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UNIVERSITY OF DELHI

Bachelor of Science Programme in Applied Life Sciences with Agrochemicals and Pest Management

(Botany Component)

(Effective from Academic Year 2019-20)

Revised Syllabus as approved by

Academic Council

Date: No:

Executive Council

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Applicable for students registered with Regular Colleges, Non Collegiate Women's Education Board and School of Open Learning

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Preamble

The objective of anyprogramme at Higher Education Institute is to prepare their students for the society at large. The University of Delhi envisions all its programmes in the best interest of their students and in this endeavour it offers a new vision to all its Under-Graduate courses. It imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. The Under-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of B.Sc. Programme in Applied Life Sciences with Agrochemicals and Pest Management offer essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core and elective papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

The University of Delhi hopes the LOCF approach of the B.Sc. Programme Applied Life Sciences with Agrochemicals and Pest Management will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

B.Sc. Programme Applied Life Sciences with Agrochemicals and Pest Management

(CBCS)

(Botany Component)

INTRODUCTION

The Learning outcomes-based curriculum framework is designed around the Choice-Based Credit System (CBCS) and is intended to suit the present day needs of the student in terms of securing their path towards higher studies or employment. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. The uniform grading system will also enable potential employers in assessing the performance of the candidates. The Choice-Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising of:

1. Core Course: compulsory course studied by a candidate as a core requirement is termed as a Core course.
2. Elective Course: A course which can be chosen from a pool of courses and which may be very specific or specialized subject of study which enables an exposure to some other discipline/ subject is called an Elective Course.

2.1 Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

2.2 Dissertation/ Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

3. Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course: The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication.

3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Programme Duration and Design:

The B.Sc. Programme with Agrochemical and Pest Management (ACPM) will be of three years duration. Each year will be called an academic year and will be divided into two semesters. Thus there will be a total of six semesters. Each semester will consist of sixteen weeks. The teaching-learning will involve theory classes (Lectures) of one hour duration and practical classes. The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, virtual labs, simulations, fieldtrips/Industry visits, seminars (talks by experts), workshops, projects, models and class discussions. Assessment will be based on continuous evaluation (class test, presentation, group discussion, quiz, assignment etc.) and end of semester examination. Each theory paper will be of 100 marks out of which 25% marks are reserved for internal assessment while a practical paper will be of 50 marks comprising 50% internal assessment.

LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

Nature and Extent of the Programme B.Sc. Applied Life Sciences with Agrochemicals and Pest Management

The programme includes Core Courses and Elective Courses. The Core Courses are all compulsory courses. There are three types of Elective Courses – Discipline Specific Elective (DSE), Skill Enhancement Courses (SEC) and Ability Enhancement Courses (AEC). The Core and DSE are six credit courses; the SEC are four credit courses and AEC are two credit courses. A student has to study a minimum of 128 credits to get a degree in B.Sc. Programme with Agrochemical and Pest Management (ACPM). To acquire a B.Sc. Programme with Agrochemical and Pest Management (ACPM) degree, the student will study twelve Core Courses, six Discipline Specific Elective Courses, four Skill Enhancement Courses and two Ability Enhancement courses.

The student will study four Core Courses from each discipline in Semesters I, II, III and IV; two Discipline Specific Elective Courses from each discipline in Semesters V and VI; one Skill Enhancement Course in Semester III, IV, V and VI. And two compulsory Ability Enhancement Courses are Environmental Sciences and English Communication and the student will study one each in Semesters I and II.

Aims of Bachelor's degree programme in (CBCS)

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. Programme Agrochemicals and Pest Management is designed to allow the flexibility in programme design and course content development, while at the same time maintaining a basic uniformity in the structure in comparison with other Universities across the country. The B.Sc. Programme ACPM covers a wide range of basic and applied courses in the fields of Botany, Zoology and Chemistry covering the areas like Agricultural Botany, Immunology, Molecular Biology, Inorganic Chemistry, Organic Chemistry, Physical Chemistry and many more. The core courses that are a part of the programme are designed to build a strong knowledge base in the fields already mentioned so that the student gets acquainted with the all aspects of this interesting course. The student is thus equipped to pursue higher studies in an institution of her/his choice, and to apply the skills learnt in the programme in solving the practical problems. The programme also offers a wide range of elective and skill enhancement courses to the student. The well-designed papers and the exhaustive training in the diverse fields help them to explore prospect in the higher studies and the jobs in academia or industry.

GRADUATE ATTRIBUTES IN SUBJECT

1. Communication skills: Develops effective communication skills through oral presentations of on-going developments in the field and the compiling of information in the form of reports.

2. Cooperation/Team work: Understands the importance and strengths of interacting with and working alongside people from diverse backgrounds with a meaningful contribution to team ethos and goals.

3. Moral and ethical awareness/reasoning: Awareness of ethical issues: Is aware of what constitutes unethical behaviour-plagiarism, fabrication and misrepresentation or manipulation of data.

4. Ethics: Acquires an awareness of work ethics and ethical issues in scientific research as well as plagiarism policies.

5. Self-directed learning: Self-motivation: Develops self-discipline, planning and organization skills, and time management skills.

6. Research-related skills: Is inquisitive about processes and phenomena happening during experiments in laboratories and seeks answers through the research path.

7. Knowledge acquisition: Gathers in-depth knowledge of basic and applied areas of ACPM

8. Laboratory skills: Understands and becomes conversant with various methods of safer handling of chemicals, biological specimens and various scientific equipments.

9. Interdisciplinary approach: Becomes aware of the synchronization of the main scientific fields viz. Chemistry, Botany and Zoology and its application in the daily life.

10. Environmental literacy: Develops a basic understanding of the Chemistry, Botany and Zoology principles that have environmental implications, gains an awareness of environmental safety like safer handling of chemicals in the laboratories, their safe disposal and replacement of harsh chemicals with the safer and environmental friendly options.

11. Scientific logic: Develops a scientific logic and approaches a problem with critical reasoning.

QUALIFICATION DESCRIPTION

The qualification description for B.Sc. Programme in Agrochemicals and Pest Management includes:

- Demonstration of a comprehensive knowledge of the basic concepts, principles and theories of the fields- Chemistry, Botany, Zoology, Agriculture & Pest management and an awareness of the emerging areas/topics of these fields.
- Enhancement of ability to read, assimilate and discuss scholarly articles and research papers of the mentioned diverse fields of sciences with a sense of interdisciplinary scenario.
- Acquisition of practical laboratory skills, enabling the systematic collection of experimental data of all the three fields and correlating them to accurately design an experiment.
- Ability to analyse and interpret experimental data and maintain records of the same.
- Development of literature searching and information management skills.
- Development of strong oral and written communication skills promoting the ability to present the studies in all the three fields by using the concepts and knowledge acquired.
- Development of awareness of the role of Chemistry, Botany, Zoology, Agriculture & Pest management in contemporary societal and global issues, including areas such as sustainability and green chemistry and environmental science.
- Demonstration of the ability to work effectively and productively, independently or as part of a team.
- Development of competence in intellectual, practical and transferable skills (Communication and Interpersonal skills) necessary for employment as a professional scientist.

PROGRAMME LEARNING OUTCOME IN COURSE

Students of B.Sc. programme in Agrochemicals and Pest Management (ACPM) are designed to develop in depth knowledge of the core concepts and principles of Agrochemical and Pest Management. Undergraduates pursuing this programme of study go through laboratory work that specifically develops their quantitative and qualitative skills, provides opportunities for critical thinking and team work and exposes them to techniques useful for applied areas of scientific study.

- Knowledge, Width and Depth: Students acquire sound theoretical knowledge and understanding of the fundamental concepts, principles and processes in Agrochemical and Pest Management. Depth in understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.
- Instrumental technique: A much valued learning outcome of this programme is the laboratory skills that students develop during the course. The techniques gained through hands- on methods opens a choice of joining the industrial laboratory work force after graduation. The programme also provides an ample training in handling basic chemical and biological laboratory instruments and their use in the interfacial scientific determinations. Undergraduates on completion of this programme can cross branches to join pharmaceutical, material testing besides agrochemicals, pest management labs.
- Communication: Communication is a highly desirable attribute to possess. Opportunities to enhance student's ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.
- Capacity Enhancement: Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The ACPM course is designed to take care of this important aspect of student development through effective teaching learning process.
- Portable Skills: Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of ACPM programme. These are problem solving, information retrieval skills and organizational skills. These are valued across work environments.

