A Textbook of Economic Botany. Wiley Eastern Ltd. New Delhi.
12. Sharma O.P. 1996. Hills Economic Botany. Tata McGraw Hill Co. Ltd. New Delhi.
13. Sinha R.K. 1969. Ethnobotany. The Renaissance of Traditional Herbal Medicine –INA – SHREE Publishers. Jaipur.
14. Verma V. 2009. Text Book of Economic Botany. Ane Books Pvt. Ltd. New Delhi

Reference Books

1. Pullaiah T., Krishnamurthy K.V. and Bahadur B. 2017. *Ethnobotany o fIndia .The Indo-Gangetic Region and Central India* (vol. 5). Apple Academic Press, USA.
2. Simpson B.B. and Conner-Ogorzaly M. 1986. Economic Botany- Plants in Our World. McGraw Hill. New York.

SOFT CORE –PAPER 4
III Semester

MOLECULAR PLANT BREEDING

Theory (Credits: 2)

Course Code: 516 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course is aimed at providing exposure modern and contemporary approaches in plant breeding
- Learners will have an opportunity to blend the knowledge on convention methods followed by plant breeders with the improvisations brought in since the advemt of studies on polyploidy and mutagenesis
- It specially seeks to focus on effective ways of pursuing plant breeding in the light of current advances made in gene technology

Course outcome:

On successful completion of the course students will be able to

- Perform controlled pollinations and envisage on field selection looking for elite plants with desirable agronomic traits
- produce new hybrids with desirable traits and assess their stability.
- Use molecular markers and provide solution by developing crops that can to resist diseases, and otter biotic, cum / or biotic stresses.

Unit 1 Introduction, Reproduction and Pollination Control **12 Lectures**

Introduction to Plant Breeding – genetic basis of Plant Breeding – creation of variability. Reproduction and pollination control – molecular mechanisms of self and cross fertilization, gametogenesis and embryogenesis, molecular basis of male sterility, self compatibility and apomixis.

Unit 2 Plant Introduction **12 Lectures**

Domestication, plant introduction, acclimatization, genetic variation, crop genetic resources, germplasm conservation and molecular basis of varietal adaptation. Biometric techniques in Plant Breeding – assessment of variability, statistical tools in genetic analysis of variation.

Unit 3 Genetic basis of Self and Cross Pollinated Crops **12 Lectures**

Genetic basis of self pollinated crops- breeding procedures for self pollinated crops – concepts and methods – case studies. Genetic basis of cross pollinated crops- breeding procedures for cross pollinated crops – concepts and methods – case studies.

Unit 4 Breeding for Vegetatively Propagated Plants **12 Lectures**

Breeding for vegetatively propagated plants- clonal selection – distant hybridization and in vitro techniques. Genetic and molecular basis of heterosis and inbreeding depression- hybrids and synthetic production. Mutation breeding and selection of mutations for crop improvement.

Unit 5 Crop Improvement **12 Lectures**

Innovative approaches in crop improvement – Molecular markers for tagging disease resistance, insect resistance, quality and special characteristics - gene transfer in crop breeding program through transgenic approach.

Suggested Readings

Text Books

1. Acquaah G. 2012. Principles of Plant Genetics and Breeding (2nd edition). Wiley India Pvt Ltd. New Delhi.
2. Allard R.W. 1999. Principles of Plant Breeding. John Willey and Sons Inc., New York.
3. Chaudhari H.K. 1984. Elementary Principles of Plant Breeding (2nd edition). Oxford – IBH. New Delhi.
4. Chopra V.L. 2005. Plant Breeding- Theory & Practice. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.

5. Sharma J.R. 1994. Principles and Practices of Plant Breeding. Tata McGraw Hill Publishing Co.Ltd. New Delhi.
6. Shukla R.S and Chandel P.S. 1996. Cytogenetic, Evolution and Plant Breeding. S.Chand & Co., New Delhi.
7. Singh B.D. 2005. Plant Breeding: Principles and Methods (7thed.). Kalyani Publishers. New Delhi.

References

1. Hartmann H.T., Kester D.E., Davies J.R F.T. and Geneve R.L. 2011. Hartmann & Kester's Plant Propagation: Principles and Practices (8thed.).PHI Learning Pvt. Ltd. , Delhi.
2. Stoskf N. C., Tomes D.T. and Christie B.R. 2019. Plant Breeding- Theory and Practice (First Indian Print), Scientific Publishers, India.
3. Vijendra Das L.D. 2006. Genetics and Plant Breeding, New Age International. New Delhi.

Journals

- Crop Science
- Trends in Genetics
- Plant Breeding

HARD CORE –PAPER 15
IV Semester

PROJECT

(Credits: 4)

Course Code: 521 **Lectures: 60**
Max. Marks – 100 **(ICA = 40 + ESE = 60)**

Course objectives:

- To provide training in scientific skills.
- To prepare students for professional training programmes or entry level jobs in any area of Botany

Course outcome:

At the end of the project, students should have acquired capabilities to

- think critically in acquiring knowledge surveying literature
- collect information and be familiar with methods in designing and executing experiments
- pursue data collection and entrain themselves in interpreting of data of from their scientific experiments and
- would have grown in their ability to design, analyze and execute an experiment and eventually
- brim with confidence and ability in communication skills, both in writing and in articulation.

Assessment:

Dissertation submitted by the students would be assessed both by external and internal examiner during end semester university practical examinations.

HARD CORE –PAPER 16
IV Semester

GENOMICS AND BIOINFORMATICS
Theory (Credits: 4)

Course Code: 522 **Lectures: 60**
Max. Marks – 100 **(ICA = 40 + ESE = 60)**

Course Objectives:

- This course will provide knowledge for determining the genetic basis of plant characters and their inheritance, and mutations
- This course will present the fundamentals for pursuing independent investigation to procure a detailed knowledge on plant genomics using Bioinformatics tools
- A broader introduction on the contributions of the premier institutions that are engaged in developing and maintaining data bases to support contemporary reading and research in biological data sconces will be introduced

Course outcome:
On successful completion of the course students will be able to

- Access knowledge available in the various databases for carrying out genomic and proteomic research
- Understand the role played by mutations in plant and would be in a position to put the accrued knowledge for use
- Genomics will provide the way for the students to take up *in silico* investigations towards assisting work in manipulating genes to produce plants with desired characters.

