

Master of Science in Botany

Course Structure and Syllabus

For students admitted from academic year 2025-26 onwards

(Regulations:R25)



Department of Biosciences & Biotechnology

Krishna University

Machilipatnam – 521004
Andhra Pradesh

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➤ **VISION**

- ❖ To strive for all round development of students for attainment of scientific empowerment both in teaching and research and self-reliant as well.
- ❖ To establish multi-institutional, interdisciplinary and international collaborations in thrust areas of scientific research so as to acquire national and international recognition.
- ❖ To develop advanced characterization facilities for cutting edge research with a roadmap towards the establishment of Centre for plant tissue culture.
- ❖ To strive for transformation of laboratory research towards industrial scale so as to acquire industrial collaboration and funding as well.

➤ **MISSION**

- ❖ Dissemination of knowledge through research-based teaching and learning processes with a motive to inculcate strong research attitude in student community.
- ❖ Build good character and educate students so as to become enlightened individuals, improving the living standards of their families and society.

➤ **PROGRAMME OBJECTIVES**

- ❖ To develop the basic and applied concepts in core areas of Botany.
- ❖ To perform the experiments in order to inculcate the critical thinking with proper interpretation and analysis of results with logical thinking.
- ❖ To develop the critical analysis and problem-solving skills of students required in the application of principles of Botany.
- ❖ To undertake small academic and/or research projects in the area of interest and Preparation of document/present a technical report/ dissertation/document.
- ❖ To Prepare the students with a working knowledge of experimental techniques required to work independently.
- ❖ To strengthen student's capability in organizing and presenting the acquired knowledge both in oral and written discourse.

➤ **PROGRAMME OUTCOMES**

- ❖ To acquire knowledge and understanding of fundamental and applied concepts, principles and theories related to the identified subject areas.
- ❖ To plan, execute and analyze the experiments either individually or as a part of team.

Signature of H. K. Kumbhar
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Signature of H. K. Kumbhar
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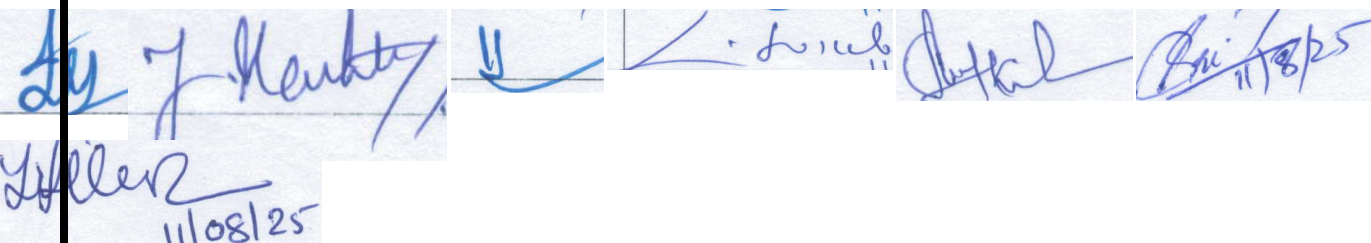
Signature of H. K. Kumbhar
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Signature of H. K. Kumbhar
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- ❖ To develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory.
- ❖ To demonstrate written and oral communication skills for dissemination of scientific results in report, article, or oral presentation formats, which helps to develop his/her professional development.

COURSE STRUCTURE AND REQUIREMENTS FOR M.Sc. BOTANY
(REGULATION: R25)

1	Title of the Program	M.Sc. BOTANY
2	Duration of the Program	2 years (Four Semesters)
3	Eligibility criteria for admission	The candidate seeking admission into M.Sc. Botany Program should have passed Bachelor's Degree Examination not less than three years duration in any discipline with Botany as one of the subjects or biological sciences with Botany at 10+2 level.
4	Level of the Program	Post Graduate.
5	Mode of Admission	The mode of admission is through APPGCET conducted by Andhra Pradesh State Council of Higher Education or KRUCET conducted by Krishna University.
6	Objectives of the Program	The Objective of M.Sc. Botany Program is to impart knowledge in basic and applied concepts in core areas of Botany as well as recent advances in Botany, training in experimental skills with an aim to develop research in industry and academic orientation.
7	Program requirements	The Program shall include theory (core as well as non-core, open electives, specializations) papers, Laboratories, Tests, Seminars and Project Work.
8	Number of working days	In each semester at least ninety (90) working days must be dedicated for theory classes, practical classes, seminars and project work.


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KRISHNA UNIVERSITY: :MACHILIPATNAM
COURSE STRUCTURE FOR M.Sc. BOTANY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS) & OUTCOME BASED EDUCATION (OBE)
W.E.F 2025-26 (R25 Regulations)

I SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE /IDC/ DSE/ SEC/ OEC/ MOOCS	Internal Marks	External Marks	No. of Credits
		Lecture (L)	Practical (P)	Tutorial (T)				
25BOT101	Cell Biology	4	0	0	Core	30	70	4
25BOT102	Genetics	4	0	0	Core	30	70	4
25BOT103	Biomolecules	4	0	0	Core	30	70	4
25BOT104	Biodiversity of non-flowering plants	4	0	0	Core	30	70	4
22 BOT 105 Compulsory	Personality Development through Life Enlightenment Skills	3	1	0	Core	30	70	3
25BOTL101	Cell Biology & Genetics	0	6	0	Core	30	70	3
25BOTL102	Biomolecules and Biodiversity of non-flowering plants	0	6	0	Core	30	70	3
TOTAL FOR FIRST SEMESTER						210	490	25

II SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE /IDC/ DSE/ SEC/ OEC/ MOOCS	Internal Marks	External Marks	No. of Credits
		Lecture (L)	Practical (P)	Tutorial (T)				
25BOT201	Bioanalytical techniques	4	0	0	Core	30	70	4
25BOT202	Plant Ecology	4	0	0	Core	30	70	4
25BOT203	Biosystematics of Angiosperms	4	0	0	Core	30	70	4
25BOT204 Compulsory	Research Methodology& IPR	3	1	0	SEC	30	70	3
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
25BOTDSE201	Plant Molecular Biology	4	0	0	DSE	30	70	4
25BOTDSE202	Horticulture	4	0	0	DSE	30	70	4
25BOTDSE203	Marine Botany	4	0	0	DSE	30	70	4
LAB PRACTICALS								
25BOTL201	Bioanalytical techniques & Plant Ecology	0	6	0	Core	30	70	3
25BOTL202	Biosystematics of Angiosperms and plant molecular biology	0	6	0	Core	30	70	3
25BOTOM201	Foundations of Quantum Science for Life Sciences	0	4	0	OM	30	70	4
TOTAL FOR SECOND SEMESTER						210	490	25

At the end of 2nd semester, every student must undergo summer Internship/ Apprenticeship/Project work/Industrial training/research-based Project work for Six weeks and must prepare a report concerned as per approved project guidelines and submit the same to the University 14 days before the commencement of third semester end examinations.

