GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

COIMBATORE-641 018

Learning outcomes-based Curriculum Framework (LOCF)
for

M.Sc. BOTANY

(Effective from the Academic year 2021-2022)

POSTGRADUATE AND RESEARCH DEPARTMENT

OF BOTANY

MAY-2021

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Preamble

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome-based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome-based curriculum will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

Tamil Nadu State Council for Higher Education (TANSCHE) has formed the State Integrated Board of Studies with great diligence and expertise has devised the mandatory areas that have to be covered for three-year under graduation and two-year postgraduation courses to realize the facilitation of the mobility of faculty and students from one university to another and to easily solve the problem of equivalence among courses. Greatcare has been taken so that these areas would take 75% of the course content and the remaining25% can be decided by the individual institutions. The areas that must be covered by the studentthat are mandatory for earning the degree to have due value has been worked out so that the student will gain enough depth of knowledge in the subject concerned. 25% percent of the syllabus should be designed by the institutions, and the areas covered under this also must havea weightage of 25%. This gives the autonomous institution seamless liberty on every Board ofStudies (BOS) to innovate and experiment, and more importantly, it is here that the institution devises appropriate strategies by which (i) to make creative and critical applications of what has been learnt in the mandatory components, and (ii) to meaningfully connect the learners tothe career demands and expectations. It is essential that the theoretical subject knowledge of the students must be translated into practical hands-on experience.

One of the significant reforms in the postgraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the students to ensure similar quality of education irrespective of the institute and location.

With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for Master's programme in colleges, universities and HEIs in general. A Core Expert Committee (CEC) was constituted to formulate the modalities for developing the LOCF in various subjects being taught in the Postgraduate courses in sciences, humanities, commerce and professional courses. The CEC also constituted the Subject Expert Committees (SEC) in various subjects to prepare detailed guidelines for the LOCF in subjects concerned.

The key components of the planning and development of LOCF are given in terms of clear and unambiguous description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) to be achieved at the end of the successful completion of each Postgraduate program to be offered by HEIs. In Postgraduate education in Botany, the programme of study leading to the degree of M.Sc. in Botany is discussed herewith.

The Qualification Descriptors (QD), Program Learning Outcomes (PLO) and the Course Learning Outcomes (CLO) were also finalized keeping the broad requirement of the programme in view. The LOCF also gives general guidelines for the Teaching Learning Process (TLP) corresponding to each component of theory, experiment, tutorials, projects and industrial / field visits to be followed in order to achieve the stated outcomes for each component. Finally, some suggestions for using various methods in the assessment and evaluation of learning levels of students are also made.

1 INTRODUCTION

This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student-centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid rote -learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for botany-related careers, careers with the general graduate-level aptitude and for higher education in Botany and allied subjects.

Augmented in this framework are graduate attributes including critical thinking, basic psychology, scientific reasoning, moral-ethical and so on, qualification descriptors that are specific outcomes pertinent to the discipline of botany, learning outcomes that have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods. While designing these frameworks, emphasis is given on the objectively measurable teaching-learning outcomes to ensure the employability of the graduates.

In line with recent trends in education section, these frameworks foster the implementationof modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. In addition, the framework is pragmatic to the core; it is designed in sucha way to enable the learners to implement the concepts to address real-world problems. A major emphasis of these frameworks is that the curriculum focuses on issues pertinent to Indiaand also of the west; for example, biodiversity and conservation of endemic and threatened species that are found in India, Indian climatological variables, Indian biodiversity and so on. Above all, these frameworks are holistic and aim to mould responsible Indian citizen who haveadequate skills in reflective thinking, rational skepticism, scientific temper, digital literacy andso on such that they are equipped to fight immediate social issues apropos to Indian milieu, including corruption and inequity.

Aims:

1. To transform curriculum into outcome-oriented scenario
2. To develop the curriculum for fostering discovery-learning
3. To equip the students in solving the practical problems pertinent to India
4. To adopt recent pedagogical trends in education including e-learning, flipped class, hybrid learning and MOOCs

5. To mold responsible citizens for nation-building and transforming the country towardsthe future

1.1 Types of courses and Course structure

Each program may have three types of courses namely Core courses, Elective courses and Self-study/Skill-based courses

1.1.1 Core Courses

The Core courses are those courses whose knowledge is deemed essential for the students registered for a particular Master's degree program. Where feasible and necessary two or more programs may prescribe one or more common core courses.

- The core courses shall be mandatory for all the students registered for the Master's degree program.
- The core courses shall be spread all the semesters of the program.

2.1 Elective courses

The elective courses can be chosen from a pool of papers. These courses are intended to

- allow the student to specialize in one or more branches of the broad subject area;
- help the student to acquire knowledge and skills in a related area that may have applications in the broad subject area;
- help the student to bridge any gap in the curriculum and enable acquisition of essential skills, for example, statistical, computational, language, communication skills etc.
- help the student to pursue area of interest
- The student may also choose additional elective courses offered by the college to enable him /her to acquire extra credits from the discipline or across the discipline

3.1 project work

A course (core/elective/self-study/skill based) may take the form of a project work.

2 LEARNING OUTCOMES BASED APPROACH TO CURRICULUM PLANNING AND DEVELOPMENT IN MSc. BOTANY PROGRAMME

Curriculum is the heart of any educational system. It can be focused either to achieve the objectives of each course of the programme or on the expected learning outcomes from each course. The objective based curriculum refers to the overall targets to be achieved through the curriculum which may be long term or immediate. On the other hand, the learning outcome based curriculum is very specific in nature in terms of changes in the cognitive, effective and psychomotor behavior of the students as a result of their exposure to the curriculum. The outcome based curriculum provides the teacher very specific targets which he can achieve through the selected instructional process as compared to the objective based curriculum whichprovides general outcomes.

The learning outcome based curriculum has a very close relationship with the learning ofthe students whereas objective based curriculum focusses on only providing knowledge to thestudents. In other words, higher cognitive skills are developed through learning outcome basedcurriculum. Hence, it is preferred to develop learning outcome based curriculum which will provide specific directions to the teacher with respect to the transaction process and expected changes in the behavior of the students as well.

2.1 Nature and extent of the M.Sc Botany Programme

Botany, as traditionally delimited epistemologically, is the broad discipline encompassing various subjects involved with the study of plants. Emphasis has been shifted to modern science at the cost of traditional botany. This shift is discussed at various forums. There is a need to balance the traditional botany and upcoming modern computational and applied approach. In view of above, adequate balance of topics is proposed displaying latest APG IV based phylogenetic systematics of plants covering higher plants, lower plants, aquatic (fresh and marine water) plants, nature/ field study, functional Genomic aspects of various cellular processes of plants, molecular genetics and modern tools i.e. tissue culture, genetic engineering and computational studies, reverse pharmacognostic studies are required to be introduced at postgraduate level.

This modified syllabus has been drafted to enable the students to equip for national level competitive exams. To ensure implementation of a holistic pedagogical model, several allied disciplines are covered/introduced in this framework, including Chemistry, Statistics,

Physics, Informatics and a number of generic electives. In addition, employability of M.Sc. Botany graduate is given due importance such that their core competency in the subject matter, both theoretical and practical, is ensured. To expand the employability of graduates, a number of skill development courses are also introduced in this framework.

Aims of Master's degree programme in Botany

The broad aims of the Master's degree programme in Botany are:

1.To provide an environment that ensures cognitive development of students in a holistic manner. A dialogue about plants and its significance is fostered in this framework, rather than didacticmonologues on mere theoretical aspects

2.To provide the latest subject matter, both theoretical as well as practical, such a way to fostertheir core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies and begin domain-related employment.

3.To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.

4.To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

3 GRADUATE ATTRIBUTES IN MSc. BOTANY

The student graduating with the Degree M.Sc Botany should be able to acquire

- **Core competency**: Students will acquire core competency in the subject Botany, and in allied subject areas.
- The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.
- Students will be able to use the evidence based comparative botany approach to explain the evolution of organism and understand the genetic diversity on the earth.
- The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome and how organism's function is influenced at the cell, tissue and organ level.
- Students will be able to understand the adaptation, development and behavior of different forms of life.
- The understanding of network of life on earth and tracing the energy pyramids through nutrient flow is expected from the students.
- Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.
- **Analytical ability:** The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.
- Application of various scientific methods to address different questions by formulating the hypothesis, data collection and critically analyzing the data to decipher the degree to which their scientific work supports their hypothesis.
- **Critical Thinking and problem-solving ability:** An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem solving capabilities.
- **Digitally equipped:** Students will acquire digital skills and integrate the fundamental concepts with modern tools.
- **Ethical and Psychological strengthening:** Students will also strengthen their

ethical and moral values and shall be able to deal with psychological weaknesses.

- **Team Player:** Students will learn team workmanship in order to serve efficiently in the institutions, industry and society.
- **Independent Learner:** Apart from the subject specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations and employment. Learning outcomes based curriculum would ensure equal academic standards across the country and broader picture of their competencies.

4 QUALIFICATION DESCRIPTORS IN M.Sc BOTANY PROGRAMME

The qualification descriptors for a Master's degree in Botany may include following: (vii) Apply one's knowledge and understanding of Botany to new/unfamiliar contexts and to identify problems and solutions in daily life

(i) To demonstrate a systematic, extensive and coherent knowledge and understanding of academic fields of study as a whole and its applications and links to disciplinary areas of the study; including critical understanding of the established theories, principles and concepts of a number of advanced and emerging issues in the field of Botany.

(ii) To demonstrate procedural knowledge that creates different types of professionals in the field of Botany i.e. research and development, teaching government and public services. Further application of knowledge can enhance productivity of several economically important product/botanicals. Knowledge of Botany is also necessary for the development and management of forests, parks, wastelands and sea wealth.

(iii) Develop skills and ability to use knowledge efficiently in areas related to specializations and current updates in the subject.

(iv) Demonstrate comprehensive knowledge about plants, current research, scholarly and professional literature of advanced Learning areas of Botany

(v) Use, knowledge, understanding and skills for critical assessment of wide range of ideas and problems in the field of Botany

(vi) Communicate the results of studies in the academic field of Botany using main concepts, constructs and techniques

(vii) Apply one's knowledge and understanding of Botany to new/unfamiliar contexts and to identify problems and solutions in daily life

5 PROGRAMME LEARNING OUTCOMES IN MSc. BOTANY

The programme learning outcomes to M.Sc. Degree in Botany

- will be able to demonstrate:

(i) a systematic, extensive and coherent knowledge and understanding of **Botany** as a whole and its applications and links to disciplinary areas of the study; including critical understanding of the established theories, principles and concepts of a number of advanced and emerging areas in the field of Botany such as Plant diversity, Plant Molecular development biology, Functional plant biology and their coexistence in nature interacting with various factors in the changing environment since the origin of life to present time.

(ii) the procedural knowledge that creates different types of professionals in the field of Botany like in research and development, teaching government and public services for example, conservationist, plant explorer, ecologist, horticulturist, plant biochemist, genetics, nursery manager, molecular biologist, plant pathologist, taxonomist, farming consultant and environmental consultant. Further application of knowledge can enhance productivity of several economically important product/botanicals. Knowledge of Botany is also necessary for developing and managing forests, parks, wastelands, and sea wealth.

(iii) practical skills related to specialization area(s) within botany as well within the subfields of botany (Plant diversity, Plant Molecular development biology, Functional plant biology), and other related fields of study, including broader interdisciplinary subfields (chemistry, agricultural and environmental sciences);

(iv) Use, knowledge, understanding and skills to identify the problems faced by various plants and plant communities today and assessment of wide range of ideas and solutions from scholarly and professional literature of advanced learning in the field of Botany such as crop improvement, plant conservation and sustainable ecosystem management.

(v) Communicate the results of studies in the academic field of Botany using main concepts, constructs and techniques to the people for the transfer of knowledge, science and technology from laboratory to the field.

(vi) Apply the disciplinary knowledge and transferable skills for taxonomical identification of suitable medicinal plants and suggest well-defined solutions to common health issues as a complementary and alternative medicine.

(vii) Employ biochemical techniques relevant to academia, industry and government, and generic skills and global competencies, including relevant disciplinary knowledge and skills that enable to undertake further studies in the field of botany or multidisciplinary areas such as biotechnology, biochemistry, bioinformatics, biostatistics, etc, and apply standard methodology to the solution of problems in biology in general and botany in particular.

(viii) Undertake hands on lab work and activities that help develop practical knowledge and skills, that are required for pursuing career in agricultural, horticultural, phytopharmaceutical industry, teaching, research, environmental monitoring, quality control, consumer goods industry, food products, cosmetics industry, etc. and skills for working safely and competently in the laboratory.

(ix) To think of the adopting expertise in plant structure, functions and solve the problems of environment, ecology, sustainable development, climate change and hunger.