Unit 1 Mendelian Genetics **12 Lectures**

Laws of inheritance, modified Mendelian ratios, complementary and supplementary genes. Lethal genes, multiple alleles - Polygenic inheritance (kernel colour in wheat, ear head length in maize). Extra-chromosomal or Cytoplasmic inheritance: genetics of chloroplasts and mitochondria. Behavior of chromosomes during meiosis, nondisjunction, chiasma formation, linkage and crossing over – theories. Ploidy types and significance - haploids, aneuploids and euploids, auto and allopolyploids. Cytoplasmic male sterility. Self-incompatibility in *Nicotiana*. Population genetics; Hardy-Weinberg Equilibrium.

Unit 2 Mutations **8 Lectures**

Types of mutations, methods of detection of mutations, CIB method and attached-X method, Molecular mechanism of spontaneous and induced mutations, site directed mutagenesis. Homeotic mutants in *Arabidopsis* and *Antirrhinum*. Mutagenic effects of food additives and drugs. Ames test. DNA damage and repair.

Unit 3 Genomics and Proteomics **14 Lectures**

Genomes: definition, size, approximate number of genes in sequenced organisms (viral, bacterial, fungal, plant, animal, and human genomes). Genome map, genome sequence - differences. EST maps and markers. Identification of protein-coding genes, determining gene functions from gene sequence; introns and exons, repetitive sequences; Accessing and annotating genomes; The Bio Project; Specialized genomic data bases**:** BOLD,GOLD, *Arabidopsis* Information Resource.

Outlines on metagenomics, functional genomics, comparative genomics, and proteomes. Practical applications of genomics. Next (2^{nd}, 3^{rd}) Generation sequencing.

Proteomes: deducing proteome from genome sequence, post-translation modification prediction.

Unit 4 Bioinformatics **12 Lectures**

History, introduction and scope; role of computers in biology. Search and Retrieval in literature databases (Pubmed). Bioinformatics Workstations. Biological databases; types: sequence, structures, genome and organism-specific databases; open source and web services. Data warehousing, data capture, data mining, data analysis.

Unit 5 Biological Databases **14 Lectures**

Primary nucleotide sequence databases: Genbank, European Nucleotide Archive, DDBJ. Primary protein sequence databases: NCBI, PIR, EMBL, ExPAsy, Uniprot, signal peptide data bank. Data submission and retrieval with: Entrez, DBGET/Link, and SRS. Sequence Analysis: Pair-wise alignment (Smith-Waterman similarity searches); BLAST & FASTA types and algorithms; Multiple sequence alignment (CLUSTAL: V, W, X, Omega; T-Coffee); gene and protein families, motif finding. Structural databases (PDB, CSD). Gene expression databases and transcriptomes, DNA microarray. Molecular modeling and visualization tools; docking and drug designing. Metabolic and signalling pathways databases. Phylogenetics: phylogenetic trees and clades, software and online tools; inference methods (UPGMA). Biodiversity informatics: introduction, global (GBIF, ITIS, Plant List, BHL, RBG, Kew) and national databases, standards, and protocols.

Suggested Readings

Text Books

1. Acquaah G. 2010. Principles of Plant Genetics and Breeding. Wiley India Pvt. Ltd. New Delhi.
2. Brown T. A. 2002. Genomes. Wiley-Liss Publications.
3. Campell and Heyer. 2003. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbor Laboratory.
4. Gardner E.J., Simons M.J., Snustard D.P. 2006. Principles of Genetics. John Wiley and Sons Inc.
5. Krane, *et al.* 2002. Fundamental Concepts of Bioinformatics. Benjamin Cummings. Learning. U.K.
6. Pierce B.A. 2011. Genetics: A Conceptual Approach (4thed.). Macmillan Higher Education.
7. Sinnott E.W., Dunn L.C. and Dobzhansky T. 2004. Principles of Genetics. Tata Mc Graw Hill.
8. Snustad D.P. and Simmons M.J. 2010. Principles of Genetics (5th edition).John Wiley & Sons Inc. India.
9. Snustad D. P. and Simmons M. J. 2000. Principles of Genetics (2nd edition). John Wiley & Sons, Inc.

References Books

1. Griffiths A.J.F., Wessler S.R., Carroll S.B. and Doebley J. 2010. Introduction to Genetic Analysis(10th edition). W. H. Freeman and Co. U.S.A.
2. Guttman B., Griffiths A., Suzuki D. and Cullis T. 2011. Genetics: The Code of Life. Rosen Publishing, New York.
3. Herron J.C. and Freeman, S. 2014. Evolutionary Analysis (5th edition). Pearson.
4. Jolles O. and H. Jornvall (editors). 2000. Proteomics in Functional Genomes. Birk hauser Verlag, Basel, Switzerland.
5. Lesk AM. 2002. Introduction to Bioinformatics. Oxford University Press.
6. Liebler. 2001. Introduction to Proteomics: Tools for the new biology. Humana Press.
7. Mount D. 2004. Sequence and Analysis. Cold Spring Harbor Laboratory Press. New York.
8. Pennington S. and Dunn MJ. 2001. Proteomics: From protein sequence to function (2nd edition). Bios Scientific Publications Ltd.
9. Primrose SB.1995. Principles of Genome Analysis. Blackwell Science, Oxford.

HARD CORE –PAPER 17
IV Semester

PLANT BIOTECHNOLOGY

Theory (Credits: 4)

Course Code: 523 **Lecture:60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:
To enable students understand and appreciate the fundamental principles that sustain biotechnology as an interdisciplinary domain of learning and research.
To provide details about three major domains of application namely fermentation biology, rDNA technology and plant tissue culture and find their specific applications.

Course outcome:
On successful completion of the course students will be able to

- understand and apply the principles of fermentation technology to produce consumable an marketable fermented products
- acquire hands-on experience and knowledge in handling molecular tools to manipulate plant genes
- produce plants through tissue culture methods and exploit the various options vested with this procedure.

Unit 1 Fermentation Technology **10 Lectures**

Historical developments – fermentor (construction, components, types, basic functions) – media formulation – sterilization and culture methods (batch, continuous and fed–batch systems) – industrial microbes (isolation and strain improvement) – inoculums development – fermentation kinetics – fermentation scale–up , upstream and downstream processing – fermented products (milk products, alcoholic beverages, organic acids and amino acids) – single cell proteins (bacteria, algae and fungi).