STRUCTURE OF B.Sc. PROGRAMME (APPLIED LIFE SCIENCES WITH AGRO-CHEMICALS AND PEST MANAGEMENT)

Semester Core Course (12) Ability Enhancement Course (AEC) (2) Skill Enhc. Course (SEC) (4) Discipline Specific Elective (DSE) (6)

I Core course Botany –I Environmental Science / English Communication

Core course Zoology- I

Core course Chemistry- I

II Core course Botany –II Environmental Science / English Communication

Core course Zoology- II

course Chemistry- II

III Core course Botany –III SEC -1

Core course Zoology- III

Core course Chemistry- III

IV Core course Botany –IV SEC -2

Core course Zoology- IV

Core course Chemistry- IV

V SEC -3 DSE-1

DSE-2

DSE-3

VI SEC -4 DSE-4

DSE-5

DSE-6

SEMESTER WISE COURSES OFFERED UNDER B.Sc. PROGRAMME (APPLIED LIFE SCIENCES WITH AGRO-CHEMICALS AND PEST MANAGEMENT)

SEMESTER	COURSE CODE	NAME OF THE COURSE	CREDITS
I	BOTANY – C I	Biology of life forms: Plants	L=4 P=2
	CHEMISTRY – C I		
	ZOOLOGY-C I		
II	BOTANY – C II	Agricultural Botany and Weed science	L=4 P=2
	CHEMISTRY – C II		
	ZOOLOGY-C II		
III	BOTANY – C III	Fundamentals of Plant Systematics and Ecology	L=4 P=2
	CHEMISTRY – C III		
	ZOOLOGY-C III		
IV	BOTANY – C IV	Developmental Biology: Plants	L=4 P=2
	CHEMISTRY – C IV		
	ZOOLOGY-C IV		

(L=Lecture, P=Practical Core Courses –12 papers)

Credits: 12x 6 = 72

Discipline Specific Elective Courses (DSE) – 6 papers**

V, VI Discipline Specific Electives-Botany (Any two)

Genetics and Plant Biotechnology L=4 P=2

Plants regulators and Economic Botany L=4 P=2

Dissertation 6

Skill Enhancement Elective Courses (SEC) – Any 4 papers

III, IV, V, VI

Botany Medicinal Plants and IPR (Intellectual Property Rights) L=2 P=2

Plants Quarantine L=2 P=2

Plant health diagnostics and Management L=2 P=2

Plants regulators and Economic Botany L=2 P=2

Ability Enhancement Courses (AEC)

I-II AEC-I Environmental Science 2

AEC-IIEnglish Communication 2

Credits: 2□2 = 04

COURSE LEARNING OBJECTIVES

The progamme is designed to equip students with essential knowledge and technical skills to study plants and related subjects in a holistic manner. hteh main aim is to train the learners in all areas of plant biology using appropriate combinations of core and elective papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

COURSE LEARNING OUTCOME

The course learning outcomes are aligned with program learning outcomes but these are specific-to-specific courses offered in a program. The course level learning shall be reflected as program level learning. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

1. Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms. Understanding of various analytical techniques of plant sciences, use of plants as industrial

resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.

2. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.

TEACHING-LEARNING PROCESS

B.Sc. programme in Agrochemicals and Pest Management (ACPM) aims to make the student proficient in theoretical background and practical training in all aspects of ACPM. It also helps them to develop an appreciation of the importance of ACPM in different contexts through the exposure to the spectrum of the knowledgeable and facts in this field. For this, an exhaustive training in the classroom and laboratory is given.

In the classroom, this will be done through the lectures delivered using both conventional methods and smart technology. The protocol may vary from using blackboard/ whiteboard to the power-point presentations with the inclusion of the information from internet viz. animations. So the different pedagogies such as problem-based learning, peer-led instruction, and technology-aided instruction (blended learning) are adopted wherever suitable. Like in the interactive mode of teaching, the student will be encouraged to participate in discussions and deliver presentations on the relevant topics.

In the laboratory, the student will first learn good laboratory practices and then get hands-on training on basic techniques and methods adopted for simple synthesis and characterization of agrochemicals. The student will participate in field trips to industries that give an insight to the future areas of the employment.

ASSESSMENT METHODS

The student will be assessed over the duration of the programme by many different methods. These include short objectives-type quizzes, assignments, written and oral examinations, group discussions and presentations, problem-solving exercises, case study presentations, experimental design planning, execution of experiments, seminars, preparation of reports, and presentation of practical records. The wide range of assessment tasks aim to break the monotony of having a single assessment method.

KEYWORDS

Plant Sciences, Biology, biodiversity, biotechnology, botany, bryophytes, fungi, algae, mocrobes, bacteria, plant pathology, plant reproduction, anatomy, developmental biology, molecular biology, genetics, systematics, taxonomy, plant physiology, biostatistics, bioinformatics, ecology, biochemistry,

Agricultural Botany and Weed Science
(APLSC2)

Core Course - (CC) Credit: 6

Course Objective (2-3)

To gain the knowledge on

1. Requirement of the conditions for seed germination, plant growth and development

2. Role of growth hormones in plant development and flowering

3. Weed control methods

Course Learning Outcomes

After completion of this course the students would be able to

1. How the quality of seeds are judged and how to create suitable conditions for the seed germination.
2. How the growth, flowering and fruiting in plants are managed through the application of hormones
3. How the weeds are managed in commercial crops?

Unit 1

Agricultural Botany

Seed Physiology - Seed dormancy, types, factors causing dormancy, mechanism and methods for breaking seed dormancy, seed viability, seed vigour, hormonal regulation of seed dormancy and germination (Lectures: 8)

Unit 2

Physiology of Growth and Yield - Principal of growth analysis, source-sink relationship, factors affecting growth, dry matter partitioning and yield, crop simulations and modeling, use of controlled environment for plant growth and development studies, concept of phytotronics. (Lectures: 8)

Unit 3

Chemical Regulation of Growth and Development - Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness. (Lectures: 8)

Unit 4

Reproductive Physiology and Senescence - Photoperiodism, flowering response, photo perception, critical photoperiod, photo-induction, phytochrome and its role in flowering, hormonal regulation, vernalization, physiology of fruit ripening, senescence, regulation of senescence.(Lectures: 10)

Unit 5

Weed Science

Biology of Weeds - Ecology of weeds, competition, reproduction of weeds. Seed biology.(Lectures: 6)

Unit 6

Weed Management Practices - Mechanical Practices, Cultural Practices, Biological control. (Lectures: 8)

Unit 7

Chemical Weed Control - Herbicide classification, Selectivity of herbicides, absorption and translocation of herbicides, Mode of action of herbicides, Detoxification mechanisms of herbicides.Weed resistance to herbicides. (Lectures: 8)

Unit 8

Weed Control Methods: Weed control in wheat, rice and vegetable crops. Control of five abnoxious weeds. (Lectures: 4)

Practical

1. To study opening and closing of stomata.
2. To determine stomatal index of the given leaf.
3. To study the effect of ethylene on shelf life of cut flowers.
4. To study the effect of cytokinin on leaf senescence.
5. To study effect of heavy metals on growth and development.
6. To test the viability of weed seeds.
7. To evaluate the allelopathic effects of weeds on germination of crop seeds.
8. To evaluate effect of herbicides on seed germination and seedling growth of weeds.

References

1. Ashton, F. M., Monaco, T. J. (2002). Weed Science: Principles and Practices. New Jersey, U.S.: John Wiley and Sons. Inc.
2. Hopkins, W.G. (1995). Introduction to plant physiology. Jersey, U.S.: John Wiley and Sons. Inc.
3. Mandal, R.C.(1990). Weeds, weedicides and weed control: Principle and Practice. New Delhi, Delhi: Agro Botanical Publishers.
4. Rao, V. S. (1999). Principles of Weed Science. Oxford and IBH Publishers, New Delhi
5. Subramanian,S. (2017). All about weed control. New Delhi, Delhi: Kalayani publishers.

Additional Resources:

6. Taiz, L., Zeiger, E. (2006). Plant Physiology, 5th edition. Sunderland, Massachusetts: Sinauer Associates, Inc.

Teaching Learning Process

Teaching and Learning Process: Theoretical knowledge will be imparted through lectures and power-point presentations. Practical sessions would help students identify the plants, their economically important parts. Project and field work will help students gain experimental knowledge and some skills help in extraction of resources.

Teaching Learning Plan
Week 1: Unit I
Week 2: Unit II
Week 3: Unit II
Week 4: Unit III
Week 5: Unit III,
Week 6: Unit IV
Week 7: Unit IV
Week 8: Unit V
Week 9: Unit VI
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VII
Week 13: Unit VII
Week 14: Unit VIII
Week 15: Unit VIII

Assessment Methods

Assessment Methods: Group discussions, Multiple choice questions, Written examination including project work presentation.