(x) Demonstrate the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

6. COURSE STRUCTURE IN MSc. BOTANY PROGRAMME

SCHEME OF EXAMINATIONS: CBCS PATTERN

(For the students admitted during the academic year 2021-2022 and onwards)

Part	Sub Code	Title of thePaper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext_Min.	Total Pass Mark	Credits
	Semester – I								
A	21MBO11C	Core: Paper – I Microbiology, Mycology and Plant Pathology	7	50	50	100	25	50	4
A	21MBO12C	Core: Paper – II Plant Diversity – I (Phycology & Bryology)	7	50	50	100	25	50	4
A	21MBO13C	Core: Paper – III Cell Biology	6	50	50	100	25	50	4
B	21MBO14E	Elective: Paper – I Bioinstrumentation and Research Methodology	4	50	50	100	25	50	3
A	21MBO15P	Core: Practical Paper – I (Comprised of Paper I, II, III and Elective Paper – I)	6	50	50	100	25	50	4
	Semester – II								
A	21MBO21C	Core: Paper – IV Plant Diversity – II (Pteridophytes, Gymnosperms and Paleobotany)	6	50	50	100	25	50	4
A	21MBO22C	Core: Paper – V Anatomy and Embryology	7	50	50	100	25	50	4
A	21MBO23C	Core: Paper – VI Phytochemistry	7	50	50	100	25	50	5
B	21MBO24E	Elective Paper – II Biostatistics and Seed Technology	4	50	50	100	25	50	3
A	21MBO25P	Core: Practical Paper – II (Comprised of Paper IV, V, VI & Elective Paper – II)	6	50	50	100	25	50	4

Part	Sub Code	Title of thePaper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext_ Min.	Total Pass Mark	Credits
	Semester – III								
A	21MBO31C	Core: Paper – VII Plant Systematics, Resources and Ethnobotany	7	50	50	100	25	50	5
A	21MBO32C	Core: Paper – VIII Plant Physiology	7	50	50	100	25	50	5
B	21MBO33E	Elective: Paper – III Molecular Biology and Bioinformatics	7	50	50	100	25	50	4
A	21MBO34P	Core: Practical Paper – III (Comprised of Paper - VII)	5	50	50	100	25	50	4
A	21MBO35P	Core: Practical Paper – IV (Comprised of Paper VIII and Elective Paper – III)	4	50	50	100	25	50	4
	Semester – IV								
A	21MBO41C	Core: Paper – IX Genetics, Cytogenetics and Plant Breeding	7	50	50	100	25	50	5
A	21MBO42C	Core: Paper – X Plant Ecology, Conservation and Phytogeography	7	50	50	100	25	50	5
B	21MBO43E	Elective Paper – IV Biotechnology	7	50	50	100	25	50	5
A	21MBO44P	Core: Practical Paper – V (Comprised of Paper IX, X and Elective Paper - IV)	5	50	50	100	25	50	4
A	21MBO45V	Project Viva Voce	4	50	50	100	25	50	10
		Total				**2000**			**90**

Note: Project evaluation done jointly by both Internal and External examiners for 50 Marks

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	I	21MBO11C	PAPER – I MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY	7

COURSE LEVEL OUTCOMES:

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

1. Demonstrate the role of microbes in the welfare of humans
2. Outline the concept of plant diseases.
3. Characterize and culture microorganisms from substrates.
4. Develop practical skills in the use of microbiological techniques.
5. Outline the classification of virus, their replication strategies, pathogenicity, and transmission of virus
6. Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation, etc.

Unit – I

Brief history of Microbiology; Whittaker's Five kingdom concept; Ultra structure of bacteria; Classification of Bacteria (Bergey's manual of Systematic Bacteriology); General account of Archaeobacteria, Eubacteria, Cyanobacteria and Actinomycetes.

Methods in Microbiology: Sterilization methods, Staining, Pure culture and sub-culture methods. Preservation and storage of cultures; Bacterial Growth Curve in batch culture.

Unit – II

Viruses: General characters and classification of viruses, types of phages, Life cycle of viruses (Lytic and Lysogenic); Transmission of viruses and economic importance; General account of TMV, CaMV and Mycoplasma.

Industrial application of Microorganisms: Organic acids (Acetic acid and Citric Acid); Alcohol; Milk products (cheese and yogurt); Antibiotics (Penicillin and Streptomycin); Bio pesticides (*Trichoderma sp*. and *Bacillus sp*.).

Unit – III

Fungi: General characteristics of fungi; Mode of nutrition (Saprophytic, Parasitic and Symbiotic); Reproduction (Vegetative, Asexual and Sexual); Heterothallism; Heterokaryosis; Parasexuality; Types of fungal spores and mode of dispersal; Classification of Fungi (Alexopoulos and Mims, 1979); Phylogeny of fungi and General account of Mastigomycotina and Zygomycotina.

Unit – IV

General account of Ascomycotina, Basidiomycotina, Deuteromycotina. Mycorrhiazae as bioinoculants. General account of Lichens – Thallus structure, reproduction and Economic importance.

Unit – V

Plant Pathology: General account of plant pathogens: Diseases caused by plant pathogens and defense mechanism: Physical, physiological, biochemical and molecular mechanisms.

Plant disease epidemiology: Transmission and spread of plant pathogens; disease cycle, epidemics: Modeling and disease forecasting. Biological control of plant diseases
Plant Diseases: Symptoms, Causative organisms and control measures of the following diseases:

1. Blast disease of Paddy
2. Powdery mildew of Grapes
3. Cotton blight
4. Bunchy top of Banana
5. Phyllody - Sesame

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lectures
- ❖ Power point slide presentations
- ❖ Animated demonstration video sessions
- ❖ Assignments and Seminars
- ❖ MCQ assessments
- ❖ Laboratory practical's

TEXT BOOKS

1. Pelczar, M. J. (Jr), Chan, E.C.S. and Krieg, N. R. 1986. Microbiology. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. Dubey, R. C. and Maheshwari, D. K. 2003. Textbook of Microbiology. S. Chand & Co. Ltd., New Delhi.
3. Sharma, O. P. 1989. Textbook of Fungi. Tata McGraw- Hill Publishing Company Pvt. Ltd., New Delhi.
4. Gangulee, H. C. and Kar. A. K. 1989. College Botany, Vol. II. New Central Book Agencies Ltd., Kolkata.
5. Pandey, B. P. 1982. Plant Pathology – Pathogen and Plant disease. S. Chand & Company Pvt. Ltd., New Delhi.
6. Malhotra, R. S. and Agarwal, A. 2003. Plant pathology, 2nd edition.Tata McGraw-Hill Publishing Company Ltd., New Delhi.
7. Sambamurthy, A.V.S.S. 2013. A textbook of Plant Pathology. I.K. International Publishing House Pvt. Ltd., New Delhi.

REFERENCES

1. Alexopoulus, C. J., Mims, C. W. and Blackwell, M. 1996. Introductory Mycology. John Wiley & Sons Inc. UK.
2. Rao, A. S. 1997. Introduction to Microbiology. Prentice Hall of India Pvt. Ltd., New Delhi.
3. Ahemed, M. and Basumatary, S. K. 2006. Applied Microbiology. MJP Publishers, Chennai.
4. Rajni Gupta. 2004. A Textbook of Fungi. A.P.H. Publishing Corporation, New Delhi.
5. David, H. Griffin. 1994. Fungal Physiology. Wiley-Liss, Inc., New York.
6. Pathak, Khatri and Pathak. 1996. Fundamentals of Plant Pathology. AgroBios, Jodhpur.
7. George, N. Agrios. 2003. Plant Pathology, 5th edition. Academic Press, University of Florida, USA.
8. Mishra, A., Bohra, A. and Mishra, A. 2011. Plant Pathology-Disease and Management. AgroBios, Jodhpur.

ONLINE / E-RESOURCES:

https://www.classcentral.com/course/swayam-general-microbiology-14088
https://www.swayamprabha.gov.in/index.php/program/archive/9
www.nos.org/media/documents/dmlt/microbiology
www.columbia.edu/itc/hs/medical/pathophys/id/2009
http://microbiologyinfo.com
https://www.gardeningknowhow.com/plant-problems/disease/aster-yellows-disease.htm

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME:

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**					
	1	2	3	4	5	6
Disciplinary Knowledge	√	√			√	√
Communication Skills		√			√	
Critical Thinking			√	√		√
Research related skills			√		√	√
Analytical reasoning	√		√		√	
Problem Solving		√		√		√
Team Work	√		√	√		√
Moral and ethical awareness	√	√		√	√	

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	I	21MBO12C	PAPER – II PLANT DIVERSITY - I (PHYCOLOGY AND BRYOLOGY)	7

COURSE LEVEL OUTCOMES

On completion of this course students will be able to:

1. Recall the diversity of algae.
2. Compare the habit, reproduction and phylogeny of primitive algal classes.
3. Evaluate the structural, reproductive and phylogenetic aspects of the higher algal classes.
4. Illustrate the cultural methods of algae.
5. Segregate the algae upon their economic importance.
6. Assess the origin and enumerate the range of diversity in Bryophytes.
7. Distinguish the higher class of bryophytes.
8. Prioritize their ecological and economical value of lower plants.

Unit – I

The classification of Algae – Fritsch (1945) & Prescott (1969); Comparative study of the range of thallus structure, morphology, reproduction, life cycle, phylogeny of the Cyanophyceae and Chlorophyceae.

Unit - II

Comparative study of the range of structure, morphology, reproduction, life cycle, phylogeny of the Bacillariophyceae, Phaeophyceae and Rhodophyceae.

Unit-III

Methods of cultivation of freshwater and marine Algae: Indian contribution to Algalogy; Economic importance of algae – beneficial and harmful aspects; Significant role of algae in Agriculture – Fertilizers and manure, nitrogen fixation, reclamation of alkaline soil; Fossil algae.

Unit – IV

Classification of Bryophytes (Reimer, 1954), Origin, General characters and Distribution of Bryophytes; Comparative study of gametophytes and sporophytes of the following major classes: Hepaticopsida, Anthocerotopsida.

Unit – V

General characters, Distribution, Morphology, Reproduction and Life history of Bryopsida with special reference to Sphagnales, Funariales and Polytrichales; Evolution of sporophytes and gametophytes in Bryophytes, Ecological aspects and economic importance; Fossil Bryophytes.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Powerpoint slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Field study

TEXT BOOKS

1. Sharma, O. P. 1986. Textbook of Algae. Tata McGraw-Hill Company Pvt. Ltd., New Delhi.
2. Sambamurthy, A.V.S.S. 2005. Textbook of Algae. IK International Publications, New Delhi.
3. Sharma, O. P. 2011. Algae. Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi.
4. Gangulee, H. C. and Kar. A. K. 1989. College Botany,Vol. II. New Central Book Agencies Ltd., Kolkata.
5. Vashista, S. 1986. Bryophytes. S. Chand Co. Pvt. Ltd., New Delhi.
6. Sharma, O. P. 2014. Bryophytes. Tata McGraw-Hill Publication, New Delhi.
7. Pandey, B. P. 2013. College Botany, 5th Edition. S. Chand Co., Pvt. Ltd., New Delhi.

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1. Gupta, J. S. 1981. Textbook of Algae. Oxford and IBH Publishing Co., UK.
2. Round, F. E. 1981. The Ecology of Algae. Cambridge University Press, UK.
3. Vashista, B. S. 1983. Algae. S. Chand Co., Pvt. Ltd. New Delhi.
4. Singh, Pandey and Jain. 2010. A Text Book of Botany, 4th Edition. Rastogi Publications, New Delhi.
5. Reddy, S. M. 1996. University Botany I: Algae, Bryophyta and Pteridophyta. New Age
6. International Publishers, New Delhi.
7. Chopra, R. N. 1998. Biology of Bryophytes. New Age International Pvt. Ltd., New Delhi.
8. Tuba, Zoltan, Slack, Nancy G. and Stark, Lloyd R. 2011. Bryophyte Ecology and Climate Change. Cambridge University Press, UK.

ONLINE / E-RESOURCES

http://www2.estrellamountain.edu/faculty/farabee/BIOBK/biobookdiversity_5.html
https://www.youtube.com/watch?v=FmBZGx8fkp0
https://www.youtube.com/watch?v=VhXs1LwnR1k
https://www.youtube.com/watch?v=VHoNVuh24hc

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√		√	√	√		√	
Communication Skills	√		√			√	√	
Critical Thinking		√			√	√		
Research related skills			√	√		√		√
Analytical reasoning		√		√		√		√
Problem Solving	√		√	√		√	√	√
Team Work	√		√		√	√	√	√
Moral and ethical awareness	√		√	√			√	√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	I	21MBO13C	PAPER – III CELL BIOLOGY	6

COURSE LEARNING OUTCOMES

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

1. Identify the cell organelles
2. Distinguish between normal cells and abnormal cells and stages of cell division
3. Interpret and Grade the types of deformities in the cell
4. Explain the structure and importance of non-chromosomal DNA
5. Demonstrate and illustrate the genetic material
6. Analyse the genotoxicity of chemicals/drugs
7. Measure the toxicity of various substances on Chromosomes
8. Rank the drugs/chemicals according to the level of genotoxicity

Unit – I

The Cell: cell theory; ultrastructure of a typical plant cell. Cell wall: Origin, ultra structure, chemical constituents and functions of cell wall. Plasmodesmata; Pit types; Cell membrane organization with reference to fluid mosaic model; role of various membrane proteins, lipids and carbohydrates; role of ion channels and pumps in cellular transport and signaling.