Unit 2 Gene Manipulation **12 Lectures**

Scope **-** cloning strategies – restriction endonucleases, modifying enzymes (ligases, phosphatases, kinases) – gene cloning vectors (plasmid vectors, phage vectors, expression vectors – binary vectors – shuttle vectors) – DNA library – poly nucleotide probe – cDNA cloning – Ti plasmids – transformation (*Agrobacterium* mediated and biolistics method) –marker and reporter genes.

Unit 3 Molecular Tools and Techniques **12 Lectures**

Promoters – open reading frames – linkers and adaptors – fusion protein – DNA amplification (principle and applications) – RtPCR –blotting techniques (Southern, Northern and Western blotting) – nonradioactive probe – DNA diagnostics (RFLP, AFLP, RAPD, SNP) – gene chip – DNA sequencing – restriction mapping - online resources (NCBI and EBI) – softwares (Bioedit, ClustalW, NJplot).

Unit 4 Fundamentals of Plant Tissue Culture **12 Lectures**

Founding Principles – rationale for *in vitro* culture – techniques of asepsis –patterns of regeneration– bud and meristem culture – genetic stability and variability - suspension culture; batch and continuous – mericloning, micropropagation and disease elimination-cryopreservation of elite germplasm.

Unit 5 *In vitro* applications **12 Lectures**

In vitro mutagenesis (physical and chemical) – protoplast culture and somatic cell fusion – somaclonal variations - cell line selection – triploids, haploids – advantages of polyploidy – as an adjunct to plant breeding (embryo rescue and embryo culture) – limitations and break even.

Suggested Readings

Text Books

1. Bhojwani S.S. and Razdan M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Das H.K. 2010. Textbook of Biotechnology (4th edition). Wiley India Pvt. Ltd. New Delhi.
3. Glick, B.R. & J.J. Pasternak. 2009. Molecular biotechnology, Panima Publishing Co.
4. Kumar H.D. 1998. Modern Concepts of Biotechnology. Vikas Publishing House Pvt. Ltd. New Delhi.
5. Kumaresan V. 2010. Biotechnology. Saras Publication. Nagercoil. Tamil Nadu.
6. Narayanasamy S. 1994. Plant Cell and Tissue Culture. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
7. Pelczar Jr. M.J., Chan E.C.S. and Krieg N.R. 2009. Microbiology: Application Based Approach. Tata McGraw-Hill Education. New Delhi.
8. Tortora G.J., Funke B.R. and Case C.L. 2010. Microbiology: An Introduction (10th edition). Pearson Benjamin Cummings. U.S.A.
9. Verma P.S. and Agarwal V.K. 2009. Genetic Engineering. S.Chand & Co. Ltd. New Delhi.

Reference Books

1. Brown T.A. 2001. Gene Cloning and DNA Analysis- An Introduction (4th edition). Blackwell Science. Oxford.
2. Clark D.P. and Pazdernik N.J. 2009. Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press. USA.
3. Desmond S.T. Nicholl. 2010. An Introduction to Genetic Engineering. Cambridge University Press. New Delhi.
4. Dods J.H. and Robers L.W. 1995. Experiments in Plant Tissue Culture (3rd edition).Cambridge University Press. Cambridge.
5. Glick B.R. and J. J. Pasternak. 2009. Molecular Biotechnology, Panima Publication Co.
6. Harisha S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
7. Madigan M.T., Martinko J. M. and Parker J. 2003. Brook Biology of Microorganisms. Prentice Hall.
8. Mosier N.S. and Ladisch M.R. 2009. Modern Biotechnology- Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. John Wiley & Sons Inc. New Jersey.
9. Primrose S., Twyman R. and Old B. 2001. Principles of Gene Manipulation (6th ed.).Blackwell Science. Oxford.

HARED CORE- PAPER 18

IV Semester

PRACTICAL VI- (GENOMICS AND BIOINFORMATICS&PLANT BIOTECHNOLOGY)

Practical (Credits 2)

Course Code: 514 **Lecture: 30**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This course will provide knowledge on how to isolate nucleic acids and quantify them.
- This will provide knowledge on nucleic acid staining and sequencing of plant DNA
- This course is teach and train students on plants in tissue culture

Course outcome:

On successful completion of the course students will be able to

- isolate, quantify and identify nucleic acids of plant tissues
- align a gene sequence and study gene identity using bioinformatics
- produce genetically uniform plants and raise useful variants as well.

SUGGESTED LABORATORY EXERCISES

GENETICS

1. Colorimetric estimation of DNA using diphenylamine
2. Colorimetric estimation of RNA using Orcinol
3. Estimation of total RNA from plant tissues and its colorimetric estimation
4. Study of cytological cell division stages in onion root tip tissues
5. Feulgen staining of nucleic acids in onion root tissues
6. Induction of polyploidy using colchicines

BIOINFORMATICS

1. Biological sequence (Nucleic acids and Protein) searching using appropriate Software.

PLANT BIOTECHNOLOGY

1. Production of ethanol using yeast
2. Sterilization of glass wares
3. Preparation of plant tissue culture media
4. Callus induction and maintenance *in vitro*
5. Cell suspension culture initiation
6. Micropropagation of plants using nodal explants and shoot apex
7. Culture of ovary and ovule *in vitro.*
8. Construction of a recombinant DNA using a gene of interest and bacterial plasmid vector.
9. Bacterial transformation using recombinant DNA.
10. Selection of recombinant DNA by X-gal/IPTG method.
11. Isolation of bacterial plasmids.
12. Confirmation of recombinant DNA by restriction digestion.
13. Agarose gel electrophoresis.

Suggested Readings

GENETICS

1. David Freifelder. 2004. *Essentials of Molecular Biology (4th edition)*, Narosa Publishing House, New Delhi.
2. De Robertis, E.D.P. and De Robertis,E.M.P. 1987. *Cell and Molecular Biology*, Lea and Febiger, Philadelphia, USA.
3. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. *Principle of Genetics*, John Wiley & Sons, New York.
4. Gupta, P.K. *2005. A Textbook of Cell and Molecular Biology*, Rastogi Publications, Meerut.
5. Gupta, P.K. 2007. *Cytogenetics,* Rastogi Publications, Meerut.
6. Dnyansagar, V.R. 1986. *Cytology and Genetics*. Tata McGraw Hill Publishing Co.Ltd., New Delhi.
7. Sharma, J.R. 1994. *Principles and Practices of Plant Breeding*. Tata McGraw Hill Publishing Co.Ltd., New Delhi.