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Seed Physiology - Seed dormancy, types, factors causing dormancy, mechanism and methods for breaking seed dormancy, seed viability, seed vigour, hormonal regulation of seed dormancy and germination	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

II	Physiology of Growth and Yield - Principal of growth analysis, source-sink relationship, factors affecting growth, dry matter partitioning and yield, crop simulations and modeling, use of controlled environment for plant growth and development studies, concept of phytotronics.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Chemical Regulation of Growth and Development - Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Reproductive Physiology and Senescence - Photoperiodism, flowering response, photo perception, critical photoperiod, photo-induction, phytochrome and its role in flowering, hormonal regulation, vernalization, physiology of fruit ripening, senescence, regulation of senescence.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Weed Science Biology of Weeds - Ecology of weeds, competition, reproduction of weeds. Seed biology.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Weed Management Practices - Mechanical Practices, Cultural	Class room lectures and Practical demonstration,	Hands on exercises, PPT, assignments, tests

	Practices, Biological control.	experiments	
VII	Chemical Weed Control - Herbicide classification, Selectivity of herbicides, absorption and translocation of herbicides, Mode of action of herbicides, Detoxification mechanisms of herbicides. Weed resistance to herbicides.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Weed control in wheat, rice and vegetable crops. Control of five abnoxious weeds.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Seed dormancy, seed viability, hormonal regulation, source sink, crop simulation, phytotronics, flowering ,phytochrome, vernalization, weed, photoperiodism

Biology of Life Forms: Plants
(APLSC1)
Core Course - (CC) Credit:6

Course Objective (2-3)

1. Introduction to Biodiversity ranging from Microbes (Viruses and Bacteria), to Fungi, to various plant groups (Algae and Archegoniates- Bryophytes, Pteridophytes and Gymnosperms).
2. Information on the Ecological and Economic Importance of Microbes, Fungi and various plant groups to enable students understand and appreciate relevance of Microbes and Plants to environment and human well-being.
3. Insight into the line of Plant Evolution on Earth and the consequent Biodiversity is instrumental in creating Awareness on the threats to biodiversity and sensitize young minds towards the Biodiversity Conservation for sustainable development.

Course Learning Outcomes

1. Combination of Theoretical and Practical components will provide comprehensive information and insight into the fascinating world of Microbes and Plants.
2. Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.
3. Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
4. Scope of Biodiversity includes Medicinal field, Industry, Agriculture, Research and Study, Job Opportunities and Environmental Conservation. This paper is both informative and interesting and will enable students to learn about Biodiversity not only as a plant or nature lover, but also for higher academic pursuits, particularly in the field of Biological Sciences, Environment and Biodiversity Conservation.

Unit 1

Classifying the diversity of life: Kingdoms of Life –Eubacteria, Archaea and Eukaryotes
(4 Lectures)

Unit 2

Viruses: Discovery; Physiochemical and biological characteristics; Classification; Replication,Lytic and Lysogenic cycle; Structure of DNA virus (bacteriophage T4), RNA virus(TMV), economic importance. (6 Lectures)

Unit 3

Bacteria: Discovery of bacteria; Ecology and distribution; General structure; Comparison of Archaea and Eubacteria; Wall-less forms (L-forms, Mycoplasma, Protoplasts and Sphaeroplasts) Nutrition; Reproduction–vegetative, asexual and recombination; Economic importance. (8Lectures)

Unit 4

Algae: Diagnostic features of identification; morphology, reproduction and classification with special reference to *Nostoc*, *Volvox*, and Spirogyra. Economic importance of Algae. (10 Lectures)

Unit 5

Fungi: Diagnostic features of identification; morphology, reproduction and classification with special reference to *Rhizopus*, *Penicillium*, *Agaricus*and*Alternaria*; Lichens (a general account), and economic importance of lichens and fungi. (10 Lectures)

Unit 6

Archegoniate: Characteristic features of identification, classification and reproduction of Bryophytes and Pteridophytes with special reference to *Marchantia*, *Funaria*, and *Pteris*; economic importance of bryophytes and pteridophytes. (12 Lectures)

Unit 7
Gymnosperms: Characteristic features, classification, study of vegetative structures and reproduction of gymnosperms, economic importance of gymnosperms. *Pinus*: detailed account. (5 Lectures)

Unit 8
Angiosperms: Diagnostic features, Structure of flower, inflorescence, and fruits. (5 Lectures)

Practical

1. Viruses: EM of TMV and Bacteriophage, study specimens of virus infected plants (any two)
2. Bacteria: Types through permanent slides/photographs, specimens of infected plants (any two).
1. Algae: Study of vegetative and reproductive structures of (a) *Nostoc* (b) *Volvox* (c) *Spirogyra* through temporary preparations and permanent slides.
2. Fungi: Study of vegetative and reproductive structures of (a) *Rhizopus*, (b) *Penicillium*, (c) *Alternaria* and (d) *Agaricus* through temporary preparations and permanent slides/specimen/photographs.
3. Study of growth forms of Lichens (crustose, foliose and fruticose)
4. Bryophytes: Study of (a) *Marchantia* morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides), (b) *Funaria*: detailed study and classification from W.M. rhizoids, leaf, operculum, peristome, spores and permanent slides of archegonia, antheridia and capsule.
5. Pteridophytes: Study of (through temporary/permanent slides) and classification of *Pteris:* detailed study of T. S. of rachis, V.S. of sporophyll and W.M. of sporangium.
6. Gymnosperms: Study of *Pinus* from specimens and permanent slides only.
7. Angiosperms: Study of flower morphology, types of inflorescence (any 5 types) and fruit type (any 5 types) through specimen or photographs.

References

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). *Introductory Mycology*, 4th edition. Singapore, John Wiley and Sons (Asia).
2. Bhatnagar, S.P., Moitra, A. (1996). *Gymnosperms*. New Delhi, Delhi: New Age International (P) Ltd Publishers.
3. Kumar, H.D. (1999). *Introductory Phycology*, 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.
4. Kaur I.D. Uniyal, P.L. (2019). *Text Book of Gymnosperms.* New Delhi, Delhi: Daya Publishing House.
5. Parihar, N.S. (1991). *An introduction to Embryophyta. Vol. I. Bryophyta*. Prayagraj: U.P.: Central Book Depot.

Additional Resources:

6. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). *Biology*. Delhi, Delhi: Tata McGraw Hill.
7. Sethi, I.K., Walia, S.K. (2011). *Text book of Fungi & Their Allies.* New Delhi, Delhi: MacMillan Publishers Pvt. Ltd.
8. Tortora, G.J., Funke, B.R., Case, C.L. (2010). *Microbiology: An Introduction*, 10th edition. San Francisco, California: Pearson Benjamin Cummings.

9. Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). *Pteridophyta.* New Delhi, Delhi: S. Chand & Co Ltd.

Teaching Learning Process

1. The theory topics are covered in lectures with the help of both conventional (chalk board) and modern (ICT) methods, including use of Charts.
2. Emphasis is on interactive class room environment so as to encourage students ask questions/ doubts/ queries for clarification/explanation and discussion.
3. Students are encouraged to refer to reference books in library to inculcate reading habit for better grasp and understanding on the subject.
4. Emphasis is given to illustrations- neat, well-labelled outline and cellular diagrams/ flowcharts for improving creative skills and to substantiate the text content.
5. On completion of theory syllabus, previous years' question papers are discussed so as to apprise students about the general format of semester exam question papers.
6. Assignment (10), Test (10) and Theory Attendance (5) are components of Internal Assessment Scheme for compilation of Internal Assessment Score of each student out of 25 marks.

PRACTICAL:

1. Plant study is done using fixed plant materials, museum and herbarium specimens, photographs and permanent slides.
2. The students are instructed about maintaining practical records, which includes comments and diagrams.
3. Students are asked to submit practical records regularly, on a continuous basis, for checking.
4. Practical Exam Guidelines are discussed to apprise students about the formant of Practical exam.
5. As part of Continuous Evaluation guidelines, total score for each student is calculated out of 25 marks, taking into consideration Practical Records (10), Practical Test/ Assessment (10) and Practical Attendance (5).

Weekly lesson plan

Week 1: Unit I
Week 2: Unit II
Week 3: Unit II
Week 4: Unit III
Week 5: Unit III,
Week 6: Unit IV
Week 7: Unit IV
Week 8: Unit V
Week 9: Unit V

Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VI
Week 13: Unit VI
Week 14: Unit VII
Week 15: Unit VIII

Assessment Methods

Emphasis is given for an interactive classroom environment, with at least few minutes for question-answer session.

1. Assignment topics are given to students for submission of hand written assignments.
2. Test is taken, with both objective and descriptive questions, from a defined portion of syllabus.
3. Assignment (10), Test (10) and Theory Attendance (5) are components of Internal Assessment Scheme for compilation of Internal Assessment Score of each student out of 25 marks.
4. Students are monitored in the practical class w.r.t their performance in table work for detailed plant study.
5. Students are asked to submit practical records regularly, on a continuous basis, for checking.
6. Emphasis is given on neat, labelled diagrams and proper, concise comments in practical records, with properly maintained Index page regularly signed by the teacher.
7. Practical Test/ Assessment is taken to evaluate students' performance as per guidelines framed for Continuous Evaluation under C.B.C.S.
8. As part of Continuous Evaluation guidelines, total score for each student is calculated out of 25 marks, taking into consideration Practical Records (10), Practical Test/ Assessment (10) and Practical Attendance (5).