Unit – II

Structure and function of sub - cellular structures: Golgi complex; endoplasmic reticulum (RER and SER); lysosomes; Microbodies – peroxisomes, glyoxysomes and sphaerosomes. Ribosome: structure; prokaryotic, eukaryotic and organelle ribosomes and their functional significance. Cytoskeleton – microtubules, microfilaments and intermediary filaments – structure and function.

Unit – III

Mitochondria – origin, distribution and structure – mit DNA – organization and function. Chloroplast - origin, distribution, types and structure – chl DNA – organization and function. Nucleus: Ultrastructure; nuclear envelope, nuclear pore complex, nuclear matrix, nucleoplasm and nucleolus.

Unit – IV

Chemical structure of DNA- Watson and Crick model - Types of DNA; RNA structure and types. Chromosome architecture: Packaging of DNA: Nucleosome – organization of histone octamer – 300 A0 Chromatin fiber – DNA scaffolds – solenoid model – Euchromatin and Telomere and its importance Heterochromatin, DNA methylation. Chromosome banding techniques (G banding), karyotype and Idiogram. Specialized chromosomes – polytene – lampbrush and B chromosome

Unit – V

Cell cycle – four phases – biochemical and cellular activities. Cell division types - amitosis, endomitosis, polyteny, Mitosis and Meiosis. Kinetochore, Role of centromere and spindle fibers- Spindle apparatus – Mitotic poisoning and Chromosomal abnormalities in different

stages of Mitosis - C-Metaphase, Sticky metaphase, laggards, micronuclei; Cytokinesis. Apoptosis and its significance.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Powerpoint slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Laboratory practicals
- Field study

TEXT BOOKS

1. Powar, C. B. 1984. Cell Biology. Himalaya Publishing House, New Delhi.
2. Sundararajan, S. 1998. Introduction to Cell Biology. Vikas Publishing House Pvt. Ltd., New Delhi.
3. De Robertis, E. D. and DeRobertis, E. M. F. 2002. Cell and Molecular Biology, 8th edition. Lee and Fab International edition, Philadelphia.
4. Verma, P.S. and Agarwal,V. K. 2011. Cytology. S.Chand and Co. Ltd., New Delhi.
5. Gupta, P. K. 2013. Genetics and Cytogenetics. 7th edition. Rastogi Publications, New Delhi.

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2. David Freifelder. 1987.Molecular Biology. Narosa Publishing House, NewDelhi.
3. Cooper, G. 1996.The Cell–A molecular approach. ASM Press,Washington.
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https://www.google.com/search?q=meiosis+by+neela+bakore
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COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√	√		√			√	
Communication Skills		√	√		√			
Critical Thinking			√			√		√
Research related skills			√		√		√	
Analytical reasoning	√	√			√	√	√	
Problem Solving						√		√
Team Work						√		√
Moral and ethical awareness			√				√	√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	I	21MBO14E	ELECTIVE PAPER – I BIOINSTRUMENTATION AND RESEARCH METHODOLOGY	4

COURSE LEARNING OUTCOMES

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

1. Choose the right type of microscopy and apply it in analyzing the plant structure.
2. Design and execute experiments for separation of plant organelles and metabolites.
3. Decide appropriate laboratory techniques for analysis of separated plant metabolites.
4. Illustrate various electrophoretic separation of plant metabolites.
5. Organize analytical procedures for sequencing Nucleic acids and *in situ* hybridization.
6. Hypothesize and plan experimental work in plant biology.
7. Analyze the scientific findings and compile them into a manuscript for publication.

Bioinstrumentation

Unit- I

Principle and applications of Light (bright field and fluorescent) and Electron (TEM and SEM) Microscope. Microtome - Types and their uses. Principle and types of centrifuges (Refrigerated and Ultracentrifuge); Chromatographic Techniques: Paper, TLC, HPLC and GC.

Unit- II

Principle and applications of Spectrophotometer (Visible and UV- Visible); Electrophoretic techniques: SDS- Polyacrylamide Gel Electrophoresis (PAGE) and Agarose Gel Electrophoresis (AGE); Pulse Field Gel Electrophoresis; Autoradiography; DNA probes and hybridization techniques.

Unit - III

Working principle, types and applications of PCR; RAPD, RFLP, FISH, DNA sequencing (Maxam and Gilbert's & Sanger's methods); DNA microarray; Cryogenic Freezer; Gene editing in plants (CRISPR – Cas9 technique).

Research Methodology

Unit– IV

Basic concepts of research; types of research; Research objectives; Testing hypothesis (Null hypothesis); Literature review; research design; survey and sampling; Data collection and documentation.

Unit – V

Data analysis (univariate & bivariate); interpretation of data; Research paper writing; ethical issues related to publishing (Plagiarism); use of softwares in research (reference management software, paper formatting software and software for detection of Plagiarism); paper presentation (oral and poster).

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Power point slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Laboratory practical's

TEXT BOOKS

1. Jeyaraman, J. 1981. Laboratory Manual in Biochemistry. Wiley Eastern Ltd. Mumbai.
2. Keith Wilson and John Walker. 1995. Practical biochemistry. Univ. of Cambridge, New York.
3. Nagarajan, P. and Senthilkumar, N. 2001. Molecular biology principles and methods a practical approach: Sree Narmatha Printers, Coimbatore.
4. Plummer, D.T. 2003. An Introduction to practical biochemistry. Tata Mc-Graw Hill Co. New York.
5. Sharma, R. K. and Sangha, S.P.S.. 2009. Basic Techniques in Biochemistry and Molecular Biology. I.K. International Pvt. Ltd, New Delhi.
6. Kothari, C. R. and Garg, G. 2014. Research Methodology – Method and Techniques, New Age International (P) Ltd., New Delhi.

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1. Terrance G Cooper. 1942. The tools of Biochemistry. A Wiley Interscience publication.UK.
2. Glick and Thompson. 1993. Methods in plant Molecular Biology & Biotechnology. CRC Press, BR, Florida, USA.
3. Rastogi, S.C. 2010. Biochemistry, 3rd edition. Tata Mc-Graw Hill Education private limited New Delhi.
4. Chawla, H.S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co., New Delhi.
5. Johansen, D.A. 1940. Plant Microtechnique: McGraw- Hill Co., New York.
6. Keith Wilson and John Walker, 2010. Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, New York.

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COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcomes (CLO)						
	1	2	3	4	5	6	7
Disciplinary Knowledge	√			√		√	√
Communication skills	√			√		√	√
Critical thinking	√	√	√	√			√
Research- related skills	√	√	√	√	√	√	√
Analytical reasoning		√	√			√	√
Problem solving	√		√		√	√	
Team work			√		√	√	√
Moral and ethical awareness	√	√	√	√	√	√	√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	**I**	**21MBO15P**	**PRACTICAL PAPER – I** (Microbiology, Mycology, Plant Pathology, Phycology, Bryology, Cell Biology, Bioinstrumentation and Research Methodology)	**6**

COURSE LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Isolate and identify the soil microorganisms
2. Establish pure microbial cultures
3. Explain the morphological and anatomical features of fungi
4. Recognize the algal species based on character study
5. Point out the specific characters of Bryophytes
6. Observe and distinguish the ultrastructure of the cell organelles
7. Demonstrate the protocols for DNA studies
8. Compose write ups on technical basis

MICROBIOLOGY

1. Preparation of Basic medium – solid medium(PDA) and broth (Nutrient Broth)
2. Preparation of agar plates, agar slants and agar deep tubes.
3. Simple staining of bacteria.
4. Gram's staining of bacteria.
5. Hanging drop technique.
6. Isolation of Bacteria from soil by serial dilution method.
7. Isolation and Enumeration of Fungi from the infected plant tissues.
8. Slide culture technique.
9. Subculture, pure culture and maintenance of cultures.

MYCOLOGY AND PLANT PATHOLOGY

1. Study of morphology and anatomy of *Pythium, Mucor, Phyllachora, Polyporus* and *Trichoderma.*
2. Pathology Herbarium Submission (Any 5 Plant specimens).
3. Screening plant roots for Arbuscular mycorrhizal colonization.

PHYCOLOGY

1. Study of the morphology of Algae with particular reference to the following Genera: *Chlorella, Pithophora, Bulbochaeta, Fritschiella, Codium, Nitella, Diatoms, Padina, Turbinaria, Sargassum, Batrachospermum, Gelidium, Gloeocapsa, Lyngbya* ;
2. Algal culture.
3. Visit to CMFRI, Mandapam.

BRYOPHYTES

1. Morphological and Anatomical study of Bryophytes with reference to the following Genera: *Targionia, Lunularia, Reboulia, Dumortiera* and *Sphagnum.*

CELL BIOLOGY

1. Observation of ultrastructure of cell organelles (Electron micrographs).
2. Observation and study of different stages of mitosis by onion root tip squash.
3. Observation and study of different stages of meiosis using Rheo/Onion flower bud squash.
4. Isolation of cell organelles - chloroplast and mitochondria (only schematic representation).

BIOINSTRUMENTATION AND RESEARCH METHODOLOGY

1. Separation of leaf pigments by TLC
2. Demonstration of UV – Visible Spectrophotometer
3. Separation of DNA fragments through Agarose Gel Electrophoresis (Demonstration)
4. DNA sequencing (Protocol)
5. Demonstration of PCR
6. Poster presentation on defined topics
7. Technical writing on topics assigned
8. Visit to Biotechnological Laboratories

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1. McMahon, K., Levetin, E. and Reinsvold, R. 2001. Laboratory Manual for Applied Botany. McGraw-Hill Education, New York, USA.
2. Arora, B. and Arora, D.R. 2009. Practical Microbiology. 2nd ed. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
3. Bendre, A. M. 2010. A Text Book Of Practical Botany – 1. Rastogi Publications, Meerut, India.
4. Chmielewski, J. G. and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
5. Gupta, V. K., Tuohy, M.G., Ayyachamy, M., Turner, K.M. and O'Donovan, A. 2013. Laboratory Protocols in Fungal Biology: Current Methods in Fungal Biology. Springer, London, UK.
6. Jha, D. K. 2014. Laboratory Manual on Plant Pathology (English). Pointer Publishers, Jaipur.
7. Sivakumar, K. 2016. Algae- A Practical Approach. MJP Publishers, Chennai, India.
8. Das, S. and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.

ONLINE/E-RESOURCES

https://www.geobotany.uaf.edu/teaching/plant_keys/bryophytes.pdf

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√	√	√	√	√			√
Communication Skills			√		√		√	
Critical Thinking	√					√		
Research related skills	√			√			√	√
Analytical reasoning	√		√					
Problem Solving		√				√		
Team Work					√		√	
Moral and ethical awareness				√	√			

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	II	21MBO21C	PAPER – IV PLANT DIVERSITY - II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	6

COURSE LEARNING OUTCOMES

On the successful completion of the course, students are able to:

1. Infer the diverse range of Pteridophytes.
2. Associate the vast range of evolution of their morphological and anatomical features.
3. Interpret the diverse organization of the reproductive structures and their development in Pteridophytes.
4. Assess the economic value of the Pteridophytes.
5. Prioritize the various classes of gymnosperms based on their evolutionary trend.
6. Evaluate and distinguish the gymnosperms upon the various structural and reproductive characters
7. Integrate the significance of gymnosperms to human existence.
8. Convince and judge the chronology of events on the Earth upon its evolution and the geological significance of Indian land towards exploration of fossils.

Unit- I

Pteridophytes: General characters; Reimer's Classification (1954); Theories of Origin of Sporophyte; Telome concept; Sporangium development: Eusporangiate type and Leptosporangiate type; Range of structure; Reproduction and Evolution of the Gametophytes: Sex organs; Life cycle Patterns; Apogamy and Apospory; Detailed account of Stelar and Soral evolution; Heterospory and Seed habit.

Unit – II

Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following classes: Psilophytopsida, Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Economic importance of pteridophytes.

Unit- III

Gymnosperms: Introduction; Classification of Gymnosperms (Sporne, 1965); Characteristic features and Life cycle of Gymnosperms; Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following Orders: Pteridospermales, Bennettitales, Pentoxylales, Cycadales and Cordaitales.

Unit- IV

Comparative study of Morphology, Anatomy, Reproduction and Phylogeny of the following orders: Coniferales, Taxales, Ginkgoales and Gnetales; Economic importance of Gymnosperms.