BIOINFORMATICS

1. Henry, R.J. 1997. *Practical applications of Plant Molecular Biology,* Chapman & Hall, London, UK.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 1987. *Cell and Molecular Biology*, Lea and Febiger, Philadelphia, USA.
3. Old, R.W. and Primrose, S.B. 2006. *Principle of Gene Manipulation (7th edition)*. Blackwell Scientific Publications, Oxford, UK.
4. Lewin, B. 2017. *Genes XII*, Oxford Univ., Press, New York.

SOFT CORE –PAPER 5
IV Semester

NANOBIOLOGY

Theory (Credits: 2)

Course Code: 525 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- To introduces the learners to the basic concepts in the emerging frontiers of nanotechnology.
- To provide the know-how on the most recent molecular diagnostic and therapeutic tools used for various diseases.

Course outcome:

On successful completion of the course students will be able to

formulate procedures for the synthesis of nanoparticles which are of medical importance which could be used to treat specific diseases.

- characterize the various types of nano particle synthesis and advocate promote the use of nano materials and anno composites.

Unit 1 Basic concepts in Nanobiology **12 Lectures**

Social background, definition –nanobiotechnology- timeline of nanotechnology - types, magnitude of particles, shape and phase of molecules – Moore's law - top down and bottom up approaches, delivery systems – liposome, Blood Brain Barrier.

Unit 2 Diversity in Nanosystems **12 Lectures**

Carbon based nanostructures - fullerences, nanotubes, nanoshells, buckyballs – biomolecules and nanoparticles, nanosensors, nanomaterials -Classification based on dimensionality-quantum dots, wells and wires – metal based nano materials (gold, silver and oxides) - Nanocomposites- Nanopolymers – Nanoglasses–Nano ceramics.

Unit 3 Fabrication of Nanostructures **12 Lectures**

Photolithography and its limitation-Electron beam lithography (EBL)- Nanoimprint – Soft lithography patterning, optical lithography –characterization – Bionanostructures and their properties - DNA nanowires, Peptide nanowires and nanotubes - Protein nanoparticles - Bioinspired nanomaterials – DNA as a nano structure – silk protein - biomineralisation (diatoms) - lotus effect – nanomotors (ATPase, flagella).

Unit 4 Nanobiotechnology **12 Lectures**

Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nanoarrays, tissue engineering - medical applications -nanotechnology for reducing energy consumption and pollution.

Unit 5 Biophysical Applications **12 Lectures**

Solar energy conversion and catalysis, biosensors –Nanomedicine - Nanoparticles in bone substitutes and dentistry. Nanotoxicology -challenges. Nanotechnology in agriculture (fertilizer, pesticides and food), cosmetics(gels, sun-screen, shampoos and hair conditioners) – dispersions for UV protection using titanium oxide – color cosmetics - commercial exploration. Biosafety and bioethics.

Suggested Readings

Text Books

1. Kohler M. and Fritzsche W. 2004. Nanotechnology- An Introduction to Nanostructuring Techniques. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.
2. Nalwa H. S. 2002. Nanostructured Materials and Nanotechnology, Academic Press.
3. Niemeyer C. M. and Mirkin C. A. 2004. Nanobiotechnology: Concepts, Applications, and Perspectives, Wiley-VCH, Weinheim, Germany.
4. Pradeep T. 2012. A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.
5. Ratner M. A. and Ratner D. 2003. Nanotechnology: A Gentle Introduction to the Next Big Idea. Prentice Hall Professional, New York.

Reference Books

1. Boisseau P. and Lahmani M. 2009. Nanoscience: Nanobiotechnology and Nanobiology, Springer, UK.
2. Dupas C., Houdy P., Lahmani M. 2007. Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg.
3. Nabok A. 2005. Organic and Inorganic Nanostructures, Artech House.
4. Nicolini C. 2008. Nanobiotechnology and Nanobiosciences, Pan Stanford Publishing, Singapore.
5. Zelkowitz M.V. (editor). 2007. Advances in Computers (vol. 71)- Nanotechnology. Elsevier, Amsterdam.

SOFT CORE –PAPER 5
IV Semester

***IN VITRO* TECHNOLOGIES AND INDUSTRIAL APPLICATIONS**

Theory (Credits: 2)

Course Code: 525 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

To provide students with an overview of plant tissue culture techniques,

To equip learners with a potential to take entrepreneurial assignments or help them secure positions as technician and scientist in research firms aiming at the production of preparative material

To entrain students to liaison and interact with industries and small business houses that is involved in plant trade.

Course outcome:

On successful completion of the course students will be able to

- Design their own laboratories to pursue plant tissue culture
- Raise clonal populations
- Pursue callus cultures and produce useful genetic variants

Unit 1 Introduction to culture media **12 Lectures**

• Culture systems: Differentiated, undifferentiated, physiological, biochemical and molecular role of minerals and growth regulators in understanding differentiation of organs under *in vitro* conditions.

Unit 2 Micropropagation **12 Lectures**

Micropropagation (via organogenesis and embryogenesis) of floricultural, agricultural and pharmaceutical crops: Orchids, *Chrysanthemum, Gerbera, Carnation, Anthurium,* Bamboos, *Spilanthes, Stevia, Psoralea*, Chickpea and elite tree species of national importance.

• Production of virus free plants through meristem culture in orchids and fruit trees.

• Germplasm conservation *in vitro*.

• Variations: Somaclonal and gameto clonal variations, spontaneous, genetic and epigenetic variations.

Unit 3 Problems encountered cultures **12 Lectures**

• Problems in Plant Tissue Culture: contamination, phenolics, recalcitrance.

• Problems in establishment of regenerated plants in nature: hardening, association of mycorrhiza and rhizobia.

• Factors responsible for *in vitro* and *ex vitro* hardening.

Unit 4 Secondary Metabolites production **12 Lectures**

• Use of bioreactors in secondary metabolite production and scale up automation of plant tissue culture.

Unit 5 Applications **12 Lectures**

• Recent applications of tissue culture techniques and biotechnology in the introduction of economically important traits in horticultural, agricultural and medicinal plants.

• Interactions, training and workshops in Biotech industries and placements.

Suggested Readings

Text Books

1. Bhojwani S.S. and Razdan M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Chawla H.C. 2003. Plant Biotechnology- Laboratory Manual for Plant Biotechnology. Oxford& IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Gamborg O.L. and Philip G.C. 1995. Plant Cell, Tissue and Organ Culture. Narosa Publishing House. New Delhi.
4. Gupta P.K. 1995. Elements of Biotechnology. Rastogi Publication. Meerut.