Assessment method

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Classifying the diversity of life: Kingdoms of Life –Eubacteria, Archaea and Eukaryotes	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Viruses: Physiochemical and biological characteristics; Classification; Replication, Lytic and Lysogenic cycle; Structure of DNA virus (bacteriophage T4), RNA virus (TMV), economic importance.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Bacteria; Ecology and distribution;	Class room lectures	Hands on exercises,

	General structure; Comparison of Archaea and Eubacteria; Wall-less forms (L-forms, Mycoplasma, protoplasts and Sphaeroplasts) Nutrition; Reproduction– vegetative, asexual and recombination; Economic importance.	and Practical demonstration, experiments	PPT, assignments, tests
IV	Diagnostic features of identification; morphology, reproduction and classification with special reference to *Nostoc*, V*olvox*, and *Spirogyra*. Economic importance of Algae.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Diagnostic features of identification; morphology, reproduction and classification with special reference to *Rhizopus, Penicillium, Agaricus* and *Alternaria*; Lichens description, economic importance lichens and fungi.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Characteristic features of identification, classification and reproduction of Bryophytes and Pteridophytes with special reference to *Marchantia*, *Funaria* , and *Pteris* ; economic importance of bryophytes and pteridophytes	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Characteristic features, classification, study of vegetative structures and reproduction of gymnosperms, economic importance of gymnosperms. *Pinus*: detailed account.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Angiosperms: Diagnostic features, Structure of flower, inflorescence, and fruits.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Biodiversity; Microbes; Viruses; Bacteria; Fungi; Algae; Archegoniates; Bryophytes; Pteridophytes; Gymnosperms

Developmental Biology: Plants
(APLSC4)
Core Course - (CC) Credit:6

Course Objective (2-3)

- To acquaint the students with internal basic structure and cellular composition of the plant body.
- To correlate structure with important functions of different plant parts.
- Study of various tissue systems and their development and functions in plants
- To have knowledge of the flowering and fruiting, reproduction process, role of pollinators, ovule and seed development.

Course Learning Outcomes

Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.Various aspects of growth, development of the tissues and differentiation of various plant organs. Knowledge of basic structure and organization of plant parts in angiosperms. Correlation of structure with morphology and functions.

1. Pollen development, dispersal and pollination
2. Ovule development and fertilization,
3. Endosperm development and its importance
4. alternation pathways of reproduction

Unit 1

Meristematic and permanent tissue: (10 Lectures)
Meristems and derivatives- structural organization of shoot and root apices; permanent tissue: simple and complex tissues.

Unit 2

Dermal system (4 Lectures)
Epidermis, cuticle, stomata, trichomes and glands

Unit 3

Organs (6 Lectures)

Structure of dicot and monocot root, stem and leaf.

Unit 4

Secondary Growth (10Lectures)
Vascular cambium – structure and function, Secondary growth in root and stem, periderm.

Unit 5

Structural organization of flower (1Lecture)

Unit 6

Anther: (8Lectures)
structure and development, microsporogenesis, pollen development; structure of pollen wall.

Unit 7

Ovule: (8Lectures)
Structure and types, megasporogenesis and megagametogenesis, mature embryo sac

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Unit 8

Pollination and fertilization: (6 Lectures)
Pollination mechanisms and adaptations; double fertilization; sexual incompatibility- basic concepts

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Unit 9

Endosperm and embryo: (5Lectures)
Types and function of endosperm, embryogenesis, Dicot and monocot embryo

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Unit 10

Seed development basic concepts (2 Lectures)

Practical

1. Study of root and shoot apex through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Structure of anther (young and mature).
7. Calculation of percentage of germinated pollen in a given medium.
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Mature embryo sac (photographs).Ultrastructure of mature egg apparatus cells through electron micrographs.
9. Dissection of embryo and endosperm from developing seeds.

References

1. Bhojwani, S.S., Bhatnagar, S.P. (2011). *Embryology of Angiosperms*, 5th edition. New Delhi, Delhi: Vikas Publication House Pvt. Ltd.
2. Mauseth, J.D. (1988). *Plant Anatomy*. San Francisco, California: The Benjamin/Cummings Publisher.
3. Bendre and Kumar (2004). *A Textbook Of Practical Botany. Vol II.* Meerut, U.P.: Rastogi publications.
4. Franklin, E. R. (2006). *Esau's Plant Anatomy: Meristems, Cells, And Tissues of the Plant Body: Their Structure, Function, and Development.* New Jersey, U.S.: John Wiley & Sons, Inc., Hoboken.
5. Shivanna, K.R. (2003). *Pollen Biology and Biotechnology*. Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Additional Resources:

6. Raghavan, V. (2000). *Developmental Biology of Flowering plants*. Netherlands, Europe: Springer.
7. Johri, B.M. (1984). *Embryology of Angiosperms*. Netherlands, Europe: Springer-Verlag.

Teaching Learning Process

Chalk and blackboard teaching methodology

Powerpoint presentations
Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples

Weekly lesson plan
Week 1: Unit I
Week 2: Unit I
Week 3: Unit II
Week 4: Unit III
Week 5: Unit IV
Week 6: Unit V
Week 7: Unit VI
Week 8: Unit VII
Week 9: Unit VII
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VIII
Week 13: Unit VIII
Week 14: Unit IX
Week 15: Unit X

Assessment Methods

Assignments/ Projects
Class tests
Student presentations
Continuous evaluation
Making drawings as a part of practical record books.we may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Meristems and derivatives-structural organization of shoot and root apices; permanent tissue: simple and complex tissues.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Epidermis, cuticle, stomata, trichomes and glands	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Structure of dicot and monocot root, stem and leaf.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Secondary Growth Vascular	Class room lectures and	Hands on exercises,

	cambium – structure and function, Secondary growth in root and stem, periderm.	Practical demonstration, experiments	PPT, assignments, tests
V	Structural organization of flower	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Anther: structure and development, microsporogenesis, pollen development; structure of pollen wall.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Ovule: structure and types, megasporogenesis and megagametogenesis, mature embryo sac	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Pollination and fertilization Pollination mechanisms and adaptations; double fertilization; sexual incompatibilitybasic Concepts	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	Endosperm and embryo: Types and function of endosperm, embryogenesis, Dicot and monocot embryo	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit X	Seed development basic concepts	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Tissues, Stem, Leaf, Root, Vascular cambium, Wood, Periderm, Anatomical adaptations, Secondary anomalies. Plant tissue systems, meristems, trichomes,flowering development, anther, plooen biology, ovule , gametogenesis, Pollination, fertilization, self -incompatibility, endosperm, seed, apomixix, polyembryony

Fundamentals of Plant Systematics and Ecology
(APLSC3)
Core Course - (CC) Credit:6

Course Objective(2-3)

To make students understand ecology and basic ecological concepts, inter-relation between the living world and environment. Also to make them aware about identification, nomenclature and classification.

Course Learning Outcomes

After successful completion of the course the student shall have adequate knowledge about the basic principals of environment and taxonomy. They will be able to identify the plants and their resources and the ecological conditions for the growth and development of the plants

Unit 1

SECTION A: Systematics
Aims, fundamental components of systematics description, identification, nomenclature, phylogeny, classification: artificial, natural and phylogenetic, biosystematics. (5 Lectures)

Unit 2

Systematics in Practices: Herbarium- Methods and their roles, role of computers and internet resources in identification; Keys, floras, monographs, manuals and journals. (8 Lectures)

Unit 3

Taxonomic Hierarchy- Concept of taxa, categories and hierarchy. (4 Lectures)

Unit 4

Botanical Nomenclature- principles and rules; ranks and names, type method; author citation; valid publication; rejection of names, principle of priority and its limitations; names of hybrids and cultivars. (9 Lectures)

Unit 5

System of classification: An outline of Bentham and Hooker's and Engler and Prantl's systems of classification and their merits and Demerits. APG-III (brief introduction only) (6 Lectures)

Unit 6

SECTION B: Ecology
Introduction to ecology, level of organization (2 Lecture)

Unit 7
Ecological factors (10 Lectures)
Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 8
Biotic interactions (2 Lectures)

Unit 9
Plant communities (6 Lectures)
Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 10
Ecosystem (8 Lectures) Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; biogeochemical cycling; carbon, nitrogen and Phosphorous cycle.

Practical

1. Study of herbarium technique (Mounting of a properly dried and pressed specimen of any wild plant on sheet with complete herbarium label).
2. Taxonomic study of characters of 2 plants from each of the following families:
    (a) Malvaceae
    (b) Solanaceae,
    (c) Asteraceae
    (d) Fabaceace

    Classification according to the system of Bentham and Hooker.
3. Use of internet in identification of plants.

4. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
5. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
6. (a)Study of morphological adaptations of hydrophytes and xerophytes (four each).
   (b)Study of biotic interactions of the following: Stem parasite (Cuscuta), Symbiotic interaction: Root nodules, Epiphytes, Predation (Insectivorous plants)
7. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (Species to be listed)
8. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law

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References

1. Bhattacharyya, Bharati (2008). *Systematic botany*. New Delhi, Delhi: Narosa Publishing House.
2. Gurcharan Singh (2004). *Plant Systematics — Theory and Practice*. 2nd edition. New Delhi, Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
3. Kormondy, E.J. (1996). *Concepts of Ecology*. 4th edition. New Jersey, U.S.: Prentice Hall.
4. Sabamurty, A.V.V.S. (2005). *Taxonomy of Angiosperms*. New Delhi, Delhi: I.K. International Pvt. Ltd.
5. Simpson, M.C. (2006). *Plant Systematics*. Amsterdam, Netherlands: Elsevier.

Additional Resources:

6. Sharma, P.D. (2010). *Ecology and Environment*, 12th edition. Meerut, U.P.: Rastogi Publications.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and talk and chalk method. Students are encouraged to ask questions. The reading list has been suitably upgraded. A few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment. The students are asked to submit their record notebooks to the teacher/s for checking and evaluation

Weekly lesson plan

Week 1: Unit I

Week 2: Unit I

Week 3: Unit II
Week 4: Unit III
Week 5: Unit IV
Week 6: Unit V
Week 7: Unit VI
Week 8: Unit VII
Week 9: Unit VII
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VIII
Week 13: Unit VIII
Week 14: Unit IX
Week 15: Unit X

Assessment Methods

Theory: The students are continuously evaluated based on a written assignment, class test and/or presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a Assignment/PowerPoint presentation. All the students listen to the presentation of each student, and they are also encouraged to ask questions. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions. The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained are scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Systematics Aims, fundamental components of systematics description, identification, nomenclature,phylogeny, classification: artificial, natural and phylogenetic, biosystematics.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Herbarium- Methods and their roles, role of computers andinternet resources in identification; Keys,	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

	floras, monographs, manuals and journals.		
III	Taxonomic Hierarchy- Concept of taxa, categories and hierarchy.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Botanical Nomenclature- principles and rules; ranks and names, type method; authorcitation; valid publication; rejection of names, principle of priority and its limitations;names of hybrids and cultivars	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	System of classification: An outline of Bentham and Hooker's and Engler and Prantl'ssystems of classification and their merits and Demerits. APG-III	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Introduction to ecology, level of organization	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Soil: Origin, formation, composition, soil profile. Water: States of water in theenvironment, precipitation types. Light and temperature: Variation Optimal and limitingfactors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Biotic interactions	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	Plant communities Characters; Ecotone and edge effect; Succession; Processes and types.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit X	Ecosystem Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; biogeochemical cycling;carbon, nitrogen and Phosphorous cycle.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Environment, Soil, Water, Plant communities, Succession, Ecosystem, Phytogeography, Endemism, Plant taxonomy, Taxonomic hierarchy, Botanical Nomenclature, Classification, Biometrics

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Dissertation
(APLSD3)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To enhance the learning habit through the reading of literature and preparing of a manuscript

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Course Learning Outcomes

Students would gain the skill of understanding the conclusion of scientific data. The will bve able to analyze the data and have a gain good writing , presentation and communication skills,

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Unit 1

Students will select the topic/ unit in consultation with the teachers/ mentors and write a dissertation

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Unit 2

Unit 3

Unit 4

Unit 5

Unit 6

Practical

Experimental/ practical will be designed as per the topic of dissertation

References

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). *Introductory Mycology,* 4th edition. New Jersey, U.S.: John Wiley and Sons Inc.
2. Bhojwani, S.S., Bhatnagar, S.P. (2011). *The Embryology of Angiosperms,* 5th edition. New Delhi, Delhi: Vikas Publishing House.
3. Bhatnagar, S.P., Moitra, A. (1996). *Gymnosperms.* New Delhi, Delhi: New Age International (P) Ltd Publishers.
4. Fritsch, F.E. (1965). *The Structure and Reproduction of the Algae*. Vol.1,2. Cambridge, U.K.: Cambridge University Press.
5. Kumar, H.D. (1999). *Introductory Phycology,* 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.

Additional Resources:

6. Parihar, N.S. (1991). *An Introduction to Embryophyta.* Vol. I. Bryophyta. Prayagraj, U.P.: Central Book Depot.
7. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). *Biology*. New Delhi, Delhi: Tata McGraw Hill.
8. Singh, G. (2012). *Plant Systematics. Theory and Practice,* 3rd edition. New Delhi, Delhi: Oxform and IBH Pvt. Ltd.,
9. Sethi, I.K., Walia, S.K. (2011). *Text book of Fungi & Their Allies.* New Delhi, Delhi: MacMillan Publishers Pvt. Ltd.
10. Tortora, G.J., Funke, B.R., Case, C.L. (2010). *Microbiology: An Introduction,*10th edition. Denver, Colorado: Pearson Benjamin Cummings.
11. Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). *Pteridophyta.* New Delhi, Delhi: S. Chand & Company Pvt. Ltd.
12. Vashishta, B.R., Sinha, A.K., Kumar, A. (2011). *Bryophyta.* New Delhi, Delhi: S. Chand & Company Pvt. Ltd.
13. Webster, J., Weber, R. (2007). *Introduction to Fungi,* 3rd Edition.Cambridge, U.K.: Cambridge University Press.

Teaching Learning Process

Students will learn through the reading of the relevant literature, books article and research papers. They will analyze the data. Preparation of the dissertation will acquaint the student the writing and preparation of manuscript

Weekly lesson plan
Week 1: Selection of topics
Week 2: Literature survey
Week 3: Literature survey
Week 4: Preparation of subtopics
Week 5: Content writing
Week 6: Content writing
Week 7: Content writing
Week 8: Discussion
Week 9: Content writing
Week 10: Mid semester Presentation
Week 11: Mid Semester Break
Week 12: Checking of the manuscript
Week 13: Checking of the manuscript
Week 14: Editing of the manuscript
Week 15: Submission and presentation

Assessment Methods

Student will be assessed on the basis of the
Quality and coherence of content in the dissertation
Originality of the content
Language quality,
Writing skill
Quality of conclusion
Novelty
Presentation of the dissertation

Keywords

Dissertation, project, article, manuscript reference, material and methods, results, discussion conclusion

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Genetics and Plant Biotechnology
(APLSD1)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To have knowledge of Mendelian and non-Mendelian inheritance, Chromosome biology and structure and function of genes. To have understanding of structure and functions of DNA and RNA, models of DNA replication, prokaryotic and eukaryotic genome-structure, Central dogma and genetic code, transcription and gene silencing. Acquaintance of RNA processing and translation, protein synthesis and gene functions. Such knowledge is applied in the field of biotechnology

To give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including tissue culture for healthy plants, plants with improved characteristics. This course explores the use of biotechnology to both generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.

Understanding of biotechnological processes such as recombinant DNA technology and its applicative value in pharmaceuticals (vaccines, antibodies, antibiotics etc.), food industry (transgenic crops with improved qualities (nutraceuticals, industrial enzymes etc.), agriculture (biotic and abiotic stress tolerant plants, disease and pest resistant plants, improved horticultural varieties etc.), ecology (plants role in bioremediation). This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.

Course Learning Outcomes

To generate interest among the students in Genetics and make them aware about the importance and opportunities in higher education and research, the first unit should be Introductory dealing with how this area has revolutionised all aspects of our life from its growth from Mendel to Genetic Engineering. The first unit may include brief introduction of: Definition, Application of this field in Food production, Medicines, Industries, Bioinformatics, Genomics, Proteomics, Transcriptomics, System Biology to Personalised medicines.

The successful students will be able to learn the basic concepts, principles and processes in plant biotechnology. They will have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications.
Use basic biotechnological techniques to explore molecular biology of plants

Explain how biotechnology is used to for plant improvement and discuss the biosafety concern and ethical issue of that use.