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III SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / IDC/ DSE/SEC/ OEC/MOOCs	Internal Marks	External Marks	No. of Credits
		Lecture (L)	Practical (P)	Tutorial (T)				
25BOT301	Plant Reproduction	4	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
25BOTDSE301	Plant Physiology	4	0	0	DSE	30	70	4
25BOTDSE302	Plant Genetic Engineering	4	0	0	DSE	30	70	4
25BOTDSE303	Plant tissue culture	4	0	0	DSE	30	70	4
25BOTDSE304	Cytogenetics	4	0	0	DSE	30	70	4
25BOTDSE305	Ethnobotany	4	0	0	DSE	30	70	4
25BOTDSE306	Paleobotany	4	0	0	DSE	30	70	4
LAB PRACTICALS								
25BOTLAB301	Plant Reproduction & Plant Physiology	0	6	0	Core	30	70	3
25BOTLAB302	Plant Genetic Engineering & Plant tissue culture	0	6	0	Core	30	70	3
OPEN ELECTIVE (INTERDISCIPLINARY/MULTIDISCIPLINARY) COURSES (CHOOSE ANY ONE)								
25BOTOEC301		3	0	0	OEC	30	70	3
25BOTOEC302		3	0	0	OEC	30	70	3
25BOTOEC303		3	0	0	OEC	30	70	3
TOTAL FOR III SEMESTER						210	490	25

IV SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / IDC/DSE/ SEC/OEC/ MOOCs	Internal Marks	External Marks	No. of Credits
		Lecture (L)	Practical (P)	Tutorial (T)				
25BOT401	Plant Breeding	4	3	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
25BOTDSE401	Plant resources and Utilization	4	3	0	DSE	30	70	4
25BOTDSE402	Sustainable agriculture	4	0	0	DSE	30	70	4
25BOTDSE403	Plant Biochemistry	4	0	0	DSE	30	70	4
25BOTDSE404	Plant Pathology	4	0	0	DSE	30	70	4
25BOTDSE405	Bio membranes & Bioenergetics	4	0	0	DSE	30	70	4
25BOTDSE406	Pharmacognosy	4	0	0	DSE	30	70	4
LAB PRACTICALS								
25BOTL401	Plant Breeding & Plant resources and Utilization	0	6	0	Core	30	70	3
ENTREPRENEURIAL & INNOVATION/IT SKILL RELATED TO DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
25BOTSEC401	Mushroom cultivation	3	0	0	SEC	30	70	3
25BOTSEC402	Olericulture	3	0	0	SEC	30	70	3
25BOTSEC403	Seed technology	3	0	0	SEC	30	70	3
* CHOOSE MOOCs FROM SWAYAM/NPTEL SOURCES								
25BOT MOOCs 401								4
25 BOTP401- PROJECT WORK EVALUATION AND VIVA-VOCE							100	4
						180	520	30

Open electives offered by Biosciences & Biotechnology to the other departments

25BITOEC301	Entrepreneurship in Biotechnology
25BITOEC302	Gender based Health & Education
25BITOEC303	Food & Nutrition

L – Lecture, T- Tutorial & P – Practicals

Note: Students may be allowed to register and appear for MOOCS from the third semester itself. However, students are to complete the MOOCS successfully and submit pass certificate of the same to the University through the Principal of the College concerned for approval and endorsement of the same on grade cards and PCs and ODs as per the regulations of the University.

22 BOT P401: PROJECT WORK EVALUATION AND VIVA-VOCE

A). Research activity: A short research activity on any significant or interesting aspects of the works (preferably relevant to the students' field of study/specialization) has to be performed or observed by a student in the organization. As part of curriculum students are required to write a short report generally named as a Research activity under the guidance of supervisor.

B). Purpose of Research activity: The basic purpose of writing a Research activity is to allow students to explore the breadth of research that is performed within the organization. For students, this breadth of exposure to outside research may prove fruitful as a platform for their own research at some later point (can be extended to as a thesis topic for Ph.D. degree) and also for career connections/employment opportunities prior to post graduation through demonstrating their competences in research techniques. It is up to the student to choose/select the title/topic for Research activity from any interesting aspects of their duties they are involved. However, the supervisor may also assist the student in selecting the Research Activity Report title that can satisfy him/her expectation as well as it is related to the student's fields of study. It is expected that the supervisor stays in regular contact with the student for monitoring and checking the smooth progress of the research activity and assuring and contributing to the assessment. Supervisor is expected to provide feedback on student performance to the HoD.

c) Project Evaluation:

Out of a total of 100 marks, 20 marks for Pre- Project Review, 50 marks shall be for Project report/dissertation/record and 30 marks for the End Semester Examination (Viva-voce). The Viva- Voce shall be conducted by a committee consisting of HOD, Project Supervisor and an Examiner nominated by the University.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, I SEMESTER

Course Name	CELL BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOT101	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

The focus of Cell Biology is the study of the structure and function of the cell. In this course we will focus on Eukaryotic cell biology and will cover topics such as membrane structure and composition, transport, and trafficking; the cytoskeleton and cell movement; the breakdown of macromolecules and generation of energy; and the integration of cells into tissues. We will also cover important cellular processes such as cell cycle regulation, signal transduction, apoptosis (programmed cell death), and cancer cell biology.

❖ **Course Learning Objective(s):**

- To make the learners understand the functional aspects of the cell at molecular level.
- To focus on the up-coming molecular mechanisms involving the membrane organization and signal transduction.
- To understand the inheritance pattern at molecular level.

❖ **Course Learning Outcome(s):**

- Students will be able to explain the basic concepts of cell biology.
- Students will learn a variety of skills necessary to function as a biologist in the workplace or as a candidate for an advanced degree.

❖ **Course Content**

UNIT –I: Structure and Functions of Cells

Discovery of the cell and the cell theory, exceptions to the cell theory. Cell shape, cell size and cell number.

Prokaryotic vs eukaryotic cells. Cell motility in prokaryotes and eukaryotes by cilia and flagella. Cytoskeleton: Microfilaments (actin filaments), microtubules, and intermediate filaments.

UNIT–II: Structure and Function of Major Cellular Organelles

Structure and function of cell wall, plasma membrane, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria and chloroplast. Structure and role of ribosomes.

UNIT–III: Nucleus and Chromatin

Structure and function of nuclear membrane. Organization of nuclear material in prokaryotes and eukaryotes. Eukaryotic chromosome – Histone proteins and nucleosomes.

Organization of metaphase chromosome in eukaryotes. Chromosome banding pattern, polytene and lamp brush chromosomes. Organization of nucleolus.

UNIT –IV: Cell cycle, apoptosis and cancer

Phases of cell cycle-Cell division by mitosis and meiosis, Regulation of cell cycle: Discovery of MPF, cyclins and cyclin dependent kinases, Check points- role of Rb and p53.

Apoptosis- caspases, Pathways of apoptosis.

Cancer- Types and stages of cancer, characteristics of cancer cell, carcinogens, carcinogenesis, protooncogenes, oncogenes, & Tumour suppressor genes,

Molecular basis of cancer, cell senescence.

UNIT – V: Cell –Cell Interactions and Signalling

Cell to cell interaction–Micro villi, tight junctions, gap junctions, desmosomes. Cell adhesion and cell signalling (autocrine, paracrine, synaptic and endocrine).

Second messengers–Types (Cyclic AMP, Cyclic GMP, IP₃, DAG, Calcium ions) and mechanism of action.