5. Harisha S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
6. Keshavachandran R. and Peter K.V. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Universities Press (India) Pvt. Ltd. Hyderabad.
7. Kumaresan V. 2015. Plant Biotechnology. Saras Publication. Nagercoil.
8. Misra S.P. 2015. Plant Tissue Culture (2nded.). Ane Book Pvt. Ltd. Chennai.
9. Narayanasamy S. 1994. Plant Cell and Tissue Culture. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
10. Prakash J. and Pierik R.L.M. 1991. Horticulture - New Technologies and Applications (Current Plant Science and Biotechnology in Agriculture). Kluwer Academic Publishers.

Reference Books

1. Dods J.H. and Robers L.W. 1995. Experiments in Plant Tissue Culture ((3rd edition). Cambridge University Press. Cambridge.
2. George E.F., Hall M.A. and De Klerk G.-J. 2008. Plant Propagation by Tissue Culture (3rd edition), Springer, Netherlands.
3. Herman E.B. 2008. Media and Techniques for Growth, Regeneration and Storage 2005-2008. Agritech Publications, New York, USA.
4. Pierik R.L.M. 1999.*In Vitro* Culture of Higher Plants. Kluwer Academic Publishers.

Journals

Plant Cell, Tissue and Organ Culture
Plant Cell Reports

SOFT CORE –PAPER 5
IV Semester

MOLECULAR INTERACTIONS OF PLANTS WITH MICROBES

Theory (Credits: 2)

Course Code: 525 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- Aim of this course is to introduce various aspects of molecular and biochemical interactions of plants with symbionts, pathogens and pests at an advanced level.

Course outcome:

- Students will understand the intricacies of the relationship of plants with microbes.

Unit 1 Introduction **8 Lectures**

Introduction to biotic interactions with plants.

Unit 2 Plant Pathogen Interactions **16 Lectures**

Recent advances in plant-fungi, plant-insect and plant-nematode interactions: Stages of pathogenesis, Structural and biochemical host defense mechanisms against pathogens and pests, Basal resistance, Systemic acquired resistance (SAR), Induced systemic resistance (ISR),

Unit 3 Gene Cloning for Disease Resistance **16 Lectures**

Gene-for-gene concept, Cloning of resistance genes (R genes) and avirulence genes (Avr genes) from plants and pathogens, Induced responses to herbivory, Genetic engineering for the production of resistance plants to pathogens and pests.

Unit 4 Plant Interaction with Mycorrhiza **12 Lectures**

Recent advances in symbiotic interaction with plant with special references to mycorrhiza and plant interaction.

Unit 5 Parasitic interactions **8 Lectures**

Recent advances in parasitic interaction between plants and parasitic plants.

Suggested Readings

Text Books

1. Perry and Moens (Editors). 2006. Plant Nematology. CABI.
2. Karban R. and Baldwin I.T. 1997. Induced Responses to Herbivory. Chicago University Press.
3. Roger Hull. 2001. Mathew's Plant Virology. Academic Press, NY.
4. Strange R.N. 2003. *Plant Resistance Mechanisms (SAR, ISR)*. Introduction to Plant Pathology, John Wiley & Sons, USA.

Reference Books:

5. Dickinson M. 2003. *Signal transduction; Molecular diagnostics; Transgenic approaches for crop protection* -Molecular Plant Pathology, Bios Scientific Publishers, London.

Research Papers:

6. Davis E.L., Hussey R.S. and Baum T.J. 2004. Getting to the roots of parasitism by nematodes. *Trends in Parasitology* 20: 134–141.
7. Williamson V.M.and Kumar A.2006. Nematode resistance in plants: the battle underground.*Trends in Genetics* 22: 396–403.

SOFT CORE –PAPER – 6
IV Semester

PLANTS AND PEOPLE

Theory (Credits: 2)

Course Code: 526 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- The objective of the course is to highlight the importance of plants in our different facetsof life. The contents are divided to give an overview of plants in different aspects of human being.
- References of plants in scriptures and Sangam literature will be cited and relevance atthe context will be discussed. Cultures are identified based on their food and dressing habits, an overview of history of Indian cuisine will be traced specially with references to south India.

Course outcome:

- At the end of the semester, the students will be able to

Spot the major events that shaped up the modern society by taking into consideration the changes adopted in terms of vocation life styles.

Get a glimpse of major religions and faith component of India with a special mention about the significance of plants in each system.

Develop a wholistic appreciation of plant references made in Tamil and western literature that the learner would develop a sense of tolerance and mutual respect all faiths.

Food as basic necessity and composite and complementary amalgamations ofinputs that are geographically relevant to health, culture and practices.

Accept and adopt the Indian and indigenous systems of medicines (AYUSH) as available better alternative to allopathic practices.

Unit 1 Prehistorical evidences **12 Lectures**

Unraveling ancient civilization using plant based prehistoric evidences – cotton fabrics and dyes of prehistoric period – plants in ancient funerary rituals – pollen and paleoclimates

Unit 2 Scriptures **12 Lectures**

Forest and trees associated with Lord Buddha – plants in Bible and Quran – temple trees and sacred plants of India – sacred oil and fragrances used across the religious barriers.

Unit 3 Plants in literature **12 Lectures**

Cultural and biological diversity – Sangam landscape – Thinai concept – early livelihood strategies in Sangam literature – western literature.

Unit 4 History of Indian cuisine **12 Lectures**

Social history of food – dietary beliefs and cooking patterns of Indians – minor millets, spices and sweeteners of Indian origin.

Unit 5 Indian System of Medicine **12 Lectures**

Indian system of medicine – Siddha, Ayurveda and Unani –revitalization of indigenous medicinal practices and knowledge in south India.

Suggested Readings

Text Books

1. Acharya K. T. 1998. Indian food: A Historical Companion, Oxford University Press.
2. Ahluwalia S. 2017. Holy Herbs: Modern Connections to Ancient Plants, Fingerprint Publishers.
3. Haberman D. L. 2013. People Trees – Worship of trees in North India Oxford University Press.
4. Nanditha K. and Amirthalingam. 2014. Sacred plants of India, Penguin Books Limited.