Unit 1

Transmission Genetics: Mendel's laws of inheritance, allelic and non-allelic interactions, modified dihybrid ratios, polygenic inheritance, multiple alleles, extra nuclear inheritance. (10 Lectures)

Unit 2

Physical and Molecular Organization of Genetic Material — chromosomes, chromosome morphology, karyotype, idiogram, polytene and lampbrush chromosomes, nucleosome, DNA/RNA as genetic material, Watson and Crick's model, RNA types. (10 Lectures)

Unit 3

Mutations — spontaneous and induced mutations, mechanism of mutation, genomic mutations (aneuploidy, eupolyploidy), chromosomal aberrations. (10 Lectures)

Unit 4

Linkage and Crossing Over — complete and incomplete linkage, two-point and three point test cross, cytological basis of crossing over, Molecular basis of recombination; sex-linked inheritance. (6 Lectures)

Unit 5

Recombinant DNA Technology: Basics; Agrobacterium mediated gene transfer (4 Lectures)

Unit 6

GM plants: resistance to pathogens & pests, stress tolerance, golden rice, BT-cotton, flavor savor tomato. (8 Lectures)

Unit 7

Microbial and Industrial Biotechnology: production of antibiotics, alcohol, single cell proteins, enzymes, (4 Lectures)

Unit 8

Gene therapy, DNA Fingerprinting. (3 Lectures)

Unit 9

Ethics and Biosafety: public perception of biotechnology, ethical and biosafety issues. (5 Lectures)

Practical

1. Study of gene interaction/deviations from the Mendelian ratios using seed Samples in ratio of 9:7, 9:4:3, 9:6:1and 12:3:1.
2. To study of the karyotype of person with Down's, Turner's and Klinefelter's Syndrome.
3. Study of the organization of T-DNA and eukaryotic chromosome (through illustration).
4. Study of salivary gland and lampbrush chromosomes.
5. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.
6. Study of GM plants (Golden rice, Bt-cotton and flavor savor tomato)

References

1. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications.* Washington, U.S.: ASM Press.
2. Snustad, D.P., Simmons, M.J. (2010). *Principles of Genetics*, 5th edition. New Jersey, U.S.: John Wiley and Sons Inc.
3. Tortora, G.J., Funke, B.R., Case. C.L. (2007). *Microbiology*, 9th edition. San Francisco, California: Pearson Benjamin Cummings.

Teaching Learning Process

1) Problem oriented learning

2) Individual seminar
3) Presentation and interpretation to other students
4) Discussion of published research articles on the selected topics
5) Practical will introduce the students to a range of tools and techniques of biotechnology

Weekly lesson plan
Week 1: Unit I
Week 2: Unit I
Week 3: Unit II
Week 4: Unit III
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Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VII
Week 13: Unit VIII
Week 14: Unit VIII
Week 15: Unit IX

Assessment Methods

Assessment will be by written class test, assignment, project work, viva for internal assessment and written theory and practical examination for university evaluation.
Assessment method

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Transmission Genetics: Mendel's laws of inheritance, allelic and non-allelic interactions, modified dihybrid ratios, polygenic inheritance, multiple alleles, extra nuclear inheritance.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Physical and Molecular Organization of Genetic Material — chromosomes, chromosome morphology, karyotype, idiogram, polytene and lampbrush chromosomes, nucleosome, DNA/RNA as genetic material, Watson and Crick's model, RNA types.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

III	Mutations — spontaneous and induced mutations, mechanism of mutation, genomic mutations (aneuploidy, eupolyploidy), chromosomal aberrations.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Linkage and Crossing Over — complete and incomplete linkage, two-point and three point test cross, cytological basis of crossing over, Molecular basis of recombination; sexlinked inheritance.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Recombinant DNA Technology: Basics; Agrobacterium mediated gene transfer	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	GM plants: resistance to pathogens & pests, stress tolerance, golden rice, BT-cotton, flavor savor tomato.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Microbial and Industrial Biotechnology: production of antibiotics, alcohol, single cell proteins, enzymes,	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Gene therapy, DNA Fingerprinting.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	Ethics and Biosafety: public perception of biotechnology, ethical and biosafety issues.		

Keywords

Inheritance theory, linkage, crossing over, chromosome mapping, cytology, Gene, Gene mutation, Population genetics

Plant Regulators and Economic Botany
(APLSD2)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

The course aims at making students realize how plants functions are regulated by the hormones, and plant growth and development are influenced

To gain the knowledge on the economically important of plants, their life cycle, processing, plant part used, application of biotechnology for the production of plant resources and production of new varieties

Course Learning Outcomes

Understanding of the role of growth regulators in plant growth and development. The will be apply this knowledge for desired seed germination, plant growth , initiation of flowering and fruiting.

Understanding of morphology,and processing and economic value of plant sources of cereals, legumes,spices, oil, rubber, timber and medicines. Student would have an ability to estimate the value of plants and can apply this knowledge for sustainable use of plant resources, conservation and management.

Unit 1

Chemical Regulation of Growth and Development (5 lectures)
Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.

Unit 2

Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid. (20 lectures)

Unit 3

Origin of Cultivated Plants (4 Lectures)
Concept of centres of origin, their importance with reference to Vavilov's work

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Unit 4

Cereals (4 Lectures)
Wheat -Origin, morphology, uses

Unit 5

Legumes (4Lectures)
General account with special reference to Gram and soybean

Unit 6

Spices (6 Lectures)
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Unit 7

Beverages (4Lectures)
Tea (morphology, processing, uses)

Unit 8

Oils and Fats (5 Lectures)
General description with special reference to groundnut

Unit 9

Fibre Yielding Plants (8 Lectures)

General description with special reference to Cotton and Jute (Botanical name, family, part used, morphology and uses)

Practical

1. To study the role of ABA in leaf senescence
2. To study the role of ethylene in fruit ripening.
3. To study the effect of gibberellins in bolting of floral axis.(through photograph)
4. To study and comments (Botanical name, family, part used, morphology and uses) of economically important plants through specimens, sections and micro chemical tests:

a. Wheat,
b. Gram,
c. Soybean,
d. Black pepper & Clove,
e. Tea,
f. Cotton & Jute,
g. Groundnut.

References

1. Hopkins, W.G. and Huner, A. (2008). *Introduction to Plant Physiology*. 4th edition. New Jersey, U.S.: John Wiley and Sons Inc.
2. Kochhar, S.L. (2011). *Economic Botany in the Tropics*. 4th edition. New Delhi, Delhi: MacMillan Publishers India Ltd.
3. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). *Plant Physiology and Development*. 6th edition. Suderland, Massachusetts: Sinauer Associates Inc.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.
When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.
Weekly lesson plan
Week 1: Unit I

Week 2: Unit I
Week 3: Unit II
Week 4: Unit II
Week 5: Unit III
Week 6: Unit IV
Week 7: Unit V
Week 8: Unit VI
Week 9: Unit VII
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VIII
Week 13: Unit VIII
Week 14: Unit X
Week 15: Unit IX

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.
Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.
The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained are scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Chemical Regulation of Growth and Development (5 lectures) Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	chemical nature (basic structure),	Class room lectures and	Hands on exercises,

	bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.	Practical demonstration, experiments	PPT, assignments, tests
III	Origin of Cultivated Plants, Concept of centres of origin, their importance with reference to Vavilov's work	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Wheat -Origin, morphology, uses	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	General account with special reference to Gram and soybean	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Tea (morphology, processing, uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	General description with special reference to groundnut	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	General description with special reference to Cotton and Jute (Botanical name, family, part used, morphology and uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Plant growth regulators, photoperiodism, photomorphogenesis, Vavilov, Cultivated plants, , Wheat, Gram , soyabean, spices, Tea, cotton, groundnut,

Medicinal Plants and Intellectual Property Rights
(APLSS1)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To introduce students to complementary and alternative medicine and provide them an opportunity

To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals

To inculcate awareness about the rich diversity of medicinal plants in India.

To have knowledge of roles regulations, laws and processes of patents, copyright trademarks and concepts of traditional knowledge and protection of plant varieties

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Course Learning Outcomes

Knowledge Skills

An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.

To develop an understanding of the constraints in promotion and marketing of medicinal plants.

Professional and Practical Skills

Transforming the knowledge into skills for promotion of traditional medicine.

Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

Students would have deep understanding of patents copyrights, their importance. Thy can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions

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Unit 1

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences (2 lectures)

Unit 2

Ethnobotany and Folk medicines. Applications of Ethnobotany (2 lectures)

Unit 3

Medicinal plants: Botanical names, vernacular names, Morphology of the plant part of medicinal importance and uses with reference to*Cinchona, Digitalis, Papaver, Withania, Rauwolfia, Artemisi*a, and*Cannabis*

Unit 4

Introduction to intellectual property right (IPR) Concept and kinds.Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO). (2 lectures)

Unit 5

Patents: Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement; Copyrights: Works protected under copyright law, Rights, Transfer of Copyright, Infringement;Trademarks ,introduction, Types, Rights, Protection of goodwill, Infringement (6 Lectures)

Unit 6

Concept of Traditional Knowledge, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level. (3 Lectures)

Unit 7

Industrial Designs, Geographical Indications (only brief introduction) (2 Lectures)

Unit 8

Protection of Plant Varieties Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India.Rights of farmers, Breeders and Researchers.National gene bank, Benefit sharing.Protection of Plant Varieties and Farmers' Rights Act, 2001. (3 Lectures)

Unit 9

Biotechnology and Intellectual Property Rights. Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues (4 Lectures)

Practical

1. Study of the medicinal plants with their botanical names, vernacular names, family, plant parts used, active ingredients and uses. For Example; *Withaniasomnifera*, *Ocimumscantum, Azadirachtaindica, Plactranthusamboi nicus*, *Raulfiaserpintena, Digitilis spp., Cinchona spp., Papaversomniferum, Artemisia annua, Cannabis sativa* etc.
2. Patent procedure in India.
3. Literature survey of some Ethnobotanical journals.
4. Questionnaire for collecting information on Ethnobotany.
5. Field survey and collection of information on ethnobotanical uses from traditional healers (any two).
6. To study trademark and logo survey of any five brands which uses plants or their product as their logo or trade mark.
7. Submission of five herbarium plants of medicinal importance.
8. Biopiracy (Neem/turmeric)

References

1. Acharya, N.K. (2001).*Text Book on Intellectual Property Rights: (copyright, Trademark, Patent Design, Geographical Indications, Protection of New Plant Varieties & Farmers Rights and Protection of Biodiversity).*
2. Bhandari. M.K. (2017) Law Relating to Intellectual Property Rights (IPR). Prayagraj, U.P.: Central Law Publications.