Text books:

1. Verma P.S and Agarwal V.K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd
2. Lewin B. 2008. Genes IX. Jones and Bartlett publishers
3. Satyanarayana U. 2007. Biotechnology. Books and allied (P) Ltd
4. Darnell J, Lodish H and Baltimore D 1986. Molecular Cell Biology. Scientific American Books.
5. Watson JD, Hopkins NH, Roberts JW et al. 1987. Molecular Biology of the Gene (4th ed.) The Benjamin/Cummings Publishing Company, Inc.
6. Albert's B, Bray D, Lewis J et al. 1989. Molecular Biology of the Cell. Garland publishing Inc.
7. Pasupuleti M. 2006. Molecular Biotechnology. MJP Publishers.
8. Hartl DL and Jones EW. 2000. Genetics – Analysis of Genes and Genomes (5th Ed.) Jones and Bartlett Publishers.
9. Tamarin RH. 1999. Principles of Genetics (6th Ed.) WCB McGraw-Hill.
10. Karp G. 1998. Cell and Molecular Biology (2nd Ed.) John Wiley and Sons, Inc.
11. Lodish H, Berk A, Matsudaira P et al 2004. Molecular Cell Biology (5th ed.) W.H. Freeman and Company, New York.
12. Becker MW, Kleinsmith LJ and Hardin J. 2007. The world of the Cell (6th Ed.) Tata McGraw Hill Publications.
13. Raven PH, Johnson GB, Losos JB and Singer SR. 2006. Biology (7th Ed.) Tata McGraw Hill Publications.
14. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, I SEMESTER

Course Name	GENETICS	L	T	P	C	IM	EM	TM
Course Code	25BOT102	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:** This course provides an introductory overview of major and timely topics in genetics. The objective is to provide students with a broadly-based and fundamental understanding of genetics, and to present selected challenges and issues that currently face the genetics research and communities. This course provides students with an understanding of the principles and concepts of genetics and introduces transmission, nature and action of genetic material in organisms

❖ **Course Learning Objectives:**

- Use the principles of chromosome transmission to predict patterns of inheritance.
- Evaluate scientific data using the rules of probability.
- Understand how the structure of DNA enables it to function as genetic material.
- Explain the relationship between genotype and phenotype.
- Understand the molecular basis of mutation, and its role in genetic variation.
- Explain how the genetic code enables protein synthesis to be directed by genetic information.
- Understand how genomes are replicated, repaired, organized and packaged.
- Describe the modes of gene regulation in prokaryotes and eukaryotes.
- Use a computer to search public databases and manage bibliographic information.

❖ **Course Learning outcomes:**

- By completing Genetics course, students are expected to have achieved the following skills and capabilities.
- Comprehensive, detailed understanding of the chemical basis of heredity.
- Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.
- Understanding the role of genetic mechanisms in evolution.
- The knowledge required to design, execute, and analyze the results of genetic experimentation in animal and plant model systems.
- The ability to evaluate conclusions that are based on genetic data.

❖ **Course Content:**

UNIT – I: Mendelian Laws of Inheritance

Mendel's laws-Monohybrid and dihybrid cross. Test cross and back cross. Sex chromosomes and determination. Sex-linked inheritance. Linkage and crossing over. Interference. Recombination frequency. Numerical changes in chromosomes – euploidy, haploidy, and their fundamental and

practical significance. Polyploidy – induction. Aneuploidy – type and genetic significance. Population genetics – Hardy and Weinberg law.

UNIT – II: Nature of Genetic Material

Evidence to prove DNA and RNA as genetic material. Gene as a unit of expression. Colinearity of gene and polypeptide. Modern concept of gene. Fine structure analysis of rII locus of T4 bacteriophage – Establishment of recon, muton and cistron. Complementation test. Types of genes – Pseudogenes, House-keeping genes, homeotic genes and regulatory genes.

UNIT – III: Plasmids and Transposons

Plasmids: Types, copy number, replication, amplification and curing. Regulation of col E1 plasmid replication. Methods of plasmid transfer – Microinjection, electroporation, calcium chloride treatment, triparental mating.

Transposons: Types of bacterial transposons - insertional sequences, complex transposons. Retroposons. Transposons of eukaryotes – Copia, P3 and TY elements. Mechanism of transposition – Replicative and non-replicative.

UNIT – IV: Genetic Recombination in Bacteria

Genetic recombination in bacteria. Models of genetic recombination (Break-join, Copy-choice, Break-copy). Role of recA protein. Genetic transfers in bacteria. Discovery and mechanism of transformation. Discovery and mechanism of Transduction (generalized, specialized and abortive). Discovery of sex among bacteria. Genetic transfer by Conjugation (F^+ and F^- , F' and F^- (sexduction), and Hfr and F^-). Mapping of bacterial chromosome by genetic recombination, transformation, conjugation and transduction.

UNIT – V: Mutations and Mutagenesis

Mutations and mutagenesis: Types of mutations, Mutagenic agents, Molecular basis of mutations, Mechanism of Mutagenesis. Transposon mutagenesis, Site-directed mutagenesis and their applications. Evaluation of mutagens by Ames test and micro nuclei test. Thymine dimerization. Repair of T-dimers: Photo-reactivation, Excision repair, Post-replication, Recombination and SOS repair mechanisms. Heat-shock and adaptive responses, role of recA in DNA repair.

Text books:

1. Cell Biology : DeRobertis and DeRobertis
2. Molecular biology of cell: B.Alberts et al Cell
3. Molecular biology: G.Karp
4. Molecular Biology of the cell: J.D.Watson et al
5. Genes VII: B.Lewin
6. Lehninger's Principles of Biochemistry: Nelson and Cox. Biochemistry: L.Stryer
7. Biochemistry: Voet and Voet.

KRISHNA UNIVERSITY: : MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, I SEMESTER

Course Name	BIOMOLECULES	L	T	P	C	IM	EM	TM
Course Code	25BOT 103	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Course description & Purpose: In this course you will learn about molecules of life. Biomolecules are important for the functioning of living organisms. These are building blocks of living organisms, so the presence of appropriate concentration of biomolecules are important for structure and proper function of living cells. Macro biomolecules are built from small organic compounds the same way a railroad train is built. By linking a lot of smaller units together into long chain. The course encompasses the structure, monomer, examples, functions, bonds of biomolecules. The overall goal of this course is to give students knowledge of biomolecules.

❖ **Course Learning Objectives:**

- To provide details about the importance of the Biomolecules present in our system and the regulation of metabolic pathways.
- To expose the students to the biochemical methods used to study the biomolecules.
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❖ **Course Learning Outcomes:**

- Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure and functions of Biomolecules structures and the functions of biological/biochemical processes.
- They will gain proficiency in basic laboratory techniques in both chemistry and biology, and be able to apply the scientific method to the processes of experimentation and hypothesis testing.

UNIT – I : Carbohydrates

Definition and Classification of carbohydrates, reactions of monosaccharides, acid Derivatives of monosaccharides, Amino sugars, disaccharides, oligo saccharides, mucopolysaccharides, polysaccharides, starch, cellulose, lectins, glycoproteins.

UNIT – II: Amino acids

Classification, structure and physico-chemical properties of amino acids, stereoisomerism, chemical reactions of amino acids and chemical procedures affecting amino acid side chains.

Peptides: Structure and confirmation of peptide bond; Peptide synthesis - reactive ester method and modified merrifield solid phase peptide synthesis. Non-ribosomal peptide synthesis - glutathione cyclic antibiotics (gramicidin). Identification of peptide sequence- protease treatment, site directed mutagenesis.

UNIT – III: Proteins

Classification and biological functions of proteins (Eg: RuBisCo, LegHemoglobin). Structural organization of proteins – primary, secondary, tertiary and quaternary structure of proteins. Protein folding and significance. Ramachandran plot.

UNIT – IV: Fatty acids & Lipids

Classification, physical and chemical properties of fatty acids. Characterization of natural fats, oils. Structure and biological role of triacyl glycerol, phospholipids, sphingolipids, prostaglandins, thromboxanes, leukotrienes, and steroids. Lipids as signaling molecules. Porphyrins- Structure and functions of porphyrins, protoporphyrin, cytochrome, heme, chlorophyll.

UNIT-V: Nucleic acids

Structure of purines and pyrimidines, modified bases. Structure of DNA (Primary, Secondary and Tertiary). Structure of RNA- mRNA, tRNA, rRNA (Primary, Secondary and Tertiary) Physico-chemical properties of nucleic acids, denaturation, hyper chromic effect, T_m, kinetics of reassociation, cot values.