Reference Books

1. Hart G. L. 2015. The Four Hundred Songs of Love- An Anthology of Poems from Classical Tamil The Akananuru. Institut Francais de Pondicherry, Puducherry.
2. Hart G. L. 1999. The Four Hundred Songs of War and Wisdom- The Purananuru. Columbia University Press, New York.
3. Schmithausen L. 2009. Plants in Early Buddhism and the Far Eastern idea of the Buddha-Nature of Grasses and Trees Published by Lumbini International Research Institute.
4. Srinivasan K. Sanga Ilakkiya Thaavarangal. Tamil University, Tanjore, Tamil Nadu (சீனிவாசன், .கு.,. .சங்கஇலக்கியதாவரங்கள், தமிழ்பல்கலைக்கழகம், தஞ்சாவுர்,தமிழ்நாடு)

SOFT CORE –PAPER 6
IV Semester

AGRICULTURAL ECOLOGY

Theory (Credits: 2)

Course Code: 526 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

- This will introduce the concept on different agricultural ecosystems.
- This will provide knowledge on agricultural weeds, plant diseases.
- Help students observe and follow the cultivation practices of different crops

Course outcome:

On successful completion of the course students will be able to

- grow right plant in a right place and control the weeds and pests.

Unit 1 Carbon Cycle and Energy Flow **12 Lectures**

Ecological experimentation in agriculture; basic chemical process-carbon cycle; Climate and adaptation of agricultural crops; Physical factors affecting crop-water; Energy flow in agroecosystems; Soil type and classification; soil properties and environmental factors.

Unit 2 Importance of Nitrogen **12 Lectures**

Nitrogen in agroecosystems; fertilizer elements in the environment; Macro and micronutrients and their availability to crops; Decomposition: beneficial soil organisms; Plant succession and competition.

Unit 3 Weed ecology and management **12 Lectures**

Distribution and sampling of agricultural pests; introduction to insects; Population dynamics; pesticides and the environment; Traditional knowledge systems and agrodiversity management.

Unit 4 Plant disease and environment **12 Lectures**

Integrated pest management; plant-parasitic nematodes; Host plant resistance and conservation of genetic resources. Cropping systems and agroecosystems in the landscape; crop rotation and cover crops, Intercropping; conservation tillage; Mulches and organic amendments; Dry-land agriculture, irrigation and salinity.

Unit 5 Agro-Ecosystems **12 Lectures**

Tropical agro-ecosystems; intensive agriculture; Impact of GMOs on crop biodiversity and agroecology; Impact of agricultural policies on crop biodiversity and agroecology; Human population growth; sustainable agriculture; Agroecology: the future perspective.

Suggested Readings

Text Books

1. Gliesmann S.R. 2006. Agroecology: The Ecology of Sustainable Food Systems. Technology & Engineering.
2. Gliesmann S.R. 2006. Field and Laboratory Investigations in Agroecology. Technology & Engineering.
3. Wojtkowski, P.A. 2004. Landscape Agroecology, Haworth Press, Inc., New York.

Reference Books

1. Warner, K.D. 2007. Agroecology in Action: Extending Alternative Agriculture Through Social Networks. The MIT Press, Cambridge, Massachusetts, USA.

SOFT CORE –PAPER 6
IV Semester

SYSTEMS BIOLOGY

Theory (Credits: 2)

Course Code: 526 **Lecture: 60**

Max. Marks – 100 (ICA = 40 + ESE = 60)

Course objectives:

Systems biology had emerged as a field of biology in the post-genomic era due to availability of omics data.

This fundamental course in system biology will introduce the concepts pertaining to use of technology and computational data of biological sample materials that provides for systems biology.

Course outcome:

On successful completion of the course students will be able to

- work parallel with the experimental, computational and theoretical research in different aspects of biology.

Unit 1 Trends in biological research **12 Lectures**

Cell – a basic unit of life – molecules involved in cellular processes - cell to organism level process in biological system – paradigm in biological research – reductionism and holistic approach–Systems biology theories and time line –challenges and future perspectives.

Unit 2 Facets of Systems approach **12 Lectures**

Hierarchies in biological system: gene, molecular, cellular and organ levels and interactions. High throughput experimental techniques -post-genomic era - omics technologies – whole genome sequences - big data -interactome. Properties of biological system – system dynamics and control -experimental and computational biology - emergent properties.

Unit 3 Network biology and their applications **12 Lectures**

Cell as an integrated device – molecular interactions – network analytic methods – Gene, transcription and regulatory network – Biochemical reactions and metabolic pathway systems – disease pathway analysis - Signal transduction network.

Unit 4 System biology models and approaches **12 Lectures**

Genome to life – data integration and modeling process – hypothesis testing - flux balance analysis and applications. Cell cycle models – Microbial models (Bacterial chemotaxis and Yeast) – Plant based models (plant development and plant defense system) - Ecological models (energy flow and population dynamics).

Unit 5 Databases and Software for Systems Biology **12 Lectures**

Omics databases in plants – Software packages – Cytoscape, Cell designer, Virtual cell. MetaCyc, BioCyc, KEGG pathway, Pathguide. Features of System Biology Markup Language and PYTHON.

Suggested Readings

Text Books

1. ChoiS. 2007. Introduction to Systems Biology. Humana Press Inc., New Jersey.
2. Klipp E., Liebermeister W., Wierling C. and Kowald A. 2016.Systems Biology – A Textbook (2nd edition). Wiley-VCH, Germany.
3. Kitano H. 2001. Foundations of System Biology. MIT Press, Cambridge.

Reference Books

1. Alon U. 2006. An Introduction To Systems Biology: Design Principles of Biological Circuits. Chapman and Hall /CRC, London, UK.
2. Baginsky S. and Fernie A.R. 2007. Plant Systems Biology. Birkhäuser Verlag, Berlin.
3. Coruzzi G.M. and Gutierrez R.A. 2009. Plant Systems Biology. Annual Plant Reviews.Vol.35. Wiley-Blackwell Publishing Ltd. UK.
4. Voit E.O. 2016. The Inner Workings of Life. Vignettes in Systems Biology. Cambridge University Press.