3. Chaudhry, B. (2019). *A Handbook of Common Medicinal Plants Used in Ayurveda*. New Delhi, Delhi: Kojo Press.
4. Gokhale, S.B. Kokate, C.K. (2009). *Practical Pharmacognosy*. Pune, Maharashtra: NiraliPrakashan.
5. Purohit and Vyas (2008). *Medicinal Plant Cultivation: A Scientific Approach*, 2nd edition. Jodhpur, Rajasthan: Agrobios.
6. SP Gogia. *Textbook On Intellectual Property Rights (IPR) For B.S.L & L.L.B*. Pune, Maharashtra: Asia Law House.

Additional Resources:

7. Trivedi, P.C. (2006). *Medicinal Plants Traditional Knowledge*. New Delhi, Delhi: I.K. International Publishing House Pvt. Ltd.
8. Trivedi, P.C.(2009). *Medicinal Plants. Utilisation and Conservation*. Jaipur, Rajasthan: Aavishkar Publishers.
9. William C. E.(2010). *Trease and Evans's Pharmacognosy*. 16 th Edition. Nottingham, England: Saunders Ltd.

Teaching Learning Process

To encourage innovation, to link theoretical knowledge with practical training and application of knowledge to find practical solutions to the challenges encountered in the field of traditional medicine.

To hold regular and structured workshops, seminars, field trips, collaboration with Research institutions, Industry and other Government Organizations, in order to facilitate peer learning and skill enhancement.

To complement classroom teaching with discussions, presentations, quizzes,interpretation of results, short projects, writing project reports and field exposure.
Weekly lesson plan
Week 1: Unit I
Week 2: Unit II
Week 3: Unit III
Week 4: Unit III
Week 5: Unit IV
Week 6: Unit V
Week 7: Unit VI
Week 8: Unit VI
Week 9: Unit VII
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VIII
Week 13: Unit VIII
Week 14: Unit IX
Week 15: Unit IX

Assessment Methods

Continuous Evaluation
(Project/ E-presentation:10 marks, Lab Records :
Attendance in Practicals
Practical Examination:

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Ethnobotany and Folk medicines. Applications of Ethnobotany	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Medicinal plants: Botanical names, vernacular names, Morphology of the plant part of medicinal importance and uses with refrence to Cinchona, Digitalis, Papaver, Withania, Rauwolfia, Artemisia, andCannabis	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Introduction to intellectual property right (IPR) Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Patents: Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement; Copyrights: Works protected under copyright law, Rights, Transfer of Copyright, Infringement;Trademarks ,introduction, Types, Rights, Protection of goodwill, Infringement	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Concept of Traditional Knowledge, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

	Knowledge on the International Arena, at WTO, at National level.		
VII	Industrial Designs, Geographical Indications (only brief introduction)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Protection of Plant Varieties Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers.National gene bank, Benefit haring.Protection of Plant Varieties and Farmers' Rights Act, 2001.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	Biotechnology and Intellectual Property Rights. Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Medicinal plants, Ayurveda, Siddha, Unani,Holistic healing, Phytochemicals, Pharmacognosy, Polyherbals, Conservation, Propagation.Patents, IPR, Copyrights,trademarks, geographical indicators, traditional knowledge, industrial design, plant varieties, novelty, biotechnology

Plant Health Diagnostics and Management
(APLSS3)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

1. To introduce students with various pathogenic fungi, bactaria and viruses
2. To introduce students with the phytopathology, its concepts and principles
3. To acquaint with various plant diseases, causal organisms and their control

Course Learning Outcomes

On completion of his course the students will develop an

1. Understanding of the various fungal bacterial and virus disease of the plants
2. Understanding and identification of symptoms of plant disease
3. ability to develop the strategy to prevent and control of plant diseases

Unit 1

Plant Pathology (10 lectures)
Importance, concepts and types of plant disease symptoms, causes and classification of diseases.assessment, Diagnosis, Identification of casual organism by Koch postulates, principles of plant disease control,

Unit 2

Histo-chemical and Serological methods of studying plant pathogens, Modern techniques in analysis of plant diseases.

Unit 3

Plant disease Epidemiology, dissemination factors affecting the development of epidemics, Disease forecasting. Plant disease epidemic assessment. Transmission and Control of Plant Diseases

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Unit 4

Causal organism, symptomatology, disease cycle, prevention and control of the following fungal diseases:-
White rust of crucifers
Late blight of potato
Downy mildews
Powdery mildews
Rusts of wheat
Smut of wheat and barley

Unit 5

Bacterial Diseases (4 lectures)- Causal organism, symptomatology, prevention and control of the following
Citrus canker
Angular leaf spots of cotton

Unit 6

Viral Diseases – (4 lectures) -Causal organism symptomatology, prevention and control of the following viral diseases
Tobacco mosaic
Yellow mosaic of soybean

Practical

1. Photographs:
   (i) Powdery scab/Apple scab
   (ii) Tuber Rot
   (iii) Black wart of Potato
   (iv) Chlorosis
   (v) Disease Forcasting

2. *Albugo* – Specimen/Photograph showing symptoms of white rust of crucifers and hypertrophy. Study of asexual stage through section/temporary mount.
3. *Phytopthora* – Specimen/Photograph showing symptoms of Late blight of potato. Temporary tease mount of infected potato leaf and permanent slides/photographs to study asexual stage.
4. *Peronospora* – Specimen/Photograph showing symptoms of Downy mildew on pea or any other crucifers. Temporary tease mount of infected leaf and photographs to study asexual stage.
5. *Erysiphae* – Specimen/Photographs showing symptoms of Powdery mildew of pea. Temporary tease mount of infected leaf and permanent slides/Photographs to study asexual and sexual stages.
6. *Puccinia* – Specimen of Black stem rust of wheat and infected Barberry leaves. Sections/Mounts of spores on wheat and permanent slides/Photographs of both the hosts.
7. *Ustilago* – Specimen of Loose smut of wheat and Covered smut of Barley. Temporary mount of smut teliospores.
8. Herbarium specimens/Photographs of
9. A: Bacterial diseases
   (i) Citrus canker
   (ii) Angular leaf spot of cotton
10. B: Viral diseases
   (i) Tobacco mosaic disease
   (ii) Yellow vein mosaic of bhindi

References

1. Agrios,G. N. (2005). *Plant Pathology*. New York, NY: Academic Press.
2. Mehrotra, R. S.(2003). *Plant Pathology*. New Delhi, Delhi: Tata McGraw Hill.
3. Sharma, O. P. (2011). *Textbook of Fungi*. New Delhi, Delhi: Tata McGraw Hill.
4. Singh R. S. (2017). *Plant Diseases.* New Delhi, Delhi: Oxford and IBH.

Teaching Learning Process

To engage students and transform them into active learners the students are updated with latest books and review articles.

The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections.
Weekly lesson plan
Week 1: Unit I
Week 2: Unit I
Week 3: Unit II
Week 4: Unit II

Week 5: Unit III
Week 6: Unit III
Week 7: Unit IV
Week 8: Unit IV
Week 9: Unit IV
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit V
Week 13: Unit V
Week 14: Unit VI
Week 15: Unit VI

Assessment Methods

The students are assessed on the basis of oral presentations and regular class tests.

Students are continuously assed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

Assessment method

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Plant Pathology (10 lectures) Importance, concepts and types of plant disease symptoms, causes and classification of diseases. assessment, Diagnosis, Identification of casual organism by Koch postulates, principles of plant disease control,	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Histo-chemical and Serological methods of studying plant pathogens, Moderntechniques in analysis of plant diseases.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Plant disease Epidemiology, dissemination factors affecting the development ofepidemics, Disease forecasting. Plant disease epidemic assessment. Transmission andControl of Plant Diseases	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Causal organism, symptomatology, disease cycle, prevention and	Class room lectures and Practical demonstration,	Hands on exercises, PPT, assignments, tests

	control of the followingfungal diseases:- White rust of crucifers Late blight of potato Downy mildews Powdery mildews Rusts of wheat Smut of wheat and barley	experiments	
V	Bacterial Diseases - Causal organism, symptomatology, prevention and control of the following Citrus canker Angular leaf spots of cotton	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Viral Diseases – -Causal organism symptomatology, prevention and controlof the following viral diseases Tobacco mosaic Yellow mosaic of soybean	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Plant disease,causal organisms, serological methods, plant pathogens, epidemiology,, rust, smut, blight,, powdery mildews, citrus canker, symptomatology, tobacco mosaic.