Text books:

1. Textbook of Biochemistry. West and Todd. 1968. MacMillan.
2. Principles of Biochemistry. A. L. Lehninger. 1993. Nelson and Cox. C. B.S., India.
3. Principles of Biochemistry General Aspects. Smith et al, 1983. McGraw hill
4. Biochemistry Donald Voet and Judith Voet. 2nd Edn.
5. Biochemistry. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer 2002. 5th Edn. Freeman
6. Textbook of Biochemistry with Clinical Correlation. Thomas M. Devlin. 4th Edn
7. Biochemistry. Zubay
8. Nucleic acid Biochemistry and Molecular Biology by Main Waring et al, Blackwell.
9. Biochemistry, 2nd Edn. by Albert L. Lehninger. 1978. Kalyani Publishers, New Delhi
10. Biochemical calculations, Irwin H. Segel, John Wiley and sons Inc.
11. Biochemistry, Reginald A. Garret, Charles M. Grisham. 1995. National Academy of Sciences, USA. 2nd Edn.
12. Organic Chemistry, DJ. Cram and GS Hammon.
13. Biochemistry. Mathews
14. Biochemistry. B.D. Hames, N.M. Hooper
15. Practical Biochemistry. Wilson and Walker.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, I SEMESTER

Course Name	BIODIVERSITY OF NON-FLOWERING PLANTS	L	T	P	C	IM	EM	TM
Course Code	25 BOT104	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course provides the basic information on the diversity of non-flowering plants and basic knowledge about Bacteria, Algae Fungi, Bryophyta and Gymnosperms. This course spot lights on basics of Viruses; morphological features, classification and properties. This course also focuses on principles of Paleobotany including plant fossil preservation techniques.

❖ **Course Learning Objectives:**

- The Course will help the students to
- Understand the groups of non-flowering plants.
- Acquire basic knowledge on basics of Viruses; morphological features, classification and properties.
- Attain knowledge on Population and community dynamics.
- Introduce the principles of Paleobotany including plant fossil preservation techniques.

❖ **Course Learning Outcomes:**

- Student will gain knowledge on the general characters of non-flowering plants.
- Student will be able to know the Acquire basic knowledge on basics of Viruses; morphological features, classification and properties.
- Attain knowledge on Population and community dynamics - Student will be able to know about the importance and need for management of biodiversity.
- Student will be able to understand the application of applied ecological concepts.

❖ **Course Content**

UNIT – I: Viruses: Nomenclature and classification of viruses. Viroids. Properties of viruses. Ultra structure of Tobacco mosaic Virus(TMV) and Bacteriophage. Variability in viruses. Satellite viruses and satelliteRNA.

Replication of Viruses. Classification of Plant Viruses and isolation and purification of plant viruses.

UNIT-II : Bacteria : General characteristics of Bacteria. Ultra structure of bacteria, Bacterial growth (Phases of Growth). Recombination in bacteria (transformation, transduction and conjugation). Bergey's classification.

General characters of Actinomycetes, Mycoplasmas and Cyanobacteria. Economic importance of Bacteria.

UNIT-III : Algae: General characteristics of Algae. Salient features of Chlorophyta, Bacillariophyta, Phaeophyta and Cyanophyta. Economic importance of Algae.

Fungi: General Characteristics of fungi. Classification of fungi (Ainsworth system), Ecto and Endo-mycorrhizal associations. Economic importance of fungi.

UNIT-IV: Bryophyta: General characteristics of Bryophytes. Distribution, habit, morphology, reproduction of following classes: Hepaticopsida (Marchantia), Anthocerotopsida (Anthoceros), Bryopsida (Funaria and Polytrichum). Economic importance of Bryophytes.

Pteridophyta: Distinguishing features of Pteridophytes. Distribution, habit, morphology and reproduction of Lycopodium and Selaginella. General characteristics of ferns. Economic importance of Pteridophytes.

UNIT-V: Gymnosperms: General characteristic and classification of Gymnosperms. Cycadophyta and Coniferophyta. Economic importance of Gymnosperms.

Paleobotany: - Study of Palaeobotanical records and plant fossils. Methods of preservation of fossil plants. Exploration and significance of fossil fuels. An overview of the contributions of the Birbal Sahni Institute of Paleosciences.

Text books :

1. Kumar, H.D. and H. N. Singh (1971) Textbook of Algae
2. Sharma, O.P. (1986) Textbook of Algae
3. Pandey, B. P. (1994) Textbook of Botany – Algae
4. Vashista, B. R. (1995) Botany for degree students-Algae
5. Gangulee, H.C. and A. K. Kar (1992) College Botany Vol. III
6. Desikachary, T.V. (1972) Taxonomy and Biology of Blue - green algae
7. Alexopoulos, C.J. and C. W. Mims (1979) : Introductory Mycology
8. Sharma, O.O. (1989) : Textbook of Fungi
9. Ainsworth, G. G. and A.S. Sussman : The Fungi Vols. I, II, III, IV- A and IV-B
10. Cavers, R. (1964) : Inter-relationship of Bryophytes
11. Kashyap, S. R. (1929) : Liverworts of Western Himalayas and the Punjab
12. Plains Part I and II
13. Parihar, N. S. (1959) : An introduction to Embryophyta. Bol. I –
14. Trivedi, A. N. (2002) - Advances in Pteridology
15. Bierhorst, D.W. (1971) - Morphology of Vascular plants
14. Eames, A. J. and E. M. Giffard (1950) - Comparative morphology of vascular plants
15. Rashid, A. (1978) - An introduction of Pteridophytes
16. Spome, K.R. (1966) - Morphology of Pteridophytes
17. Bower, F. O. (1963) - The Ferns
18. Jermy, A. G. (1973) - The Phylogeny and Classification of ferns.
19. Vashishta, B.R. (1996) - Botany for degree students – Pteridophytes.
20. Spome, K.R. (1967) - Morphology of Gymnosperms
21. Vashishta, P.C. (1976) - The Gymnosperms
22. Bhatnagar, S.P. and Moitra Alok (1996)- The Gymnosperms

KRISHNA UNIVERSITY: : MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, I SEMESTER

Course Name	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C	IM	EM	TM
Course Code	25 BOT105	3	0	1	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description:**

Personality development is the development of your behavior patterns and attitude. It is the result of where we are born, the circle we interact with and our personal temperament. Every person is different. There are some characteristics traits that make you „you“. Personality development through life enlightenment course aims to help students identify negative behaviors which may be stopping them from reaching their desired goals. This course will help students both in their personal and desired professional life. The other purposes of personality development through life enlightenment course are to enable you lead stress-free and healthier life, ethical decision-making ability, enhanced confidence level, and building a more pleasing personality.

❖ **Course Objectives:**

The course aims to cause a basic awareness about the significance of soft skills in professional and inter personal communications and facilitate an all-round development of personality

Specific objectives include:

- Learn to achieve the highest goal happily.
- Become a person with stable mind, pleasing personality and determination.
- Learn to build positive attitude, self-motivation, enhancing self-esteem and emotional intelligence
- Learn to develop coping mechanism to manage stress through Yoga and meditation techniques
- Awaken wisdom among them.

❖ **Course Learning Outcomes:**

At the end of this course the students should be able to:

- Develop their personality and achieve their highest goals of life.
- Lead the nation and mankind to peace and prosperity
- Develop a versatile personality
- Practice emotional self-regulation.
- Develop a positive approach to work and duties
- Develop a versatile personality

❖ **Course Content:**

UNIT- I: Introduction to Personality Development

The concept of personality - Dimensions of Personality – Theories of Personality development(Freud & Erickson)- The concept of Success and Failure-Factors responsible for Success –Hurdles in achieving Success and Overcoming Hurdles -Causes of failure – Conducting SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

UNIT- II: Attitude, Motivation and Self-esteem

Conceptual overview of Attitude-Types of Attitudes – Attitude Formation – Advantages/ Disadvantages of Positive/Negative Attitude - Ways to Develop Positive Attitude.