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BLUE PRINT OF THEORY QUESTION PAPER FOR M.Sc. BOTANY
(Choice Based Credit System)
(Effective from the academic year 2020-2021)

Course Code:
Time: 3 hrs **Maximum Marks: 60**

Section- A
Answer ALL the questions.
Each answer should not exceed 15 words.
(10 x 1 = 10 marks)

1. Unit I
2. Unit I
3. Unit II
4. Unit II
5. Unit III
6. Unit III
7. Unit IV
8. Unit IV
9. Unit V
10. Unit V

Section- B
Answer any FIVE questions.
Each answer should not exceed 200 words.
(5 x 4 = 20 marks)

11. Unit I
12. Unit II
13. Unit III
14. Unit IV
15. Unit V
16. Any unit
17. Any unit

Section- C
Answer any THREE questions.
Each answer should not exceed 600 words.
(3 x 10 = 30 marks)

18. Unit I
19. Unit II
20. Unit III
21. Unit IV
22. Unit V

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PRACTICAL – I (PLANT DIVERSITY I)

Course Code: 414
Time – 3 Hrs. **Max. Marks –60**

1. Make a suitable micropreparation of the plant specimen **A**. Draw labelled sketches and identify it giving reasons. Leave the slide for valuation.
   (Slide-2 marks, Identification-1 marks, Sketch-1 marks, Notes-2 marks) **1X6=6 marks**

2. Make a suitable micropreparation of the plant specimen **B**. Draw labelled sketches and identify it giving reasons. Leave the slide for valuation.
   (Slide-2 marks, Identification-1 marks, Sketch-1 marks, Notes-2 marks) **1X6=6 marks**

3. Make a suitable micropreparation of the plant specimen **C.** Draw labelled sketches and identify them giving reasons. Leave the slide for valuation.
   (Slide-2 marks, Identification-1 marks, Sketch-1 marks, Notes-2 marks) **1X6=6 marks**

4. Identify, draw and write notes on plant specimens **D, E** & **F**
   (Identification-1 mark, Sketch-2 marks, Notes-2 marks) **3X5= 15 marks**

5. Identify the Genus of the given algal herbarium **G**. Write down the systematic position.
   (Genus-1 mark, systematic position 2 marks, 1 mark diagram) **1X4=4 marks**

6. Comment on **H** & **I.**
   (Identification-1 mark, Notes-3 marks) **2x4=8 marks**

Total =45marks
Record=10 marks
Submission of Algal herbarium =5 marks
Grand total=60 marks

KEY

A	ALGAE	SECTION	
B	FUNGI	SECTION	
C	LICHEN APOTHECIA	SECTION	
D	ALGAE	SLIDE/SPECIMEN	
E	FUNGI	SLIDE/SPECIMEN	
F	LICHEN	SLIDE/SPECIMEN	
G	ALGAE	HERBARIUM	
H	FUNGI	SLIDE/SPECIMEN/PHOTOGRAPH	
I	LICHEN	SLIDE/SPECIMEN/ PHOTOGRAPH	

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PRACTICAL –II (PLANT DIVERSITY II & CELL AND MOLECULAR BIOLOGY)

Course Code: 415
Time – 3 Hrs. **Max. Marks –60**

1. Make a suitable micro preparations of **A, B** & **C**. Draw labelled sketches and identify them giving reasons. Leave the slide for valuation.
(Slide-2 marks, Identification-1 marks, Sketch-1 marks, Notes-1 marks) **3X5=15 marks**

2. Make a suitable micro preparation/ staining of nucleus of specimen **D**. Identify giving reasons. Draw labelled sketches. Leave the slide for valuation.
(Slide-2 marks, Identification-1 mark, Sketch-1 mark, Notes-1 mark) **1x5= 5 marks**

3. Make a T.S of anther of the given specimen **E**. Identify the stages giving reasons. Draw labelled sketches. Leave the slide for valuation.
(Slide-1 marks, Identification-1 mark, Sketch-1 mark, Notes-1 mark) **1x4= 5 marks**

4. Dissect and mount the Embryo of the given specimen **F**
(Two stages- heart shaped- 1 marks, globular shaped-1 mark) **2x1= 2 marks**

5. Macerate the given specimen **G** and identify the plant tissues
(Maceration technique 1 marks, Sketch-1, Notes-1) **1X3= 3 marks**

6. Comment on **I, H, I, J, K** & **L**
(Identification-1 mark, Sketch-1 Notes-1 mark) **5x3= 15 marks**

Total =45 marks
Record=10 marks
Permanent slide=5 marks
Grand total=60 marks

KEY

A	BRYOPHYTE	SECTION	
B	PTERIDOPHYTE	SECTION	
C	GYMNOSPERM	SECTION	
D	CELL BIOLOGY	SECTION	
E	MOLECULAR BIOLOGY	SECTION	
F	CELL BIOLOGY	DISSECTION	
G	MOLECULAR BIOLOGY	MACERATION	
H	BRYOPHYTE	SLIDE/SPECIMEN/PHOTOGRAPH	
I	PTERIDOPHYTE	SLIDE/SPECIMEN/PHOTOGRAPH	
J	GYMNOSPERMS/ PALEOBOTANY	SLIDE/SPECIMEN/PHOTOGRAPH	
K	CELL BIOLOGY	SLIDE/SPECIMEN/PHOTOGRAPH	
L	MOLECULAR BIOLOGY	SLIDE/SPECIMEN/PHOTOGRAPH	

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PRACTICAL –III (PLANT MORPHOGENESIS)

Course Code: 424
Time – 3 Hrs. **Max. Marks –60**

1. Make a suitable micropreparations of **A, B** & **C**. Draw labelled sketches and identify them giving reasons. Leave the slide for valuation.
   (Slide-2 marks, Identification-1 marks, Sketch-1 marks, Notes-1 marks) **3X5=15 marks**
2. Make a suitable micro preparation of specimen **D**. Identify giving reasons. Draw labeled sketches. Leave the slide for valuation.
   (Slide-2 marks, Identification-1 mark, Sketch-1 mark, Notes-1 mark) **1x5=5 marks**
3. Make a T.S of anther of the given specimen **E**. Identify the stages giving reasons. Draw labeled sketches. Leave the slide for valuation.
   (Slide-1 marks, Identification-1 mark,Sketch-1 mark,Notes-1 mark) **1x4=05 marks**
4. Dissect and mount the Embryo of the given specimen **F**
   (Two stages- heart shaped- 1 marks, globular shaped-1 mark) **2x1=02 marks**
5. Macerate the given specimen **G** and identify the plant tissues
   (Maceration technique 1marks, Sketch-1, Notes-1) **1X3=3marks**
6. Comment on **I, H, I, J, K** & **L.**
   (Identification-1 mark, Sketch-1 Notes-1 mark) **5x3=15 marks**