Plant Quarantine
(APLSS2)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To acquaint the students with the Plant Quarantine Information System (PQIS)

To have the knowledge of export and import policies of Germplasm, Transgenic or Genetically Modified Organisms and live organism

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Course Learning Outcomes

Students would have deep understanding of
1. Plant Quarantine Order and Amendments, and Issuance of the export and Import Permit,
2. Procedures of Plant quarantine inspection for clearance
3. The need of quarantine of Germplasm, Transgenic or Genetically Modified Organisms, live insects and microbial cultures, plants and plant products.
4. The laws associated with various acts of plant quarantine

Unit 1

Plant quarantine: Introduction to Plant Quarantine Information System (PQIS) and objective (3 lectures)

Unit 2

Imports: Plant Quarantine Order and Amendments, Issuance of the Import Permit, Import inspection and clearance, Procedures of PEQ inspection, Time schedules for clearance, Permits required for import of Germplasm, Transgenic or Genetically Modified Organisms, live insects and microbial cultures, plants and plant products, Requirement of Import of Wood and Timber: Special conditions of Import Special conditions for import of plant species. (8 lectures)

Unit 3

Exports: Export inspection and certification procedure: Time schedules for clearance, Fees and Charges, Circular issued to Export Certification Authorities. (5 lectures)

Unit 4

Post-entry Quarantine: Appeal and Revision, Power of Relaxation, issuance of import permit, import inspection, inspection authorities Fees and charges, commodities not requiring Plant Quarantine clearance (4 lectures)

Unit 5

Phytosanitary: Phytosanitary Agreement, national standards for phytosanitary measures, accredit treatment facilities, Quarantine Disinfestation Treatment (5 lectures)

Unit 6

Laws: The Destructive Insects and Pests Act, 1914 and amendments, The Plant Quarantine Order 2003 - Amendments, International Plant Protection Convention, WTO-SPS Agreement, International Standards on Phytosanitary Measures (ISPMs) (5 lectures)

Practical

1. Learning of various techniques (conventional and modern)for the detection identification of parasite, saprophytes, microorganisms, pests
2. Dry seed examination , soaked examination, incubation test
3. Learning of various techniques of salvaging of infested/ infected/ contaminated germplasm Mechanical cleaning, hot water treatment, alcohol wash
4. Steps involved for processing of Quarantine Order
5. Visit of Plant quarantine station and preparation of report
6. Preparation of report and certificate with the help of case studies

7. Inspection report , photosanitary certificate , import permit , clearance certificate

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References

1. Muthaiyan, M.C. (2009). *Principles and Practices of Plant Quarantine.* Lucknow, U.P.: Allied publishers private limited.

Teaching Learning Process

To engage students and transform them into active learners the students are updated with latest books and review articles.

The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections.

Weekly lesson plan
Week 1: Unit I
Week 2: Unit I
Week 3: Unit II
Week 4: Unit II
Week 5: Unit III
Week 6: Unit III
Week 7: Unit III
Week 8: Unit IV
Week 9: Unit IV
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit IV
Week 13: Unit V
Week 14: Unit VI
Week 15: Unit VI

Assessment Methods

The students are assessed on the basis of oral presentations and regular class tests.

Students are continuously assessed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

Assessment method

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Plant quarantine: Introduction to Plant Quarantine Information System (PQIS) and Objective	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Unit 2 Imports: Plant Quarantine Order and Amendments, Issuance of the Import Permit, Import inspection and clearance, Procedures of PEQ inspection, Time schedules for clearance, Permits required for import of Germplasm, Transgenic or Genetically Modified Organisms, live insects and microbial cultures, plants and plant products, Requirement of Import of Wood and Timber: Special conditions of Import Special conditions for import of plant species. (8 lectures)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Exports: Export inspection and certification procedure: Time schedules for clearance, Fees and Charges, Circular issued to Export Certification Authorities.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Post-entry Quarantine: Appeal and Revision, Power of Relaxation, issuance of import permit, import inspection, inspection authorities Fees and charges, commodities not requiring Plant Quarantine clearance	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Phytosanitary: Phytosanitary Agreement, national standards for phytosanitary	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	Laws: The Destructive Insects and Pests Act, 1914 and amendments, The Plant Quarantine Order 2003 - Amendments, International Plant	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

	Protection Convention, WTOSPS Agreement, International Standards on Phytosanitary Measures (ISPMs)		

Keywords

PQIS,Import permit, import inspection, Germplasm, transgenic, genetically modified organisms,Import of species,Post-entry, Quarantine, Phytosanitary, Destructive Insects and Pests Act, Plant Protection Convention, WTO-SPS Agreement

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Plant Regulators and Economic Botany
(APLSS4)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

The course aims at making students realize how plants functions are regulated by the hormones, and plant growth and development are influenced

To gain the knowledge on the economically important of plants, their life cycle, processing, plant part used, application of biotechnology for the production of plant resources and production of new varieties

Course Learning Outcomes

Students will have an understanding of the role of growth regulators in plant growth and development. They will be apply this knowledge for desired seed germination, plant growth, initiation of flowering and fruiting.

Understanding of morphology,and processing and economic value of plant sources of cereals, legumes,spices, oil, rubber, timber and medicines. Student would have an ability to estimate the value of plants and can apply this knowledge for sustainable use of plant resources, conservation and management.

Unit 1

Chemical Regulation of Growth and Development (5 lectures)

Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.

Unit 2

Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid. (20 lectures)

Unit 3

Origin of Cultivated Plants (4 Lectures)
Concept of centres of origin, their importance with reference to Vavilov's work

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Unit 4

Cereals (4 Lectures)
Wheat -Origin, morphology, uses

Unit 5

Legumes (4Lectures)
General account with special reference to Gram and soybean

Unit 6

Spices (6 Lectures)
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Unit 7

Beverages (4Lectures)
Tea (morphology, processing, uses)

Unit 8

Oils and Fats (5 Lectures)

General description with special reference to groundnut

Unit 9

Fibre Yielding Plants (8 Lectures)
General description with special reference to Cotton and Jute (Botanical name, family, part used, morphology and uses)

Practical

1. To study the role of ABA in leaf senescence
2. To study the role of ethylene in fruit ripening.
3. To study the effect of gibberellins in bolting of floral axis.(through photograph)
4. To study and comments (Botanical name, family, part used, morphology and uses) of economically important plants through specimens, sections and micro chemical tests:
   a. Wheat,
   b. Gram,
   c. Soybean,
   d. Black pepper & Clove,
   e. Tea,
   f. Cotton & Jute,
   g. Groundnut.

References

1. Hopkins, W.G. and Huner, A. (2008). *Introduction to Plant Physiology*. 4th edition. New Jersey, U.S.: John Wiley and Sons Inc.
2. Kochhar, S.L. (2011). *Economic Botany in the Tropics*. 4th edition. New Delhi, Delhi: MacMillan Publishers India Ltd.
3. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). *Plant Physiology and Development*. 6th edition. Suderland, Massachusetts: Sinauer Associates Inc.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.
When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are

discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

Weekly lesson plan
Week 1: Unit I
Week 2: Unit I
Week 3: Unit II
Week 4: Unit II
Week 5: Unit III
Week 6: Unit IV
Week 7: Unit V
Week 8: Unit VI
Week 9: Unit VII
Week 10: Mid semester Exam
Week 11: Mid Semester Break
Week 12: Unit VIII
Week 13: Unit VIII
Week 14: Unit X
Week 15: Unit IX

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.
Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.
The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained are scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Chemical Regulation of Growth and Development (5 lectures)	Class room lectures and Practical demonstration,	Hands on exercises, PPT, assignments, tests

	Role of hormones in plant growth and development, commercial applications of growth regulators, growth retardant and its usefulness.	experiments	
II	Chemical nature (basic structure), bioassay and physiological roles of Auxin,Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Origin of Cultivated Plants, Concept of centres of origin, their importance with reference to Vavilov's work	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Wheat -Origin, morphology, uses	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	General account with special reference to Gram and soybean	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VI	General account with special reference to clove and black pepper (Botanical name,family, part used, morphology and uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Tea (morphology, processing, uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	General description with special reference to groundnut	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IX	General description with special reference to Cotton and Jute (Botanical name, family,part used, morphology and uses)	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Plant growth regulators, photoperiodism, photomorphogenesisVavilov, Cultivated plants, Wheat, Gram ,soyabean, spices, Tea, cotton, groundnut,

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