Concept of motivation: Definition and Nature of Motivation/Motive – Internal and external motives – Theories of Motivation – Importance of self- motivation- Factors leading to de- motivation.

Self-esteem - Definition and Nature of self-esteem – Do's and Don'ts to develop positive self-esteem – Low self-esteem – Personality having low self-esteem - Positive and negative self-esteem.

UNIT -III: Other Aspects of Personality Development

Body language - Problem-solving - Conflict Management and Negotiation skills - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics – Good manners and etiquette - Emotional Ability/Intelligence – Dimensions of Emotional Intelligence – Building Emotional Intelligence.

UNIT- IV: Neetisatakam-Holistic Development of Personality

Verses- 19,20,21,22 (wisdom) – Verses- 29,31,32 (pride and heroism) – Verses- 26,28,63,65(virtue)

Personality of Role Model – Shrimad Bhagwadgeeta

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 – Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37, 38, 63

UNIT -V: Yoga & Stress Management

Meaning and definition of Yoga - Historical Perspective of Yoga - Principles of Astanga Yoga by Patanjali – Meaning and Definition of Stress - Types of Stress - Eustress and Distress –Stress Management – Pranayama-Pranayama: Anulom and Vilom Pranayama - Nadishudhi Pranayama– Kapalabhati-Pranayama - Bhramari Pranayama – Nadanusandhana Pranayama – Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT) (Theory & Practical).

PRACTICAL COMPONENTS:

Students should identify different types of personality to know their own personality. Students are to describe the characteristics of their personalities and submit the same for assessment.

Students are to form in groups (a group consists of 4-6 students) to identify and write a brief note on famous personalities of India and World.

Students are required to identify different types of attitudes and give any five examples of each.

Students are expected to check their attitudes and develop ways to improve their attitudes at work place and home.

Students are required to identify keys to self-motivation to achieve their goals.

Students are expected to identify at least seven types of body language and conduct activities with the following:

S. No.	Pose	Possible Interpretations
1	Standing with your hands on your hips	Aggressive, disgusted
2	Standing upright	Confidence
3	Arms crossed on your chest	Defensive
4	Resting your hand on your cheek	Thinking
5	Touching or rubbing your nose	Doubt, lying
6	Resting your head in your hands	Boredom, tired
7	Tapping your fingers	Impatience
8	Biting your nails	Nervous, insecure
9	Playing with your hair	Insecure
10	Rubbing your eyes	Disbelief, doubt

Conduct the following exercise to develop communication skills –Negotiation Skills and Empathy

Exercise: Card Pieces

In this activity, team members trade pieces of playing cards to put together complete cards.

Uses-This exercise is useful for showing team members others' perspectives. It builds communication and negotiation skills , and helps people to develop empathy .

People and Materials

- Enough people for at least three teams of two.
- Playing cards – use between four and six for each person.
- A private room.

Time -15 minutes.Instructions:

1. Cut each playing card into half diagonally, then in half diagonally again, so you have four triangular pieces for each card.
2. Mix all the pieces together and put equal numbers of cards into as many envelopes as you have teams.
3. Divide people up into teams of three or four. You need at least three teams. If you're short of people, teams of two will work just as well. \
4. Give each team an envelope of playing card pieces.
5. Each team has three minutes to sort its pieces, determine which ones it needs to make complete cards, and develop a bargaining strategy.
6. After three minutes, allow the teams to start bartering for pieces. People can barter on their own or collectively with their team. Give the teams eight minutes to barter.
7. When the time is up, count each team's completed cards. Whichever team has the most cards wins the round.

Advice for the Teacher/Facilitator

After the activity, ask your team members to think about the strategies they used. Discuss these questions

- 1) Which negotiation strategies worked? Which didn't?
- 2) What could they have done better?
- 3) What other skills, such as **active listening** or **empathy** , did they need to use?

Conduct following Time management activity - Ribbon of Life

Take a colored ribbon length of approximately 1 meter/100 cm. and scissors. Start with the following questions:

1. If the life span of an individual is say, 100 years. Consider that each cm represents one year. The response will be that few live that long. Assuming a life of 75 to 90 years, cut 10 to 25 cm off the ribbon, accordingly.
2. What is the average age of the participants sitting here, the response would be 25 to 30 depending on the group, in that case, cut another 25 cms of the ribbon and say that is gone you cannot do anything.

3. What is left is 50 years? People will say, "Yes," but the answer is NO.
4. Every year we have 52 weeks, that is 52 Sundays. If we multiply that by 50 years, it comes to 7.14 years. Reduce the ribbon by another 7.14 cm.
5. We also usually have Saturdays off, so reduce another 7. cms.
6. Public/National holidays are 10 multiple with 50 years. That comes to another 1.5 years. Reduce ribbon by another 1.5 cms.
7. Your casual leave, sick leave, and annual holidays approx. 40 days a year, multiplied by 50. Cut off another 5 cms. Now you are left with about 29.5 years. But, the calculation is not over yet.
8. You sleep an average of 8 hours daily; multiply that by 365 days and again by 50 years (i.e. 122 days X 50 = almost 17 years). Cut off another 17 cm.
9. You spend time eating lunch, breakfast, snacks, and dinner total 2 hours daily (i.e. 30 days a year X 50 years = 4 years or so). Cut off another 4 cm.
10. Last, let's figure we spend about 1 hour a day traveling from place to place for activities and such. (that's about 2 more years). We're down to 6 (SIX) years of life to make it or break it.

- **Exercise Decision making skills - Create Your Own**

In this exercise, teams must create their own, brand new, problem-solving activity.

Uses: This game encourages participants to think about the problem-solving process. It builds skills such as creativity, negotiation and decision making, as well as communication and time management. After the activity, teams should be better equipped to work together, and to think on their feet.

What You'll Need

- Ideally four or five people in each team.
- A large, private room.
- Paper, pens and flip charts.

Time -Around one hour.

Instructions:

1. As the participants arrive, you announce that, rather than spending an hour on a problem-solving team building activity, they must design an original one of their own.
2. Divide participants into teams and tell them that they have to create a new problem-solving team building activity that will work well in their organization. The activity must not be one that they have already participated in or heard of.
3. After an hour, each team must present their new activity to everyone else, and outline its key benefits.

Advice for the Teacher/Facilitator:

There are four basic steps in problem solving : defining the problem, generating solutions, evaluating and selecting solutions, and implementing solutions. Help your team to think creatively at each stage by getting them to consider a wide range of options. If ideas run dry, introduce an alternative brainstorming technique, such as brain writing . This allows your people to develop one others' ideas, while everyone has an equal chance to contribute.

After the presentations, encourage teams to discuss the different decision-making processes they followed. You might ask them how they communicated and managed their time . Another question could be about how they kept their discussion focused. And to round up, you might ask them whether they would have changed their approach after hearing the other teams' presentations.