Unit- V

Paleobotany: Geological time scale; Fossils and Fossilization: Kinds of Fossils: Petrification, mold, cast, impression and compression; Nomenclature of Fossil plants; Indian contribution towards fossil resources; Half-life period; Radiocarbon dating. Contribution of Prof. Birbal Sahni. Fossil fuels and fossil pollen.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Powerpoint slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments

TEXT BOOKS

1. Sporne, K. R. 1967. Morphology of Pteridophytes: the structure of ferns and allied plants. Hutchinson University Library, London.
2. Rashid, A. 1999. An Introduction to Pteridophyta. Vikas Publishing House (P) Ltd., New Delhi.
3. Sambamurthy, A.V.S.S. 2005. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and paleobotany. I.K. International Publishing House. New Delhi.
4. Bhatnagar, S. P. and Moira, A. 1996. Gymnosperms. New age international Pvt. Ltd., New Delhi.
5. Govil, C.M. 2011. Gymnosperm. Krishna Prakashan Media, India.
6. Arnold, C.A. 1972. An introduction to Paleobotany. McGraw-Hill Publishers, New York.
7. Shukla, A. C. and Mishra, S. P. 1982. Essentials of Paleobotany, 2nd edition. Vikas Publishing House Pvt. Ltd., New Delhi.

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1. Eames, A.J. 1936. Morphology of Vascular Plants. Lower groups, New York.
2. Smith, G.M. 1955. Cryptogamic Botany Vol. II-Bryophytes and Pteridophytes, 2nd edition. Tata McGraw-Hill Publishing Co., New Delhi.
3. Trivedi, P.C. 2002. Advances in Pteridology. Pointer Publishers, Jodhpur.
4. Sporne, K. R. 1965. Morphology of gymnosperms. Hutchinson University Publishing House, London.
5. Chamberlain, C.J. 1966. Gymnosperms: Structure and Evolution, Dover Publications, NY, USA.
6. Bower, F.O. 1908. The origin of Land Flora. Macmillan Press, London.
7. Lily Bora. 2010. Principles of Paleobotany. International Scientific Publishing Company, New Delhi.

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https://www.youtube.com/watch?v=jH41KdywYWU
https://www.youtube.com/watch?v=BfAtbyr6Bjc
http://hhh.gavilan.edu/rmorales/documents/Gymnosperm18_withgneto.ppt
https://virtualpaleontologist.weebly.com/paleobotany.html
https://swayam.gov.in/nd2_cec20_bt11/preview
https://www.classcentral.com/course/swayam-plant-groups-19787

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√	√		√			√	√
Communication Skills	√	√	√		√	√		√
Critical Thinking	√	√	√	√	√		√	
Research related skills			√			√	√	
Analytical reasoning		√	√		√	√	√	√
Problem Solving		√	√		√	√		√
Team Work	√	√	√	√	√	√	√	√
Moral and ethical awareness	√			√	√		√	√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	II	21MBO22C	PAPER – V- ANATOMY AND EMBRYOLOGY	7

COURSE LEARNING OUTCOMES

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

1. Acquire knowledge about morphogenesis and organogenesis in higher plants.
2. Infer the internal structure and reproduction of Angiosperms.
3. Correlate the structure of phellem, periderm, and phellogen.
4. Trace the organization of xylem and phloem.
5. Employ microtechnique to analyse the wood of plants.
6. Summarize the reproductive organization in higher plants.
7. Illustrate the importance of polyembryony, apomixis and parthenocarpy.

Unit - I

Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex, process of differentiation.

Vascular Cambium: Composition and organization – multiplicative and additive divisions – seasonality of the cambium. **Xylem**: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood, Reaction wood.

Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell - Tyloses; Evolution of tracheary elements.

Unit - II

Periderm: Structure, organization and activity of phellogen, lenticells. Polyderm and Rhytiderm – wound periderm. Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Structure and types of Stomata; Major nodal types; Kranz anatomy and its significance.

Unit - III

Microtechnique: Principles of killing and fixation, maceration, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (Safranin, fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.

Unit – IV

Microsporangium and Male gametophyte: Structure and development of Anther; Ultrastructure and physiology of anther tapetum; Development of Male gametophyte; **Palynology**: Morphology and ultrastructure of pollen wall, pollen kitt, Pollen sterility (nuclear and cytoplasmic male sterility).

Megasporangium and Female gametophyte: Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus.

Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs.

Unit - V

Fertilization: Double fertilization and triple fusion; **Endosperm:** Development of endosperm, types, Ruminate endosperm. **Embryogeny**: Development of monocot (Grass) and dicot (Crucifer) embryos.

Polyembryony: Causes of Polyembryony**,** induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Powerpoint slide presentations
- Animated/demonstrative video sessions
- Assignments and Seminars
- MCQ assessments
- Laboratory practical's

TEXT BOOKS

1. Pandey, B. P. 2009. Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
2. Maheswari, P. 1963. An Introduction to embryology of Angiosperms. McGraw-Hill Publishing Co., New York.
3. Pullaiah, T., Lakshminarayanan, K. and Hanumantha Rao, B. 2001. Text book of embryology of angiosperms. Regency Publications, New Delhi.
4. Bhojwani, S.S. and Bhatnagar, S. P. 2009. Embryology of Angiosperms. Vikas Publishing House (P) Ltd., New Delhi.
5. Pandey, S.N. and Chadha, A. 1996. Plant anatomy and Embryology. Vikas Publications, New Delhi.
6. Singh, V., Pandey, P.C. and Jain, D.K. 1998. Anatomy of Seed Plants. Rastogi Publications, Meerut.

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1. Carlquist, S. 2001. Comparative Wood Anatomy. Springer Science Publication, London, UK.
2. Suan, R. F. and Eichhorn, E. 2006. Esau's Plant Anatomy: Meristems, Cells and Tissue of the Plant Body, 3rd Edition. Wiley Publishing Co., New York.
3. Charles B. Beck. 2010. An Introduction to plant structure and development. Cambridge University Press, New York.
4. Bhojwani, S.S. and Soh, W.Y. 2001. Current Trends in the embryology of angiosperms. Kluwer Academic Publishers, Netherlands.
5. Lersten, N. R. 2004. Flowering Plant Embryology. Blackwell Publishing, Australia.
6. Katherine Esau. 1965. Anatomy of seed plants, 2nd Edition. John Wiley & CO., New York.
7. Fahn, A. 1990. Plant Anatomy. Pergamon Press, New York.

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https://www.askiitians.com/biology/sexual-reproduction-in-flowering-plants/
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COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**						
	1	2	3	4	5	6	7
Disciplinary Knowledge	√		√	√	√	√	√
Communication Skills	√		√				√
Critical Thinking		√			√	√	
Research related skills			√	√		√	√
Analytical reasoning		√		√		√	√
Problem Solving	√		√	√		√	
Team Work	√		√		√	√	√
Moral and ethical awareness	√		√	√	√		√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	II	21MBO23C	PAPER –VI- PHYTOCHEMISTRY	7

COURSE LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Associate the pH and Henderson – Hasselbalch equation to design a buffer of choice.
2. Discuss laws of thermodynamics and interpolate the concept of free energy and energy transfer in biological systems.
3. Recognize the classes, nomenclature and characteristics of enzymes.
4. Integrate various components for enzyme activity and illustrate the theories of mechanism of action of enzymes.
5. Summarize the classification, structure and properties of amino acids to infer various levels of protein structure.
6. Classify the Carbohydrates and Lipids and generalize their structure and properties.
7. Differentiate the intermediates and respective enzymes of linoleic acid and cholesterol biosynthesis as well as palmitic acid oxidation with bioenergetics.
8. Extrapolate various secondary metabolites to their biosynthetic pathways and point out their biological and pharmacological significance.

UNIT – I

pH and Buffer: pH and its significance; pH scale; Derivation of Henderson – Hasselbalch equation; isoelectric point; buffers and their importance

Thermodynamics: Energy flow; enthalpy and entropy; laws of thermodynamics; concept of free energy; energy transfer and redox potential.

UNIT – II

Enzymology: Structure of enzyme – holoenzyme, apoenzyme, cofactor, coenzymes and prosthetic group; Classification and nomenclature of enzymes; concept of active site; Mechanism of enzyme action (Lock and key hypothesis and Induced fit model); factors affecting enzyme activity; Michaelis – Menten equation and Km value; Enzyme modifiers – activators, inhibitors, allosteric inhibitors and regulation of enzyme action. Coenzymes – vitamins as coenzymes; isozymes.

UNIT - III

Amino acids & Proteins: Structure, properties and classification of amino acids; peptide bond; polypeptide chain; Protein structure – primary, secondary, tertiary and quaternary; 3D structure of proteins and protein folding.

UNIT – IV

Carbohydrates: classification; structure and properties of monosaccharides (glucose, fructose); disaccharides (maltose, sucrose,lactose) and polysaccharides (starch, cellulose, glycogen)

Lipids: saturated and unsaturated fatty acids; biosynthesis of saturated fatty acid (linoleic acid); β - oxidation of fatty acid (Palmitic acid) and its bioenergetics; biosynthesis of cholesterol.

UNIT – V

Secondary Metabolites: Definition of secondary metabolism, biological significance and pharmacological importance. Outline of major types of secondary metabolites – alkaloids, terpenoids & polyphenolic compounds; A brief outline of extraction of alkaloids, terpenoids & polyphenolic compounds; detailed account on mevalonate pathway & shikimate pathway; Hard Resins, Oleoresins and Gum synthesis.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Power point slide presentations
- Animated/demonstrative video sessions
- Assignments and Seminars
- MCQ assessments
- Brainstorming, MOOC, etc.,

TEXT BOOKS

1. Satyanarayana, U, 1999. Biochemistry. Books and Allied (P) Ltd. Calcutta.
2. Jain, J.L. 2000. Fundamentals of Biochemistry. S. Chand & Co., New Delhi.
3. Lehninger, A. L. 2005. Biochemistry, Vth Edition, Kalyani Publishers, Ludhiana.
4. Devlin, T. M. 2006. Textbook of Biochemistry, 6th Edition. A John Wiley & Sons, Inc. Publication, New York.
5. Conn, E.E. and Stumpf, P.K. 2009. Outlines of Biochemistry. John Wiley and Sons, New Delhi.
6. Kumar, G. S. and Jayaveera, K. N. 2014. A text Book of Pharmacognosy and Phytochemistry. S. Chand & Co., New Delhi.

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1. David T. Dennis and David H. Turupin (Eds.) 1993. Plant Physiology, Biochemistry and Molecular Biology. Longman Scientific and Technical, Singapore.
2. Goodwin and Mercer. 1996. Introduction to Plant Biochemistry. CBS Publishers and Distributors, New Delhi.
3. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry, Elsevier publications.
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5. Fisher J. & Arnold, A. 2003. BIOS Instant notes in chemistry for Biologists. Garland Science publications.
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https://nptel.ac.in/courses/104/105/104105120/

https://nptel.ac.in/courses/104/104/104104109/

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√		√	√	√	√		√
Communication Skills		√		√				√
Critical Thinking			√			√	√	
Research related skills	√			√			√	√
Analytical reasoning				√		√	√	
Problem Solving				√			√	√
Team Work		√			√			
Moral and ethical awareness			√					√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	II	21MBO24E	ELECTIVE PAPER – II- BIOSTATISTICS AND SEED TECHNOLOGY	4

COURSE LEARNING OUTCOMES

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

1. Analyse the Scientific data statistically.
2. Sketch out different sampling methods.
3. Illustrate the collected scientific data statistically.
4. Interpret the experimental data and conclude the findings.
5. Apply the various advanced statistical tools for biological experiments.
6. Discriminate seeds based on their viability and appraise them for certification.

UNIT - I

Biostatistics: Definition, scope, functions of biostatistics; **Data**: Primary and secondary Data; Methods of collection of Data; Sampling techniques; Frequency distribution table.

UNIT – II

Presentation of Data: **Tabulation** - general rules for Tabulation, Parts of Tables and types of Tables; **Diagrammatic presentation**: Line, bar and pie; **Graphic representation**: Histogram, frequency polygon, frequency curve and Cumulative frequency curve.

UNIT - III

Analysis of Data: Measures of central tendency: Mean, Median and Mode; Measures of Dispersion: Range, Standard deviation and Standard error; Probability (addition and multiplication theorem) and distribution (Normal & Poisson Distribution); Correlation and Regression analysis. Student 't' test.

UNIT – IV

Test of significance: Analysis of variance (ANOVA): one way and two way methods; Chi-square test: Definition and applications; Role of statistical tools in biology.

UNIT - V

Seed Technology: Structure of seed and seed coats. Mechanism of seed germination and types; Mechanisms of seed dispersal: Zoochory, Anemochory, Hydrochory and Autochory. Seed processing and storage; Seed vigour and seed viability (Tetrazolium test); Seed Dormancy: Hormonal regulation of dormancy and germination; Seed certification.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Power point slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments

TEXT BOOKS

1. Arumugam, N and Meyyan, R.P. 2000. Evolution and Biostatistics. Saras Publication, Nagercoil.
2. Antonisamy, B., Solomon Christopher and Prasanna Samuel, P. 2010. Biostatistics: Principles and Practice. Tata McGraw-Hill Education Private Limited, New Delhi.
3. Prasad, S. 2011. Elements of Biostatistics. Rastogi Publications, Meerut.
4. Archana Sharma, 2014. Seed Technology and Seed Pathology. Pointer Publishers, Jaipur.