Total =45 marks
Record=10 marks
Permanent slide=5 marks

Grand total=60 marks

KEY

A	ANATOMY	SECTION	
B	EMBRYOLOGY	SECTION	
C	ANATOMY	SECTION	
D	EMBRYOLOGY	SECTION	
E	EMBRYOLOGY-ANTHER	SECTION	
F	ANATOMY	DISSECTION	
G	ANATOMY	MACERATION	
H	EMBRYOLOGY	SLIDE/SPECIMEN/PHOTOGRAPH	
I	ANATOMY	SLIDE/SPECIMEN/PHOTOGRAPH	
J	EMBRYOLOGY	SLIDE/SPECIMEN/PHOTOGRAPH	
K	ANATOMY/ ANOMALOUS SECONDORY GROWTH	SLIDE/SPECIMEN/PHOTOGRAPH	
L	EMBRYOLOGY	SLIDE/SPECIMEN/PHOTOGRAPH	

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PRACTICAL –IV (TAXONOMY OF ANGIOSPERMS &ECOLOGY AND BIODIVERSITY CONSERVATION)

Course Code: 425
Time – 3 Hrs. **Max. Marks –60**

1. Describe the given specimens **A** in technical terms and assign them to their respective families giving reasons. Draw flower. L.S, & Floral diagram. Write floral formula. (Identification-1, Technical description-2, Flower L.S-1, Floral diagram-1, Floral formula-1, Reasons-1) **1x7=7 marks**

2. Using the given plant specimens **B** prepare a taxonomic key for Identification. **1x5= 5 marks**

3. Determine frequency, abundance and density of the given vegetation in **C** by using quadrate method. Estimate Importance Value Index. (Frequency-2, Abundance-2, Density-2, IVI-2) **1x8=8 marks**

4. Identify **D** using internal features. Draw a diagram, write notes and leave the slide for valuation (Identification -1, Diagram -2, Notes -2). **1x5= 5 marks**

5. Estimate the phytoplankton density microscopically by concentrating the given watersample **E**. Leave the wet mount for the valuation. (Procedure-3, Slide mount-2, Result-1) **1x6=6 marks**

5. Identify the given spotter **F** & **G** andwrite down the salient features. (Identification-1,Notes-2) **2x3=6marks**

6. Identify, draw and write notes on **H** & **I** (Identification -1, Diagram -1, Notes -2). **2x4=8 marks**

Total =45 marks
Record=10 marks
Submission of herbarium sheets and field note= 5 marks
Grand Total =60 marks

KEY

A	TAXONOMY	SPECIMEN	
B	TAXONOMY	SPECIMEN	
C	ECOLOGY	SPECIMEN	
D	ECOLOGY	SPECIMEN	
E	BIODIVERSITY	SPECIMEN	
F	ECOLOGY	SPECIMENT/ PHOTOGRAPH	
G	BIODIVERSITY	ESTIMATION	
H	TAXONOMY	HERBARIUM SHEET	
I	ECOLOGY	SPECIMEN/ PHOTOGRAPH	

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PRACTICAL PAPER –V (PLANT PHYSIOLOGY AND BIOCHEMISTRY & MICROBIOLOGY AND IMMUNOLOGY)

Course Code: 514
Time – 3 Hrs. **Max. Marks –60**

1. Set up the experiment **A**. Write the procedure, tabulate and infer the results
(Set up -3, Procedure – 2, Results - 2, Sketch/graph-1). **1x8=8 marks**

2. Set up the experiment **B**. Write the procedure, tabulate and infer the results
(Set up -3, Procedure - 2, Results 2, Sketch/graph-1). **1x8=8 marks**

3. Stain the given bacterial specimen **C**. Write the procedure identify and draw submit the slide for valuation.
(Slide - 3, Procedure - 2, Identification -1, Diagram -1). **1x7=7 marks**

4. Calculate the bacterial density by using spectrophotometric method of the given specimen **D.**
(Procedure-2, Diagram-1, Calculation-1, Results-1) **1x5=5 marks**

5. By using Ouchterlony double diffusion technique find the reaction pattern of an antigen with a set of antibodies **E**.
(Procedure -3, Diagram- 1, Result-2) **1x6= 6 marks**

4. Identify, draw and write notes on **F** & **G.**
(Identification -1, diagram-1, Notes-2) **2x4=8 marks**

5. Write critical notes of **H** & **I.** **2X4=8 marks**
(Identification -1, diagram-1, Notes-2)

Total =50 marks
Record=10 marks
Grand Total =60 marks

KEY

A	PHYSIOLOGY	EXPIRIMENT	
B	BIOCHEMISTRY	EXPIRIMENT	
C	MICROBIOLOGY	STAINING	
D	MICROBIOLOGY	ESTIMATION	
E	IMMUNOLOGY	EXPIRIMENT	
F	PHYSIOLOGY	SPOTTER/ /PHOTOGRAPH	
G	BIOCHEMISTRY	SPOTTER/ /PHOTOGRAPH	
H	MICROBIOLOGY	SPOTTER/ /PHOTOGRAPH	
I	IMMUNOLOGY	SPOTTER/ /PHOTOGRAPH	

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PRACTICAL PAPER –VI (GENOMICS AND BIOINFORMATICS & PLANT BIOTECHNOLOGY)

Course Code: 524
Time – 3 Hrs. **Max. Marks –60**

1. Determine the biological sequence search using BLAST X for DNA/ protein sequence **A.** **1x10=10 marks**

2. Prepare Plant Tissue Culture medium/ Inoculate given explants on Plant Tissue Culture Medium **B**. **1x10=10 marks**

3. Construct a phylogenetic tree for the given gene sequence **C**. **1X5=5 marks**

4. Isolation of plasmid/restriction digestion of the given plasmid. Confirm it using agarose gel electrophoresis **D**. **1x5= 5 marks**

4. Identify, draw and write notes on **E** & **F.**
(Identification -1, diagram-2, notes-2) **2x5=10 marks**

5. Write critical notes of **G** & **H.** **2X5=10 marks**
(Identification -1, diagram-2, notes-2)

Total =50 marks
Record=10 marks
Grand Total =60 marks

KEY

A	GENOMICS	PROBLEM	
B	PLANT BIOTECHNLOGY	GENE SEQUENCING- BLAST X	
C	BIOINFORMATICS	PHYLOGENETIC TREE	
D	PLANT BIOTECHNOLOGY	EXPERIMENT	
E	GENOMICS	SPOTTER/ /PHOTOGRAPH	
F	PLANT BIOTECHNOLOGY	SPOTTER/ /PHOTOGRAPH	
G	BIOINFORMATICS	SPOTTER/ /PHOTOGRAPH	
H	PLANT BIOTECHNOLOGY	SPOTTER/ /PHOTOGRAPH	