- Students are asked to recite verses: 26,28,63,65 (virtue) of Neetisatakam-Holistic development of personality.
- Students are asked to identify personality of role models from Shrimad Bhagwadgeeta and portray the roles of the same.
- Students are asked to practice Yoga and meditation techniques

Text and Reference Books:

1. Hurlock, E.B. Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill, 2006.
2. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar- vairagya, New Delhi, 2010

3. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.
4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House.2005.
7. Smith, B . Body Language. Delhi: Rohan Book Company. 2004
8. Yogic Asanas for Group Training - Part-I: Janardhan Swami Yogabhyasi Mandal, Nagpur.
9. Rajayoga or Conquering the Internal Nature by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
10. Nagendra H.R nad Nagaratna R, Yoga Perspective in Stress Management, Bangalore, Swami Vivekananda Yoga Prakashan.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. <https://freevidelectures.com/course/3539/indian-philosophy/11>

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M.Sc. – BOTANY, I SEMESTER

Course Name	CELL BIOLOGY & GENETICS	L	T	P	C	IM	EM	TM
Course Code	25 BOTL101	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **List of experiments**

➤ **Cell biology**

1. Light microscopic examination of various plant tissues
2. Determination of cell size (ocular micrometer)
3. Stages of mitosis and meiosis
4. Squash preparation.
5. Sub-cellular fractionation- separation of macromolecules
6. Study of polytene chromosomes.
7. Karyotypic study.

➤ **Genetics**

1. Demonstration of chromosomal (structural and numerical) aberrations.
2. Effect of colchicine on chromosomes.
3. Demonstration of Mendelian laws using color marbles or beads.
4. Evaluation of segregation and random assortment using Chi square test or test of fitness.
5. Construction of genetic maps based on problems in two and three factor crosses.

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M.Sc. – BOTANY, I SEMESTER

Course Name	BIOMOLECULES AND BIODIVERSITY OF NON-FLOWERING PLANTS	L	T	P	C	IM	EM	TM
Course Code	25 BOTL102	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **Biomolecules**

List of experiments

1. Titration of Amino acids
2. Calorimetric determination of Pka
3. Model building using space, filling/ ball and stick models
4. Reactions of amino acids, sugars and lipids, including diagnostic tests
5. Isolation, purity determination and quantization of cholesterol DNA and RNA
6. Quantization of proteins and sugars
7. Analysis of oils-iodine number, saponification value and acid number

➤ **Biodiversity of non-flowering plants**

List of Experiments

1. Major equipment used for a plant science laboratory
2. Nutrient Medium preparation
3. Techniques of isolation , inoculation and sub -culturing of Bacteria& Fungi
4. Staining & Microscopic study of Bacteria and Fungi
5. Enumeration of isolated Bacteria and Fungi

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, II SEMESTER

CourseName	BIOANALYTICALTECHNIQUES	L	T	P	C	IM	EM	TM
Course Code	25BOT 201	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and Purpose**

This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic bio analytical technique and an introduction to general terminologies. This course contains bio analytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.

❖ **Course Learning Objectives:**

1. To understand about the canonical structure of bio-instrumentation systems.
2. To learn the qualitative functions of the primary system components.
3. To learn the technical information's associated with instrumentation and design and basic signal analysis.

❖ **Course Learning Outcomes:**

1. Describes and explains the principles of various bio-instrumental devices and sensors.
2. Demonstrate an ability to use appropriately and safely the techniques, sensors, and selected modern engineering tools necessary for bio-instrumentation practice.

❖ **Course Content:**

UNIT-I: Study of Solvents & Centrifugation

Measurement of pH, Ph meter, biochemical buffers. Basic principles of centrifugation, types of centrifuges and rotors. Preparative ultracentrifugation-differential centrifugation, density- gradient. Analytical ultracentrifugation and applications.

UNIT-II: Chromatography

General principles of Chromatography. Methods based on polarity - partition chromatography (paper chromatography). Adsorption chromatography (thin layer chromatography). Gas liquid chromatography, reverse phase liquid chromatography. Methods based on size- Gel filtration chromatography. Methods based on affinity: Affinity chromatography. High performance liquid chromatography and Ion-exchange chromatography.

UNIT-III: Electrophoresis

General principles of Electrophoresis and Factors affecting electrophoretic mobility. Types, methodology

and applications of Electrophoresis.

PAGE (Native–PAGE, SDS-PAGE). 2-dimensional electrophoresis Agarose gel electrophoresis Pulse field gel electrophoresis.

UNIT – IV: Spectrophotometry

Basic principles – law of absorption (Beer– Lambert law). UV – visible spectrophotometry

Infrared spectroscopy, Fluorescence Spectroscopy, Atomic absorption spectrophotometry Mass spectrophotometry and NMR spectrophotometry.

Basic principles and application of X- ray diffraction and X-ray crystallography.

UNIT–V: Radioactivity

Nature and types of radioactivity, radioactive decay. Preparation of labeled biological compounds. Detection and measurement of radioactivity (GM counter, scintillation counter, Cerenkov radiation, autoradiography, gamma- ray counter).

Production, biological uses and safety measures in handling of radio isotopes.

Text books:

1. Nuclear Magnetic Resonance: Williams
2. Biochemical Techniques theory and practice: White R
3. Analytical Chemistry: Christion G. D.
4. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K.H.
5. An Introduction to Practical Biochemistry: Plummer D. T.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, II SEMESTER

Course Name	PLANT ECOLOGY	L	T	P	C	IM	EM	TM
Course Code	25 BOT202	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course provides the basic information on the ecology including structural and functional aspects of Ecosystem. It mainly focuses on effects of ecological factors like climatic, light, temperature etc on plants. This course gives a clear picture of population ecology, Community ecology and other important aspects of Ecological succession. This course also emphasizes about phytogeography and also focusses on use of ecological concepts in management of natural resources including conservation of biodiversity to make students to understand integrated nature of ecological sciences.

❖ **Course Learning Objectives:**

The Course will help the students to

- Understand the structure and function of Ecosystems, the effect of ecological factors, climatic and edaphic on plants, and biogeochemical cycles.
- Acquire basic knowledge on environmental pollution and Global Environmental problems and their mitigation measures.
- Attain knowledge on Population and community dynamics.
- Learn the phytogeography and also use of ecological concepts in conservation of biodiversity to make students to understand integrated nature of ecological sciences.

❖ **Course Learning Outcomes:**

- Student will gain knowledge on the Structure, functioning of ecosystems and types of ecosystems.
- Student will be able to know the and process of ecological succession and Concept of population and community ecology.
- Student will be able to know about the importance and need for management of biodiversity.
- Student will be able to understand the application of applied ecological concepts.

❖ **Course Content**

UNIT-I: Ecosystem: Types of Ecosystems: Natural and engineered ecosystems. Structure of ecosystem (Biotic & Abiotic). Structure of Aquatic (Pond ecosystem & marine ecosystem), Terrestrial (Grassland, Forest & Desert) and Estuarine (Mangroves) Ecosystems. Trophic levels and Ecological pyramids.

Ecosystem Functional aspects: Food chain, food webs, ecological energetics: energy flow and laws of thermodynamics - ecological efficiencies, productivity of ecosystem and Homeostasis.

UNIT-II: Ecological Factors: Climatic factor, Fire factor and edaphic factors and their effect on plants. Concept of limiting factors. Liebig's law of minimum and Shelford's law of tolerance.

Global Biogeochemical cycles: Gaseous: Carbon & Nitrogen cycles. Sedimentary: Phosphorus and Sulphur. Hydrological cycle.

UNIT-III: Population Ecology: Population Characteristics and dynamics –:Population Size and Density, Dispersion, Age structure, Natality, Mortality and Life tables. Population Regulation. Biotic interrelationships.

Environmental Pollution: Causes, effects and control measures of Air, Water and Soil pollution. Global environmental problems; Causes, Effects and control measures of Greenhouse effect, Ozone layer depletion, acid rains and Climate change.