REFERENCES

1. Sundar Rao, P.S.S. and Richard, J. 2004. Introduction to Biostatistics and Research Methods, 4th edition. Prentice-Hall of India, New Delhi.
2. Marcello Pagano and Kimberlee Gauvreau. 2008. Principles of Biostatistics, 2nd edition. Cengage Learning India Private Limited, New Delhi.
3. Dipak kumar Kar and Soma Halder. 1997. Plant Breeding and Biometry. New Central Book Agency (P) Ltd., Kolkata
4. Sanjeev Kumar. 2014. Principles of Seed Technology. Sonali Publications. New Delhi.

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https://nptel.ac.in/courses/102/101/102101056/
https://onlinecourses.nptel.ac.in/noc19_bt19/preview
https://www.classcentral.com/course/swayam-principles-of-seed-technology-17741

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**					
	1	2	3	4	5	6
Disciplinary Knowledge	√		√	√		√
Communication Skills	√			√		√
Critical Thinking	√	√	√	√		√
Research related skills	√	√		√	√	√
Analytical reasoning		√	√			√
Problem Solving	√				√	
Team Work		√	√		√	√
Moral and ethical awareness	√			√	√	√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	**II**	**21MBO25P**	**PRACTICAL PAPER – II (Pteridophytes, Gymnosperms, Paleobotany, Anatomy, Embryology, Phytochemistry, Seed Technology and Biostatistics)**	**6**

COURSE LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Illustrate and outline the characters of Pteridophytes and Gymnosperms
2. Compare and contrast the similarities and differences between Pteridophytes and Gymnosperms
3. Recognize and assign the fossils to the respective groups
4. Interpret the anatomical characters of dicots and monocots
5. Differentiate the vascular cell types in wood sections
6. Observe and recognize the embryological features
7. Estimate the biochemical parameters in plant samples
8. Calculate the significance in the given data
9. Test the seed quality parameters and its viability

PTERIDOPHYTES

1. Study of morphology, anatomy and reproductive structures of the following genera: *Psilotum, Lycopodium, Isoetes, Osmunda, Gleichenia, Equisetum, Alsophila,* and *Marsilea.*

GYMNOSPERMS

1. Study of morphology, anatomy and reproductive structures of the following genera: *Zamia, Araucaria, Podocarpus, Ephedra*

PALEO BOTANY

1. Pteridophytes- *Rhynia, Lepidodendron, Calamites*.
2. Gymnosperms- *Lyginopteris, Williamsonia, Lagenostoma, Cordites.*

ANATOMY

1. Study of shoot apex of *Hydrilla*
2. Observation of cambial types.
3. Sectioning and observation of nodal types.
4. Study of anomalous secondary growth of the following:
   STEM- *Nyctanthus, Boerhavia, Aristolochia, Bignonia, Piper betle* and *Mirabilis*.
   ROOT- *Achyranthes*
5. Observation of stomatal types by epidermal peeling.
6. Maceration of wood and observation of the components of xylem.
7. Double staining technique to study the stem anomali.
8. Preparation and submission of 10 permanent slides (5 free hand sections; 5 microtome sections).

EMBRYOLOGY

1. Observation of T.S. of anther.
2. Observation of ovule types.
3. Observation of mature embryo sacs.
4. Dissection and observation of embryos (globular and cordate embryos).
5. Study of pollen morphology
6. Study of *in vitro* pollen germination.
7. Observation of endosperm types.

PHYTOCHEMISTRY

1. Preparation of buffer (Citrate & Phosphate)
2. Qualitative test for carbohydrates, amino acids and proteins
3. Estimation of carbohydrates by Anthrone reagent method
4. Estimation of amino acids by Ninhydrin reagent method
5. Estimation of Proteins by Lowry's method
6. Qualitative tests for alkaloids, terpenoids, flavonoids and sterols
7. Enzyme assay – Peroxidase
8. TLC separation of alkaloids and terpenoids

SEED TECHNOLOGY AND BIOSTATISTICS

1. Organization of a Table
2. Diagrammatic presentation of given Data: line, bar and pie diagram.
3. Graphic presentation of given Data: Histogram, frequency polygon, frequency curve and Cumulative frequency curve.
4. Determination of Mean, Median and Mode of the Data obtained from plant sources.
5. Determination of Standard deviation and Standard error of the Data obtained from plant sources.
6. Probability test
7. Test of significance by Chi-square test.
8. Using SPSS and 'R' Softwares
9. Seed viability test (TZ test)
10. Mode of Seed dispersal
11. Seed certification (model certificate).

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1. Cutler, D. F., Botha, C. E. J., Stevenson, D. W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK
2. Mahesh Bilwa, l, 2001. Paleontology: A Practical Manual, Studera Press, New Delhi.
3. Reddy, S. M., and Chary, S. J. 2003. University Botany II: (Gymnosperms, Plant Anatomy, Genetics, Ecology) (Vol. 2), New Age International, Delhi.
4. Sumalatha, G. 2017. Pharmacognosy and Phytochemistry Practical Manual. Create Space Independent Publisher
5. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. Pvt. Ltd., New Delhi.

ONLINE / E-RESOURCES

Biostatistics (HS167) Lab Manual.
https://docplayer.net/94815013-Biostatistics-hs167-labmanual.html.
http://cbseacademic.nic.in/web_material/publication/cbse/31Olericulture-I-XI.pdf-A Practical Manual on Olericulture.

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**								
	1	2	3	4	5	6	7	8	9
Disciplinary Knowledge	√		√		√	√	√		
Communication Skills	√	√		√					
Critical Thinking		√			√				√
Research related skills				√			√	√	√
Analytical reasoning		√		√			√	√	
Problem Solving		√						√	
Team Work							√		√
Moral and ethical awareness			√						√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III	21MBO31C	PAPER VII PLANT SYSTEMATICS, RESOURCES AND ETHNOBOTANY	7

COURSE LEARNING OUTCOMES

On completion of this course, students will be able

1. Outline the fundamental values of plant systematics
2. Demonstrate the identification and documentation of plants.
3. Assign plants to respective families based on morphological characters.
4. Analyze the plant products in use in our day-to-day life.
5. Evaluate the potential of Ethnobotany .
6. drugs from different plants for different ailments.

Unit – I

History of classification; Systems of classification: Bentham and Hooker and Cronquist; Angiosperm Phylogeny Group IV (2016); International Code of Nomenclature for Algae, Fungi and Plants (ICN); Typification, Valid publication, Citation, Retention choice and Rejection of names; Priority; Plant molecular systematics; Chemotaxonomy and Numerical taxonomy; Taxonomic evidences from Morphology, Anatomy, Embryology, Palynology and Cytology.

Unit –II

Concepts of Taxa and Taxonomic hierarchy; Construction and uses of different types of key for plant identification (indented and bracketed keys); Basic concepts of Flora, Revisions, Monographs, Herbaria and Data information system; Botanical Gardens. Morphology of Flowering plants – A brief outline.

Unit – III

Comparative and detailed study of the following families: Nymphaceae, Capparidaceae Polygalaceae, Portulacaceae, Zygophyllaceae, Rhamnaceae, Sapindaceae, Combretaceae, Passiflorae, Rubiaceae, Plumbaginaceae, Oleaceae, Boraginaceae, Bignoniaceae,Verbenaceae. Nyctaginaceae, Aristolochiaceae, Santalaceae, Orchidaceae, Scitamineae, Commelinaceae, Palmae, Aroideae and Cyperaceae.

Unit – IV

Plant Resources: Binomials, Families, Morphology of useful parts and uses of the following: **Food crops** – Cereals - Wheat and Millets (*Pennisetum*); **Pulses** - Black gram; **Nuts** - Cashew nut; **Sugar yielding plant** – Sugarcane; **Oil yielding plant** – Sunflower; **Spices** – Cardamom; **Beverage plant** – Cocoa; **Timber and pulp yielding plants**- Red sandal and *Eucalyptus*; **Fiber yielding plant** – *Corchorus*; **Fodder plant** - Fodder grass (*Panicum*); **Medicinal plant** – *Catharanthus*; **Horticultural plants** – Jackfruit, **Hedge pla**nt - *Duranta* , **Garden plant** - *Gerbera*; **Plant for soil conservation** –Lemongrass.

UNIT V

Ethnobotany: Definition, History, Modern Ethnobotany and Ethnomedicine; An insight into the ethnobotanical practices of Indian sub-continent; A listing of the medicinal practices of two tribes of Tamil Nadu (Thodas and Kurumbas).

Pharmacognosy: General introduction, classification of drugs, drug adulteration, study of crude drugs obtained from various plant parts and its uses, Underground stem- Ginger, Root- Belladonna, Bark- cinchona, Leaf- Adhatoda, Flower- Clove, Seed- Nutmeg, Fruit- Coriander, Whole plant - Phyllanthus.

Brief account of the following: Cardiovascular drug - Digitalis, Anti- Cancer drug- Catharanthus, Respiratory drug- Eucalyptus.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Power point slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Field study

TEXT BOOKS

1. Sharma, O.P. 2007. Plant Taxonomy. Tata McGraw-Hill Publishing Company, New Delhi.
2. Pandey, S.N. and Mishra, S.P. 2009. Taxonomy of Angiosperms. Ane Books Pvt. Ltd., New Delhi.
3. Singh, V. and Jain, D.K. 2010. Taxonomy of Angiosperms, 2nd Edition. Rastogi Publications, Meerut, India.
4. Verma, B.K. 2011. Introduction to Taxonomy of Angiosperms. PHI Learning Pvt. Ltd., New Delhi.
5. Pandey, B.P. 2012. Taxonomy of Angiosperms. S. Chand and Company Ltd., New Delhi.
6. Pandey, B.P. 2010. Ethnobotany. S. Chand and Co., Ltd. New Delhi.
7. Kumar, N.C. 2004. An Introduction to Medical Botany & Pharmacognosy. EMKAY Publications, New Delhi.

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1. Lawrence, G.H.M. 1961. Taxonomy of Vascular Plants. MacMillan and Co., New Delhi.
2. Singh, G. 1999. Plant Systematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Singh. 2004. Plant Systematics. Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi.
4. Subrahmanyam, N.S. 2007. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Bharathi Bhattacharyya. 2009. Systematic Botany. Narosa Publishing House, India.
6. Mondal, A.K. 2009. Advanced plant Taxonomy. New Central Agency Pvt. Ltd., New Delhi.
7. Pullaiah, T. 2007. Plant Taxonomy. Regency Publications, New Delhi.
8. The useful Plants of India. 1986. CSIR Publications and Information Directorate, New Delhi.
9. Sharma, O. P. 1996. Economic Botany. Tata McGraw Hill Co., Ltd., New Delhi.

10. Kochar, S.L. 2000. Economic Botany of the Tropics. Macmillan India Pvt. Ltd., New Delhi.
11. Verma, V. 1998. Ethnobotany. Rastogi Publications, Meerut, India.
12. William Charles Evans. 2007. Trease and Evans' Pharmacognosy, 15th edition. Elsevier India (P) Ltd, New Delhi.

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https://www.plantsnap.com/ - An online plant identifier.
PlantSnap: https://play.google.com/store/apps/details?id=com.fws.plantsnap2&hl=en_IN&gl=US
https://courses.botany.wisc.edu/botany_400/PlantSystematics.html
https://www.youtube.com/embed/SNV9omPCo0U
https://www.swayamprabha.gov.in/index.php/program/archive/9
https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book:_Concepts_in_Biology_%28OpenStax%29/14:_Diversity_of_Plants/14.4:_Seed_Plants:_Angiosperms
https://basicbiology.net/plants/angiosperms

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)					
	1	2	3	4	5	6
Disciplinary Knowledge	√	√	√		√	√
Communication Skills		√		√	√	√
Critical Thinking	√		√		√	√
Research related skills		√		√		√
Analytical reasoning		√		√		
Problem Solving	√	√	√		√	
Team Work		√	√	√	√	√
Moral and ethical awareness	√			√	√	√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III	21MBO32C	PAPER-VIII PLANT PHYSIOLOGY	7

COURSE LEARNING OUTCOMES

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

1. Explain the mechanism of water and nutrient absorption and transportation in plants.
2. Interpolate the role of vital nutrients in plant growth and grade the mineral deficiency symptoms in plants.
3. Illustrate the mechanism of photosynthesis and justify the different carbon assimilation pathways.
4. Criticize the mechanism of cellular respiration in ATP synthesis.
5. Devise the methods of applications of growth hormones for enhanced plant production and infer the ill effects of growth retardants.
6. Differentiate long and short day plants based on the underlying physiological aspects.
7. Interpret the effect of stress on plant processes.

Unit – I

Water movement in plants: Properties of water, Properties of solutions, Water potential, mechanism of water absorption by root- active and passive absorption. Movement of water towards xylem by apoplast and symplast pathway, Ascent of sap – theories: Soil – plant - atmosphere continuum, Transpiration pull theory, root pressure theory. Stomatal physiology and mechanism and guttation. Significance and factors affecting transpiration.

Unit - II

Mineral nutrition: Criteria of essentiality of elements; Macro and Micro- nutrients; Role of essential elements; Mineral deficiency symptoms; Solute transport and photoassimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules. Ion transporter.

Unit –III

Photosynthesis: Organization of photosynthetic apparatus and light absorbing antenna systems; Absorption and transformation of radiant energy; Photosynthetic Electron transport and Photophosphorylation; Photo oxidation of water; C3, C4 and CAM pathways and their efficiencies; Photorespiration and its regulation; Inorganic carbon concentrating mechanisms; RUBISCO and PEPC.

Unit - IV

Respiration: Glycolysis, TCA cycle and its regulation; aerobic and anaerobic respiration; electron transport in Mitochondria, Chemiosmosis, Redox potential, Oxidative phosphorylation, Mechanism of ATP Synthesis; ATP - biological energy currency, Pentose Phosphate Pathway.

Phyto-hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of actions of Auxin, Gibberellins, Cytokinins, Ethylene and ABA (brief out line only)

Unit – V

Growth: Growth retardants - polyamines and morphactins. Flowering, photoperiodism and its significance- short day, long day and day-neutral plants, regulations of flowering and vernalization. **Biological rhythm**- Endogenous clock mechanism- circadian rhythm. **Ageing and senescence**- Types of physiological changes. **Stress physiology** – Classification of stress – biotic and abiotic; Response of plants to stress; Mechanism of stress resistance.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Powerpoint slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Team discussions

TEXT BOOKS

1. Kochhar, P. L. and Krishnamurthy, H. N. 1989. Plant Physiology. Atmaram & Sons, New Delhi.
2. Jain, V. K. 1995. Fundamentals of Plant Physiology. S. Chand & Co. New Delhi.
3. Verma, S.K. 1995. A Textbook of Plant Physiology and Biochemistry. S. Chand & Company Ltd, New Delhi.
4. Devlin, R. M. and Witham, F. H. 1999. Plant Physiology. 4th Edition, CBS Publishers and Distributors, New Delhi.
5. Noggle, G.R. and Fritz, G.J. 2010. Introductory Plant Physiology, 2nd Edition, Prentice Hall of India, New Delhi.

REFERENCES

1. Moore, T.C. 1989. Biochemistry and physiology of plant hormones. Springer Verlag. New York, USA.
2. Hopkins, W.G. 1995. Introduction to plant physiology. John Wiley and Sons, New York, USA.
3. Taiz, L. And Zieger, E. 1998. Plant physiology. Sinauer Associates Inc. and publishers, USA.
4. Jain, A. K. 2003. Textbook of Physiology. Avichal Publishing Company. New Delhi.
5. Sinha, R.K. 2007. Modern Plant Physiology. Narosa Publishing House, New Delhi.
6. Mukherjee, S. and Ghosh, A.K. 2009. Plant Physiology, 3rd Revised edition. New Central Book Agency, Kolkata.
7. Salisbury, F. B. and Ross, C.W. 1992. Plant Physiology, 4th Edition, Wadsworth Publishing Co., California, USA.

ONLINE/E-RESOURCES

https://swayam.gov.in/nd2_cec19_bt09/preview
https://www.youtube.com/watch?v=RT-w2xHVl_E
https://www.youtube.com/watch?v=OW2nOkf3f9w
https://youtu.be/EycfjSrI7Tc
https://youtu.be/OW2nOkf3f9w

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Disciplinary Knowledge	√	√	√		√		√
Communication Skills		√		√	√	√	
Critical Thinking	√		√		√		√
Research related skills		√		√		√	
Analytical reasoning		√		√			√
Problem Solving	√	√	√		√		
Team Work		√	√	√	√	√	
Moral and ethical awareness	√			√	√	√	√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III	21MBO33E	ELECTIVE PAPER III- MOLECULAR BIOLOGY AND BIOINFORMATICS	7

COURSE LEARNING OUTCOMES

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

1. Discuss the major events under central dogma of molecular biology such as DNA replication, transcription and translation.
2. Illustrate the difference in major events between the central dogma of molecular biology of eukaryotes and prokaryotes.
3. Summarize the various types of regulation of gene expression in prokaryotes.
4. Infer the different levels of regulations of gene expression in eukaryotes.
5. Explain the significance of biological information resources, NCBI, various DNA databases and the data type DNA sequence.
6. Compare the DNA sequences from organisms using different tools of bioinformatics to conclude the biological significance of DNA sequence information.
7. Develop relation between protein sequence and their utilities with different software programs to derive meaning to various biological phenomena.
8. Extrapolate the proteomic resources for computer aided drug designing and different biological approaches to predict de novo biological outcomes.

UNIT – I

Central Dogma of Molecular Biology – Bacterial DNA replication – Rolling circle model and D-Loop replication; Replication of Eukaryotic DNA – Semi-conservative model – steps and process; Difference between Prokaryotic and Eukaryotic DNA replication; Transcription:Role of RNA polymerase, signals, chemistry and process. Difference between Prokaryotic and Eukaryotic transcription; Translation of polypeptides – initiation, elongation and termination of protein synthesis. Differences and similarities of protein synthesis between Prokaryotic and Eukaryotic organisms.

UNIT –II

Regulation of gene expression in Prokaryotes: Induction and repression in prokaryotes; The operon model: 'lac'- an inducible operon, Positive control of the 'lac' operon by CAP and cyclic AMP, glucose effect; 'trp' – a repressible operon, control of 'trp' operon by attenuation, Regulation of 'ara' operon; Allosteric enzymes and feedback regulation.

UNIT -III

Regulation of Gene expression in Eukaryotes: Transcriptional regulation, Cis and trans factors; Co-operative and on / off regulation, repressors and inducers; transcriptional regulation by sigma factors; Post transcriptional regulation (mRNA capping, pre-mRNA splicing and poly 'A' tail); Translational and post translational Control; Protein targeting; Epigenetic mechanism of gene control; Principles of RNA interference and gene silencing.

UNIT IV

Bioinformatics: Definition and Scope; NCBI, Biotechnological Information Resource: DNA sequence databases – GenBank, DDBJ, EMBL – Sequence and molecular file formats. **Genomics:** Definition – sequence alignment, global and local, pairwise and multiple, scoring matrices (PAM 250) and BLOSUM 62; An overview of BLAST tools available with NCBI. **Gene prediction methods:** (Homology, *ab initio*, and comparative method). Molecular phylogeny (Cladistics and phenetic methods), CLUSTAL and PHYLIP.

UNIT V

Proteomics: Definition, Protein databases: sequence (SWISS PROT), structure (PDB) and structural classification (SCOP). Levels of protein structure, Protein secondary structure prediction (SOPMA and JPRED4). Protein structure modeling methods – homology (SWISS MODEL), *De novo* methods and Threading / Fold recognition. Molecular visualization tool-Swiss PDB Viewer. Outline of computer aided drug designing. System biology – concept and applications.

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lecture
- ❖ Power point Slide Presentations
- ❖ Seminar
- ❖ Assignments
- ❖ Online and Offline Class Practical's
- ❖ Quizzes
- ❖ Group Discussion

TEXT BOOKS

1. Balagurusamy, E. 1985. Programming in BASIC. Tata McGraw Hill Publication Co. Ltd., New Delhi.
2. Smith, D.W. 1994. Biocomputing – informatics and Genome Project. Academic press, Inc., New York.
3. Elliott, W. H. and Elliott, D. C. 2005. Biochemistry and Molecular Biology, 3rd edition. Oxford University, Oxford.
4. Primrose, S.B. and Twyman R.M. 2003. Principles of Genome analysis and Genomics. Oxford University, Oxford.

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1. Andreas D. Baxevanis and Francis Ouellette, B. F. 2005. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. John Wiley & Sons, Inc., Publications, US.
2. David W Mount. 2004. Bioinformatics: sequence and Genome analysis, 2nd edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Primrose, S. B. and Twyman, R. M. 2004. Principles of Genomics and Proteomics, 3rd edition. Blackwell Science Ltd. Oxford, UK.
4. Cullis, C. A. 2004. Plant Genomics and Proteomics. John Wiley & Sons, Inc., Hoboken, New Jersey.
5. Gupta, P .K. 2013. Genetics and Cytogenetics, 7th edition. Rastogi Publications, New Delhi.
6. Ahluwalia, K.B. 2005. Genetics. New Age International Private Ltd. Publishers, New Delhi.

7. Pawar, C. B. 2003. Genetics, Vol. I and II. Himalaya Publishing House, Mumbai.
8. Sheeler, P. and Bianchi, D. 2004. Cell and Molecular Biology, 3rd edition. Wiley, New York, USA.
9. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders College, Philadelphia, USA.
10. Freifelder, D. 1993. Essentials of Molecular Biology. Jones & Bartlett, Boston.
11. Karp, G. 1999. Cell and Molecular Biology: Concept and Experiments. John Wiley and Sons, Inc., USA.
12. Lodish. 2004. Molecular cell biology. COH Freeman & Co. New York.
13. Watson, J.D. 2004. Molecular biology of the gene. Pearson education, Singapore.

ONLINE/E-RESOURCES

http://www.ncbi.nlm.nih.gov/genbank
www.phylogeny.fr/
www.bioinformatics.oxfordjournals.org/egi/content/full/ btp228
www.bioinformatics.org/
www.ebi.ac.uk/

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√	√			√			√
Communication Skills		√			√	√	√	√
Critical Thinking	√			√		√	√	
Research related skills				√	√	√	√	√
Analytical reasoning		√	√	√		√		
Problem Solving		√	√	√		√	√	√
Team Work	√				√	√	√	
Moral and ethical awareness	√				√	√		√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	III	21MBO34P	PRACTICAL PAPER – III (Plant Systematics, Resources and Ethnobotany)	5

COURSE LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Recognize the morphological features of higher plants.
2. Illustrate the plant parts clearly.
3. Classify the plant species.
4. Associate the characters and assign the plants to respective families.
5. Reconstruct the distribution maps based on observations during field visits.
6. Compile the data of economically important plant parts.
7. Generate data on ethnobotanical species and list their uses.
8. Grade the crude drugs based on analysis.

MORPHOLOGY

Diversity of Angiosperms: Morphology of Angiosperm plants.

TAXONOMY

Taxonomic study of plants belonging to the families Nymphaeaceae, Capparidaceae Polygalaceae, Portulacaceae, Zygophyllaceae, Rhamnaceae, Sapindaceae, Combretaceae, Passiflorae, Rubiaceae, Plumbaginaceae, Oleaceae, Boraginaceae, Bignoniaceae, Verbenaceae. Nyctaginaceae, Aristolochiaceae, Santalaceae, Orchidaceae, Scitamineae, Commelinaceae, Palmae, Aroideae and Cyperaceae. (Only Dicot families will be given for identification in practical examination).

Field visits

Botanical study tour for 3 or 4 days to be undertaken for covering various natural habitats and one or two single day collection trips.

Submission of herbarium

Submission of 50 herbarium sheets along with tour/trip report and field notebook.

ECONOMIC BOTANY

Study of the morphology and structure of useful parts of the plants mentioned in the syllabus and collection of plant samples and submission of herbarium sheets.

ETHNOBOTANY

Listing of medicinal plants and medicinal practices of Kurumbas and Irulas Tribes.

PHARMACOGNOSY

Crude Drug analysis

Underground stem	- Ginger
Root	- Belladonna
Bark	- Cinchona
Leaf	- Adhatoda
Flower	- Clove
Seed	- Nutmeg
Fruit	- Coriander
Whole Plant	- Phyllanthus

REFERENCES

1. Gamble. J.S 1935, Flora of Madras Presidency (Vol I, II & III), Calcutta.
2. Gary J. Martin, 1995. Ethnobotany: A Methods Manual, Chapman and Hall, London.
3. Pullaiah, T. Krishnamurthy, K. V. and Bir Bahadur (Eds.). 2017. Ethnobotany of India (5-Volume Set), Apple Academic Press, USA.

ONLINE/E-RESOURCES

http://www.esabii.biodic.go.jp/training/documents/04_Plant_Taxonomy_Manual.pdf
https://bio.libretexts.org/Bookshelves/Botany/Botany_Lab_Manual_(Morrow)

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√		√	√			√	√
Communication Skills		√			√	√		
Critical Thinking	√		√					√
Research related skills				√			√	√
Analytical reasoning				√				√
Problem Solving					√			√
Team Work							√	
Moral and ethical awareness					√	√		

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	III	21MBO35P	PRACTICAL PAPER – IV (Plant Physiology, Molecular Biology and Bioinformatics)	4

COURSE LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Determine the plant physiological parameters
2. Measure the effect of various parameters on vital functions of plants
3. Demonstrate the role of Chlorophyll pigments
4. Observe and analyze the biological databases
5. Generate the bio macromolecular sequences based on the properties
6. Interpret the results of structural features of protein sequences
7. Organize the bio macromolecular sequences based on their properties
8. Identify the candidate drug molecules (ligands) showing best ligand-receptor interactions through docking analysis.