UNIT-IV: Community Ecology: Classification of communities, structure and characteristics (qualitative and quantitative) of communities. Habitat and Niche. Ecotone and Edge effect

Community Dynamics: Ecological Succession. General process of Ecological succession, Types of succession, Hydrosere, Xerosere and climax concept in succession.

UNIT- V: Biogeography: Descriptive or Static Phytogeography: The Arctic, the North temperate, the Tropical and the South temperate. Interpretative or Dynamic Phytogeography: basic principles. Age and Area theory. Indicator species.

Biodiversity: Importance of biodiversity, types of biodiversity and threats to Biodiversity. Hotspots of biodiversity and Endemism. Conservation of biodiversity.

Text books:

1. Ambasht R. S. and Ambasht, N. K. (2008) Text Book of Plant Ecology (15th edn.). CBS Publishers and Distributors, New Delhi.
2. Colbert, E.M. (1996) Evolution of the Vertebrates: A History of Backboned Animals through Times. Wiley Eastern Ltd., New Delhi.
3. Kormondy, E. J. (1996) Concepts of Ecology (4th edn.). Prentice-Hall of India Pvt. Ltd.
4. Krebs, C. J. (1985) Ecology: The Experimental Analysis of Distribution and Abundance.
5. Odum, E.P. and Barrett, G.W. (2005) Fundamentals of Ecology (5th edn.). Thompson.
6. Singh, J.S; Singh, S.P. and Gupta S.R. (2014) Ecology, Environmental Science and Conservation. S.Chand & Company Pvt.Ltd. New Delhi.

Reference books:

1. Brewer, R. (1994) Principles of Ecology. Saunders College Publishing, London.
2. Chiras, D.D. (2012) Environmental Science (9th edn.). Jones and Barlett Learning.
3. Dash, M.C. and Dash, S.P. (2009) Fundamentals of Ecology (3rd edn.). Tata McGraw-Hill Publishing Co., New Delhi.
4. Nobel, B.J. and Wright, R.T. (1995) Environmental Science. Prentice Hall.
5. Santra, S.C. (2005) Environmental Science (2nd edn.). Central Book Agency, Calcutta.

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, II SEMESTER

Course Name	BIOSYSTEMATICS OF ANGIOSPERMS	L	T	P	C	IM	EM	TM
Course Code	25 BOT 203	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course is an introduction to the theory, methods and practice of the taxonomy and classification of flowering plants

❖ **Course Learning Objectives:**

- To make students to understand the taxonomy of plants.
- The main objectives of plant taxonomy is to identify characteristics of undiscovered species by comparing with known species, to specify characteristics of recently discovered species, to arrange them in respective 'taxa' after looking at their similarities and to give them scientific names.
- To develop concepts on Plant systematic, encompasses traditional taxonomy; however, its primary goal is to reconstruct the evolutionary history of plant life.
- To attain knowledge on plants into taxonomic groups, using morphological, anatomical, embryological, chromosomal and chemical data.

❖ **Course Learning Outcomes:**

- Students can understand principles of general taxonomy and they can use nomenclature rules plants. · *Understand historical development of taxonomy.*
- Students introduces the theory, methods and practice of the taxonomy and classification of flowering plants.
- Students can learn field identification of plants.

❖ **Course Content**

UNIT-I: Plant Classification and Phylogeny History of Plant taxonomy, Plant taxonomy-scope and significance; brief history of plant classifications-natural and phylogenetic; salient features and classifications of Bentham and Hooker, The sexual system: Carolus Linnaeus.

UNIT-II: TAXONOMIC HIERARCHY: Ranks of Taxa, Forms of scientific names; major categories: division, class, order, family; minor categories: genus, species and intraspecific categories.

NOMENCLATURE: A brief history of International Code of Botanical Nomenclature [ICBN]; Divisions; Principles;

Nomenclatural terminology-Type method (typification)- holotype, isotype, syntype, lectotype, paratype, neotype; Effective and Valid publication; Priority;

Scientific names-Correct name, Autonym, Basionym, Homonym, Synonym, Tautonym; alternative, ambiguous, illegitimate

UNIT-III: Selected Families of Angiosperms and Trends in Taxonomy Systematic position, key characters, representative taxa and economic importance of the angiosperm families: Magnoliaceae, Fabaceae (Faboideae, Caesalpinioideae and Mimosoideae), Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Amarnathaceae, Euphorbiaceae, Orchidaceae, Araceae, Poaceae.

UNIT-IV: EMBRYOLOGY IN RELATION TO TAXONOMY: Embryological characters of taxonomic importance, utilisation of embryological data in solving taxonomic problems at different levels.

ANATOMY IN RELATION TO TAXONOMY: Vegetative, wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding interrelationship and evolution of angiosperms and solving taxonomic problems.

UNIT-V: CHEMOTAXONOMY: Origin of chemotaxonomy, classes of compounds and their biological significance, Stages in chemotaxonomic investigations, techniques, Use of chemical criteria in plant taxonomy.

Numerical taxonomy: Phenetic methods in taxonomy[Taxometrics]: principles, Cladistics and cladogram, parsimony analysis, cladistics and classification.

MOLECULAR SYSTEMATICS: Molecular diagnostic tools, restriction fragment length polymorphism (RFLP's), Random amplified polymorphic DNA (RAPD), Polymerase chain reaction (PCR) analysis, specific applications of RAPD in molecular systematics.

Text Books:

1. O.P. Sharma, 2016. Plant Taxonomy
2. Gamble & Fischer 1915-1935. Flora of Presidency of Madras. 3 vols.BSMS, Dehradun.
3. Heywood, V.H., RK Brummitt, A. Culham, O. Seberg 2007, Flowering Plant Families of the World. Firefly books Ltd. New York.
4. Judd, W.S, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, and Michael
5. J. Donoghue. 2007. Plant Systematics: A Phylogenetic Approach, 3rd ed. Sinauer.
6. Lawrence, G.H.M 1951. Taxonomy of Vascular plants. McMillan, New York.
7. Naik, V.N. 1992. Taxonomy of Angiosperms. 2nd Edn. Tata Mc.Graw Hill.
8. Pullaiah, T. 2005. Taxonomy of Angiosperms. Regency publications, New Delhi.
9. Pullaiah, T. et al 1997. Flora of Andhra Pradesh. 4 vols. Scientific Publishers, Jodhpur.
- 10.Radford. A.E.et.al., 1974. Vascular plant systematics. Harper & Row. New York.
- 11.Ravi Prasad Rao, B. 2007. Plant Name Directory. ABCD, Planographers. Hyderabad.
- 12.Simpson, Michael G. 2006. Plant Systematics. Elseiver& Academic Press.
- 13.Singh, Gurucharan. 2005. Plant Systematics. Oxford & IBH. New Delhi.
- 14.Sivarajan, V.V.1991. Introduction to principles

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, II SEMESTER

Course Name	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS (IPR)	L	T	P	C	IM	EM	TM
Course Code	25 BOT 204	3	0	1	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description:**

Research Methodology & IPR (PHYC204) course is aimed to develop research bent of mind (spirit of inquiry) and impart research skills to the all Post graduate students. It also encompasses the series of research methodology contents: from problem formulation, to design, to data collection, analysis, reporting and dissemination. This course also covers intellectual property rights (IPR), and intended to equip students with conceptual understandings of current scenario of IPR, and the practical issues encountered in filing patents, trademarks and copyrights.