PLANT PHYSIOLOGY

1. Determination of osmotic pressure
2. Determination of water potential of Potato tuber.
3. Extraction and estimation of chlorophyll.
4. Determination of stomatal frequency and stomatal index.
5. Effect of light intensity on the rate of photosynthesis.
6. Effect of quality of light on the rate of photosynthesis.
7. Effect of varying concentrations of CO_2 on the rate of photosynthesis.
8. Separation of chlorophyll pigments using paper chromatography.
9. Measurement of respiration by simple respiroscope.
10. Determination of relative transpiration using a photometer.
11. Effect of temperature on the permeability of cell membrane (demonstration).
12. Effect of auxins on etiolated stem.
13. Hill reaction by isolated chloroplasts (demonstration).
14. Manometric determination of R.Q (demonstration).

MOLECULAR BIOLOGY AND BIOINFORMATICS

1. Observation of electronic representation of Various molecular events/Scheme of events mentioned in the theory syllabus.
2. Observation and analysis of web sites of NCBI, DDBJ, GenBank, EMBL, PDB, SWISS PROT, SCOP, SOPMA and JPRED4
3. Perform BLAST search with DNA and Protein sequences and evaluate the results.
4. Multiple sequence analysis and phylogenetic tree construction using CLUSTAL X and NJ Plot
5. Visualization of protein structure with Swiss PDB Viewer
6. Protein structure modeling using SWISS MODEL
7. Docking analysis of disease targets with plant based metabolic inhibitors

TEXT BOOKS

1. Bala, M., Gupta, S., Gupta, N. K., and Sangha, M. K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers, India.
2. Mani, K. and Vijayaraj, N. Bioinformatics a Practical Approach, Aparna Publications, Coimbatore.
3. Rajan, S. S. 2001. Practical manual of plant ecology and plant physiology. Anmol Publications, New Delhi.
4. Shanmughavel, P. and Gulshan Wadhwa. 2009. Practicals in Bioinformatics, PointerPublishers, Jaipur.
5. Sivakumar, R., Boominathan, P. and Chandrasekhar, C.N. 2015. Practical Plant Physiology. Narendra Publishing, Jammu.
6. Sharma, R.K. and Sangha, S.P.S. 2009. Basic Techniques in Biochemistry and Molecular Biology. I.K. International Pvt. Ltd., New Delhi.
7. Nagarajan, P. and Senthilkumar, N. 2001. Molecular biology principles and methods a practical approach: Sree Narmatha Printers, Coimbatore.

REFERENCE

1. Andreas D. Baxevanis and Francis Ouellette, B. F. 2004. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley and Sons, USA.
2. Miller, H., Witherow, D. S. and Carson, S. 2012. Molecular Biology Techniques: A Classroom Laboratory Manual. 3rd ed. Academic Press, San Diego, CA, USA.
3. Glick and Thompson. 1993. Methods in plant Molecular Biology & Biotechnology. CRC Press, BR, Florida, USA.

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge		√	√	√	√			√
Communication Skills	√		√					
Critical Thinking				√		√		
Research related skills		√				√		
Analytical reasoning			√		√	√		
Problem Solving							√	√
Team Work		√	√					√
Moral and ethical awareness					√			√

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	IV	21MBO41C	PAPER-IX GENETICS, CYTOGENETICS AND PLANT BREEDING	7

COURSE LEARNING OUTCOMES

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

1. Relate inheritance in plants to Mendelian principles
2. Assess allelic and non-allelic interaction in inheritance
3. Illustrate the significance of crossing over, recombination of characters and mutations
4. Analyze the DNA damage and defend the DNA repair mechanisms
5. Distinguish different extra chromosomal inheritance in plants
6. Prioritize the chromosomal variations and their role in ploidy of an organism
7. Judge the relationship between population and its genetics.
8. Classify different plant breeding methods for hybrid production and disease resistance and other preferable traits.

Unit-I

Mendel's experiments and Principles of inheritance; Back cross and Test cross; Gene interactions: Allelic Interaction (Incomplete dominance, Codominance, Lethal genes); Non-allelic Interaction (Complementary gene, Supplementary gene, Duplicate gene and Dominant epistasis); Multiple alleles; Quantitative Genetics: Quantitative traits - Multiple factor hypothesis.

Unit -II

Linkage and Crossing over: Coupling and repulsion phases; Interference and Coefficient of Coincidence, Molecular Mechanism of Crossing Over, Holliday model of recombination; Mutation (Spontaneous and Induced mutation); Physical and chemical mutagens; Molecular basis of mutation; Transposable elements in Prokaryotes and Eukaryotes; Chromosome mapping

Unit -III

DNA damage and DNA repair mechanisms (Dark repair, Photo reactivation, Excision repair, Post-replication recombination repair and SOS repair); Proto-oncogenes and oncogenes; Sex determination: Sex determining mechanisms; Extra chromosomal inheritance: Cytoplasmic Male Sterility (eg. Maize), Plastid inheritance (eg. *Mirabilis).*

Unit -IV

Variation in chromosome structure (Deletion, Inversion, Duplication and Translocation); Variation in chromosome number: Euploidy- Autopolyploidy and Allopolyploidy, Aneuploidy- Trisomics, Monosomics and Nullisomics. Polyploidy in Plants, Role of Polyploidy in Evolution (eg. Wheat); Population Genetics: Gene frequency, Hardy-Weinberg Law, Factors influencing Hardy-Weinberg equilibrium (Natural selection, Genetic Drift and Mutation).

Unit -V

Plant breeding: Methods of Plant Improvement-Introduction and Acclimatization, Selection - Mass selection - Pure line selection - Clonal selection. Hybridization: Methods of Hybridization (Pedigree method, Bulk method, Backcross method, Multiple cross method), Heterosis. Heritability, General Combining Ability (GCA), Specific Combining Ability (SCA). Mutation breeding: Breeding for disease resistance; Breeding of Wheat, Potato, Paddy and Cotton. Polyploidy breeding, Role of Biotechnology in Plant Breeding.

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lectures
- ❖ Powerpoint slide presentations
- ❖ Animated demonstration video sessions
- ❖ Assignments and Seminars
- ❖ MCQ assessments

TEXT BOOKS

1. Gupta, P. K. 2007. Genetics: Classical to Modern, 1st edition. Rastogi Publications, Meerut, India.
2. Shukla, R. S. and Chandel, P. S. 1988. Cytogenetics, Evolution and Plant Breeding. S. Chand & Company (Pvt) Ltd, New Delhi.
3. Gupta, P. K. 2013. Genetics and Cytogenetics. 7th edition. Rastogi Publications, New Delhi.
4. Sharma, J. R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Ahluwalia, K.B. 2005. Genetics, 1st edition. New Age International Private Ltd. Publishers, New Delhi.
6. Basu, S.B. and Hossain, M. 2006. Principles of Genetics. Books & Allied (P) Ltd, Kolkata.
7. Mahabal Ram. 2010. Fundamentals of Cytogenetics and Genetics. PHI Learning Private Limited, New Delhi.

REFERENCES

1. Peter J Russell. 1987. Essential Genetics, 2nd edition. Blackwell Scientific Publications, London.
2. David Freifelder. 1998. Molecular Biology, 2nd edition. Narosa Publishing House, New Delhi.
3. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
4. Gardner, E. J. Simmons, M. J. and Snustad, D.P. 1991. Principles of Genetics, 8th edition. John Wiley & Sons, Inc., New York.

ONLINE / E-RESOURCES

https://www.videezy.com/free-video/genetic
https://www.mysciencework.com/publication/download/lecture-notes-cell-biology
https://www.youtube.com/watch?v=1WuwwYcDHMg
https://www.slideshare.net/earshadshinichi/cell-biology-the-cell-its-structure-and-history
https://www.youtube.com/watch?v=OIN4keY8q3k
https://www.classcentral.com/course/swayam-plant-developmental-biology-14235
https://www.classcentral.com/course/best-practice-farming-sustainable-2050-9575
https://swayam.gov.in/nd1_noc19_bt15/preview
https://www.classcentral.com/report/list-of-mooc-based-microcredentials
https://www.classcentral.com/tag/genetics
https://swayam.gov.in/nd2_cec20_bt06/preview

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√				√	√		√
Communication Skills		√	√				√	√
Critical Thinking		√	√		√		√	
Research related skills		√	√	√		√		√
Analytical reasoning	√			√	√	√		√
Problem Solving		√	√		√		√	√
Team Work	√			√			√	√
Moral and ethical awareness	√			√			√	√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV	21MBO42C	PAPER – X PLANT ECOLOGY, CONSERVATION AND PHYTOGEOGRAPHY	7

COURSE LEARNING OUTCOMES

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

1. Interpret the biotic and abiotic factors of a holistic environment.
2. Compare and contrast the effect of ecological parameters on population in an ecosystem.
3. Integrate the methods of *in situ* and *ex situ* conservation of plants.
4. Judge the organization of an ecosystem.
5. Hypothesize the impact of pollution on the ecosystem and choose the relevant method of handling e-waste.
6. Assess the effects of deforestation and soil erosion on vegetation.
7. Predict the vegetation parameters using the latest techniques and construct and interpret the vegetation map of any ecosystem.

Unit –I

Environmental factors: Interpretation of effects of climatic, edaphic, topographic and biotic factors; Principle of limiting factors: trigger factors and significance of holistic environment; Population ecology: growth curve, biotic potential and age structure. Community ecology; Micro and Macro Climatic change and Global Warming concepts.

Unit – II

Methods of studying vegetation: Floristic, Physiognomic and Phytosociological methods; Concepts of vegetation structure – Units of vegetation; Succession: Concepts, kinds and impact of human interference on succession; Conservation: *in situ* and *ex situ*, Gene bank, Arboretum, Bambusetum, Botanical garden, Biosphere reserves, Sacred grooves. Bioethics on conservation. Status of Biodiversity Conservation in India.

Unit – III

Types of Ecosystem; Trophic structure, Ecological pyramids, Ecological niche, Food chain and Food web; Energy flow, Ecological energetics, Production ecology and biogeochemical cycles (Carbon cycle, Nitrogen cycle). Human impact on ecosystem: Pollution, types (air, water, soil, noise and radioactive pollution); Bioremediation; E- Waste: Concept and management.

Unit – IV

Forestry: Indian forest types and forest products of India; Deforestation, soil erosion and soil conservation; Forest genetic resources management: Scope and Objectives, Afforestation, Social forestry and Clonal forestry (selection and vegetative propagation); Mapping: Conservative method and Satellite Mapping. Exobiology; Remote sensing: Principle and GIS – application; Vegetation types: Rain forest, Deciduous forest, Mangroves and scrub jungle.

Unit – V

Plant geography: Plant distribution – concept, Age and Area hypothesis; Theory of Continental drift; Theory of endemism; Patterns: Cosmopolitan, pan tropical, continuous, discontinuous, endemic distribution; Plant indicators and environmental monitoring; Phytogeographical domains of World and India. Environmental Laws.

PEDAGOGY STRATEGIES

- Board and Chalk lectures
- Power point slide presentations
- Animated demonstration video sessions
- Assignments and Seminars
- MCQ assessments
- Field Study

TEXT BOOKS

1. Sharma, P. D. 1994. Environmental Biology. Rastogi and Company, Meerut.
2. Agarwal, A.K. and Deo, P.P. 2006. Plant Ecology.Agrobios (India), New Delhi.
3. Kumar, H. D. 2007. Modern concepts of Ecology, 8th edition, UBS Publishers & Distributors Pvt. Ltd. New Delhi.
4. Shukla, R. S. and Chandel. P. S. 2007. A text book of Plant Ecology, 11th edition. S. Chand and Company Ltd. New Delhi.
5. Sharma, P.D. 2009. Ecology and Environment, 10th edition. Rastogi Publications, New Delhi.

REFERENCES

1. Clifford B. Knight, 1971. Basic Concepts of Ecology: The Macmillan Company Collier – Macmillan Ltd. London.
2. Verma R.S. and Agarwal, V.K. 1998. Concepts of Ecology: C. Chand and CompanyLtd. New Delhi.
3. Surendran, C. Parthiban, K.T. Vanangamudi, K. and Balaji, S. 2000. Vegetative Propagation of Trees (Principles and Practices), TNAU, Coimbatore.
4. Tyler, G. and Miller, J.R. 2010. Environmental Science. Cengage Learning India Pvt. Ltd. New Delhi.
5. Ambasht, R.S. and Ambasht, N. K. 2011. A text book of Plant Ecology. CBS Publishers and Distributors Pvt. Ltd., New Delhi.
6. Odum, E.P. and Barrett, G. W 2005. Fundamentals of Ecology, 5th Edition, Thomas Brooks/Cole, Belmont, CA.

ONLINE/E-RESOURCES

https://www.youtube.com/watch?v=qtTLiQoYTyQ
https://www.youtube.com/watch?v=208B6BtX0Ps
https://www.youtube.com/watch?v=6p1TpVJYTds
https://www.youtube.com/watch?v=lC3XSwQ62iw
https://www.youtube.com/watch?v=V49IovRSJDs

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**						
	1	2	3	4	5	6	7
Disciplinary Knowledge	√		√	√		√	√
Communication Skills			√		√	√	√
Critical Thinking		√	√			√	√
Research related skills			√	√		√	√
Analytical reasoning		√			√	√	√
Problem Solving	√		√	√		√	√
Team Work	√		√		√	√	√
Moral and ethical awareness	√		√	√	√		√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV	21MBO43E	ELECTIVE PAPER – VI BIOTECHNOLOGY	7

COURSE LEARNING OUTCOMES:

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

1. Know various tools and techniques of plant tissue culture.
2. Perform micropropagation and regenerate plants through *in vitro* organogenesis and somatic embryogenesis.
3. Illustrate and infer the significance of haploid production.
4. Assimilate the techniques for gene construction and isolation of genes of interest in plants.
5. Incorporate the concepts of rDNA technology for production of transgenic plants.
6. Recognize the applications of transgenic technology for various stress resistance in plants.
7. Summarize the necessity of IPR, biosafety and bioethics related to transgenic plant production.

Unit –I

Plant Tissue culture: Introduction, Laboratory Organization, Culture Media (MS, White's, Knudson's & LS), Sterilization techniques, Somoclonal variation, Micropropagation - callus culture, nodal culture and meristem culture. Somatic embryogenesis and Synthetic seed production.

Unit –II

Haploid plants: (Anther, pollen, ovary and ovule culture); Embryo culture; Single cell culture, Protoplast isolation culture and Somatic hybridization, Cybridization; Production of Secondary metabolites -cell suspension culture and establishing plant cell lines; Germplasm conservation.

Unit – III

Recombinant DNA technology: Aim and scope of rDNA technology, Basic steps in Genetic Engineering; Tools and techniques of genetic engineering, cloning vectors (Plasmid, Phage, Cosmid and Yeast); Specialized vectors (Fusion and expression vectors); Selection of recombinant clones.

Unit – IV

Agrobacterium and crown gall tumors; Mechanism of T-DNA transfer; Disarmed Ti Plasmid vectors (Cointegrate and Binary vectors); plant viral vectors (TMV and CaMV); Direct gene transformation methods (Particle gun bombardment, Electroporation, $CaCl_2$, PEG and Liposome mediated transformation); Selectable markers and promoters used in plant genetic engineering; Engineering plants for Herbicide resistance and insect resistance (Bt Cotton).

Unit – V

Genetic engineering of plants for virus resistance, salt and drought tolerance, Cytoplasmic male sterility, antisense RNA technology; Flavr – Savr Tomatoes, Golden rice, Biodegradable plastics, High lysine corn. Intellectual property right; Patenting of biological material; Biosafety and Bioethics. Introduction to Nanobiotechnology - Bio-nanomaterials and applications in agriculture and medicine

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lectures
- ❖ Power point slide presentations
- ❖ Animated/demonstrative video sessions
- ❖ Assignments and Seminars
- ❖ MCQ assessments

TEXT BOOKS

1. Dubey, R. C. 1998. Textbook of Biotechnology. S. Chand & Co., New Delhi.
2. Singh, B. D. 1998. Biotechnology. Kalyani publishers, Ludhiana.
3. Narayanasamy, S. 2000. Plant Cell and Tissue Culture: Tata McGraw- Hill Publishing & Co. Ltd., New Delhi.
4. Balasubramanian. 2002. Concept of Biotechnology. University Press.
5. Gupta, P. K. 2004. Elements of Biotechnology. Rastogi Publications, New Delhi.
6. Primrose, S. Twynman, R. and Old, P. 2005. Principles of gene manipulation. Blackwell Science Ltd., New Delhi.
7. Sathyanarayana, U. 2005. Biotechnology. Books and Allied (P) Ltd., New Delhi.
8. Glick, B.R and Patten C.L. 2017. Molecular Biotechnology, 4th edition. ASM Press, New Delhi.

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1. Rienert, J. and.Bajaj, Y.P.S. 1989. Plant Cell, Tissue and Organ Culture. Narosa Publishing House, New Delhi.
2. Chawla, H. S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co., New Delhi.
3. Smith, R. H. 2000. Plant tissue Culture – techniques and Experiments. Academic Press, New York.
4. Dwivedi, P. 2004. Plant Tissue culture. Scientific publishers, New Delhi.
5. Harry Levine. 2006. Genetic Engineering - A Reference Hand book. ABC – CLIO Inc., California.
6. Purohit, S. S. 2006. A Laboratory Manual Plant Biotechnology. Agrobios (India), Jodhpur.
7. Giri, C. C. and Archana Giri. 2007. Plant Biotechnology Practical Manual. I.K. International Publishing House Pvt. Ltd., New Delhi.
8. Verma, P. S. and Agarwal, V. K. 2009. Genetic Engineering. S. Chand & Company New Delhi.

ONLINE / E-RESOURCES

https://nptel.ac.in/courses/102/103/102103016/

https://nptel.ac.in/content/storage2/courses/102103016/module1/lec1/4.html

https://nptel.ac.in/courses/102/103/102103013/
https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod6.pdf

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	Course Level Outcome (CLO)						
	1	2	3	4	5	6	7
Disciplinary Knowledge	√		√		√		
Communication Skills		√				√	√
Critical Thinking		√		√	√		√
Research related skills		√		√	√		
Analytical reasoning		√	√				√
Problem Solving					√	√	
Team Work		√		√			
Moral and ethical awareness		√	√				√

Year	Sem.	Subject Code	Title of the paper	Hours/ Week
2021 -2022 onwards	IV	21MBO44P	PRACTICAL PAPER – V (Genetics, Cytogenetics, Plant Breeding, Plant Ecology, Conservation, Phytogeography and Biotechnology)	5

COURSE LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Solve the genetic problems readily
2. Construct chromosome maps based on distance between genes
3. Calculate the gene frequency
4. Manipulate the ornamental plants using hybridization techniques
5. Determine the ecological parameters of a given area
6. Construct quadrant and compile the data on distribution of plants
7. Design the Protocols for establishing cell/organ culture
8. Separate genomic DNA/Plasmid DNA and Protoplast from plant cells

GENETICS, CYTOGENETICS AND PLANT BREEDING

1. Genetics problems related to monohybrid cross, dihybrid cross, test cross, back cross, incomplete dominance, co-dominance and dominant epistasis
2. Chromosomal mapping
3. Calculation of gene and gene frequency using Hardy – Weinberg's equilibrium.
4. Hybridization techniques using potted plants
5. Schematic flowchart of bulk and pedigree methods
6. One day training may be arranged on Plant Breeding aspects

PLANT ECOLOGY, CONSERVATION AND PHYTOGEOGRAPHY

1. Study of community structure by quadrats and transects (line & belt).
2. Determination of density, abundance and frequency of species.
3. Raunkiaer's biological spectrum and Raunkier's leaf size, plant maps.
4. A knowledge of equipment used to measure various climatic factors.
5. Determination of soil moisture, pH, EC and humus content.
6. Mapping the distribution of forest types in India and Tamil Nadu.
7. Mapping the phytogeographical regions in India.
8. Continental drift.
9. Forest based produces (major & minor)
10. Vegetative propagation methods.

BIOTECHNOLOGY

1. Sterilization techniques (Fumigation, Flame sterilization, Dry heat, Wet heat, Filter sterilization)
2. MS media preparation
3. Isolation of protoplasts (Mechanical method)
4. Callus culture
5. Nodal culture
6. Synthetic seed production
7. Isolation of Genomic DNA from Cauliflower
8. Isolation of Plasmid DNA (Protocol only)
9. Visit to Biotechnology Laboratories

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1. Bharadwaj, D. N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
2. Dixon, R.A. and Gonzales, R.A. 1994.Plant cell culture: A Practical approach, 2nd ed. Oxford University Press, UK.
3. George, E.F. 1999. Plant Propagation by Tissue Culture: Volume 1 & 2. Exegetics Limited, Worcester, UK.
4. Jackson, S. A., Kianian, S. F., Hossain, K. G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323- 333). Springer, New York, NY.
5. Rajan, S. S. 2001. Practical manual of plant ecology and plant physiology. Anmol Publications, New Delhi.
6. Richards, A. J. 1997. Plant breeding systems. Garland Science, New York
7. Vodopich, D. 2009. Ecology Lab Manual. McGraw-Hill Education, New York, USA.

COURSE LEVEL MAPPING WITH PROGRAMME LEVEL OUTCOME

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**							
	1	2	3	4	5	6	7	8
Disciplinary Knowledge	√	√	√	√	√	√		
Communication Skills	√				√			
Critical Thinking	√	√	√	√			√	
Research related skills		√				√		√
Analytical reasoning				√	√	√		
Problem Solving				√			√	
Team Work						√		√
Moral and ethical awareness					√			√

7 TEACHING LEARNING METHODOLOGIES

The learning outcomes-based course curriculum framework of botany is designed to persuade the subject specific knowledge as well as relevant understanding of the course. The academic and professional skills required for botany-based professions and jobs are also offered by same course in an extraordinary way. In addition, the learning experiences gained from this course should be designed and implemented for cognitive development in every student. The practical associated with this course helps to develop an important aspect of the teaching-learning process. Various types of teaching and learning processes will need to be adopted to achieve the same. The important relevant teaching and learning processes involved in this course are;

- ✓ Class lecturesSeminars
- ✓ Assignment
- ✓ Tutorials
- ✓ Field Trips
- ✓ Group discussions and Workshops
- ✓ Peer teaching and learning
- ✓ Question preparation
- ✓ Subjective type
- ✓ Long answer
- ✓ Short answer
- ✓ Objective type
- ✓ Multiple choice questions
- ✓ One answer/two answer type questions
- ✓ Assertion and reasoning
- ✓ Practicals and project-based learning

8 ASSESSMENT AND OUTCOME MEASUREMENT

Academic performance in various courses i.e., core, discipline electives, generic electives and skill enhancement courses are to be considered as parameters for assessing the achievement of students in botany. A number of appropriate assessment methods of botany will be used to determine the extent to which students demonstrate desired learning outcomes. Following assessment methodology should be adopted;

- ✓ The oral and written examinations (Scheduled and surprise tests),Closed-book and open-book tests,
- ✓ Problem-solving exercises,
- ✓ Practical assignments and laboratory reports,Observation of practical skills,
- ✓ Individual and group project reports,
- ✓ Efficient delivery using seminar presentations,
- ✓ Viva voce interviews are majorly adopted assessment methods for this curriculum.
- ✓ The computerized adaptive testing, literature surveys and evaluations, peers and self- assessment, outputs form individual and collaborative work are also other important approaches for assessment purposes.

MODEL QUESTION PAPER

GOVERNMENT ARTS COLLEGE

(Autonomous)

(Reaccredited "A" Grade by NAAC)
Affiliated to Bharathiar University,
Coimbatore – 641 018

21MBO11C REG. NO.....

M.Sc. DEGREE EXAMINATIONS , JANUARY/ FEBRUARY -2022
BOTANY SEMESTER – I

MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Time :2Hrs. **Max. Marks : 50**

PART - A (5 x 1 = 5 Marks)

I Choose the best answer

1. Bacterial cell wall is made up of _____
   a. Peptidoglycan b. Cellulose c. Chitin d. Sucrose
2. A bacterial host with a prophage is called _____
   a. glycogen b. lysogen c. viroids d. endospore
3. Yeasts are _____
   a. single celled prokaryotic organism b. multi celled prokaryotic organism
   c. multi celled eukaryotic organism d. single celled eukaryotic organism
4. Lichens growing on soil are known as_____
   a. Corticoles b. Saxicoles c. Terricoles d. Fericoles
5. Blast disease occurs in _____
   a. Grapes b. Paddy c. Banana d. Cotton

II Short answer (25 words) **(3 x 2 = 6 Marks)**

Answer any THREE question

6. Define Eubacteria
7. Bring out the characteristics of mycoplasma?
8. Furnish a short note on Saprophytes
9. State the types of Ascocarp
10. Define the term Disease

PART - B (5 x 3 = 15 Marks)

III Short answer (100 words)

11 a. Analyze the Whittaker's Five Kingdom Classification

or

b. Summarize the Characteristic Features of Cyanobacteria with examples

12 a. Comment on Penicillin

or

b. *Bacillus thuringiensis is a potential biopesticide - Discuss*

13 a. *Enumerate the* Characteristics of Fungi

or

b. Give the outline of fungal classification proposed by Alexopoulos and Mims

14 a. Elucidate the general features of Basidiomycotina

or

b. Mycorrhiza as bioinoculant - Discuss

15 a. Clarify the chemical defense mechanism of plants against pathogens

or

b. Expound the detailed account on disease forecasting methods

PART - C (3 x 8 = 24 Marks)

Answer any THREE questions

16. Explicate various Sterilization methods
17. Depict the life cycle of Viruses
18. Comment on the reproduction of fungi
19. Enumerate the economic importance of Lichens
20. Describe about Cotton blight disease

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