❖ **Course Learning Objectives:**

The objective of research is to find answers to the questions by applying scientific procedures. In other words, the main aim of research is to find out the truth which is hidden and has not yet been discovered

Specific objectives include:

- ✓ To understand some basic concepts of research and its methodologies
- ✓ To develop an understanding of the basic framework of research process.
- ✓ To develop an understanding of various research designs and techniques.
- ✓ To identify various sources of information for literature review and data collection.
- ✓ Ability to write a research Proposal, report and thesis
- ✓ To demonstrate knowledge and understanding of IPR Filing and Rights

❖ **Course Learning Outcomes:**

At the end of this course the students should be able to:

- Understand some basic concepts of research and its methodologies
- Identify appropriate research topics
- Select and define appropriate research problem and parameters
- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Have adequate knowledge on measurement & scaling techniques
- Have basic awareness of data analysis-and hypothesis testing procedures
- Prepare a project proposal (to undertake a project)
- Write a research report and thesis
- File Patents, Trademarks and Copy Rights

❖ **Course Content:**

UNIT- I: Foundations of Research & Research Design

Meaning of Research – Definitions of Research – Motivation in Research – General Characteristics of Research – Criteria of Good Research – Types of Research – Research Process – Research Methods vs. Methodology – Defining and Formulating the Research Problem – Review of Literature – Approaches to Critical Literature Review – Importance of Literature Review in Identifying Research Gaps and Defining a Problem – Development of Working Hypothesis.

UNIT- II: Research Design, Sampling Concepts, and Data Collection Methods

Meaning, Significance and Characteristics of Good Research Design–Types of Research Design: Exploratory, Conclusive Research and Experimental – Sampling Theory: Types of Sampling and Errors in Sampling – Data Collection: Types of Data – Data Collection Methods and Techniques for Primary and Secondary Data.

UNIT-III: Measurement & Scaling Techniques, Hypothesis Formulation and Testing, Overview of Data Analysis and Report Writing

Basic measurement scales –Reliability & Validity – Definition and Types of Hypothesis– Hypothesis Formulation and Testing Procedure – Overview of Data Analysis: Methods, Process and Types–Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report Precautions for Writing Research Reports – How to Write a Research Proposal– Research Ethics, Conflict of Interest and Plagiarism.

UNIT- IV: Intellectual Property Rights (IPR)

Definition and Nature and Features of Intellectual Property Rights (IPR) –Types of IntellectualProperty Rights – Procedure for Grants of Patents –Rights of a Patent – Scope of a Patent Rights-Licensing and Transfer of Technology–Why protection of intellectual property is important? Enforcement of IPR – Infringement of IPR

UNIT -V: Indian and International Scenario and New Developments in IPR

IPR Developments in India for the past Five Years – Development of IPR Laws in India – International Cooperation on IPR – New Developments in IPR – Administration of Patent System –International Patent protection – Case Studies in Indian and Global Contexts.

PRACTICAL COMPONENTS:

1. Students should identify different research problems with examples and describe the characteristics of researchable problems in their academic area/society/community/organization concerned.
2. Students are to form in groups (a group consists of 4-6 students) and conduct critical literature survey with regard to the identified research problems and prepare a brief literature review coupled with research gaps and working hypothesis.
3. Students are required to identify and develop good research design to address the definedresearch problems.
4. Students are expected to write the research design on Exploratory and DescriptiveResearch.
5. Students are required to develop practical experience in writing a research proposal by conducting a thorough critical review of any three research proposals (examples).
6. Students are expected to develop templates for technical report writing.
7. Students should conduct a team based mini research project, which is a unified andpractical case on a topic of their choice, with approximately 4-6 students per group.
8. Students are expected to identify types of plagiarism in academic research, and how toavoid plagiarism in research.
9. Students are asked to identify and submit a brief report on Indian patents of internationalrepute.
10. Students are asked to write on Patent registration procedure, and visit Official website ofIntellectual Property India <https://ipindia.gov.in> to know how to get IPR in India.
11. Students are asked to identity and summarize remedies available against the infringement of intellectual property rights in Indian and global contexts.
Students are asked to submit any five examples of ethical issues in copyright and patents.

Text and Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002, An introduction to Research Methodology, RBSA Publishers.
2. Cohen, L. Lawrence, M., & Morrison, K. (2005), Research Methods in Education (5th edition). Oxford: Oxford University Press.
3. Kothari, C.R., 1990, Research Methodology: Methods and Techniques, New Age International.
4. Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford University Press.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Research Methods: A Process of Inquiry, Ally and Bacon.
6. Fink, A., 2009, Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
7. Day, R.A., 1992, How to Write and Publish a Scientific Paper, Cambridge University Press.
8. Wadehra, B.L. 2000, Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
9. Coley, S.M. and Scheinberg, C. A., 1990, Proposal Writing, Sage Publications.
10. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options, Zed Books, New York.
11. Leedy, P.D. and Ormrod, J.E., 2004, Practical Research: Planning and Design, Prentice Hall.
12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

Important Websites:

- > www.ipindia.nic.in - Intellectual Property Office, India
- > www.patentoffice.nic.in – Patent office, India
- > <http://copyright.gov.in/> - Copyright Office, India
- > ipr.icegate.gov.in – Automated Recordation & Targeting for IPR Protection
- > <http://www.icegate.gov.in>- E- Commerce portal of Central Board of Excise and Customs
- > www.ipab.tn.nic.in - Intellectual Property Appellate Board, India
- > www.mit.gov.in – Department of Information Technology, India
- > <http://www.mit.gov.in/content/office-semiconductorintegrated-circuits-layout-designregistry>
- > Semiconductor Integrated Circuits Layout-Design Registry (SICLDR)
- > www.plantauthority.gov.in – Plant Varieties and Farmers' Rights Authority, India
- > <http://nbaindia.org/> - National Biodiversity Authority
- > www.nipo.in – The Indian IPR Foundation
- > www.wipo.int – World Intellectual Property Organisation
- > <http://www.wto.org> – World Trade Organisation

KRISHNA UNIVERSITY: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, II SEMESTER

CourseName	PLANT MOLECULAR BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE 201	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description**

Molecular biology is the study of biological systems at the molecular level. Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline. The topics covered include; the structure and replication of DNA, chromosome organization, the molecular mechanisms underlying the recombination of DNA, the molecular basis of gene regulation and how gene expression is tied to intracellular and extracellular factors by signal transduction pathways. To provide students with an appreciation of the experimental approaches used to do research in molecular biology several important experiments including the methodologies used to perform them will be covered. This will introduce students to recombinant DNA methodologies such as gene cloning, DNA sequencing and in vitro mutagenesis. Emphasis will be placed on understanding basic concepts and on the integration of these concepts for problem solving.

❖ **Course Learning objectives:**

This course is designed to provide students with a background in molecular genetics. The two main learning objectives of this course are; the development of an understanding of gene expression and gene regulation, and the familiarization of students with the experimental approaches used in molecular biology.

❖ **Course Learning outcomes:**

After completing the course, the student should be able to:

- Explain the structure and function of cells and cell organelles for eukaryote and prokaryote cells
- Explain the structure and function of dna, rna, protein, fat substance and carbohydrates in acell biological relation
- Explain central cell biological processes and how they are regulated and quality assured (forinstance: replication and cell division, gene expression and signal transduction)
- Explain how different cell types get and transform energy
- Explain genetic variation and inheritance
- Understand how molecular cell biology forms the foundation of biotechnology in different social structures.

❖ **Course content**

UNIT – I: DNA Replication:

Models of DNA replication – Meselson and Stahl, Cairn's experiments. Enzymes involved in DNA replication. Structure of oriC. Mechanism of oriC open complex formation. Replication initiation. Elongation –Okazaki fragments synthesis and processing. Direction of replication fork movement and termination. Replication of single stranded DNA in ØX174. Replication of bacteriophage lambda DNA

(rolling circle). Replication of closed covalent circular DNA (θ model). Problems associated with replication of linear DNA molecules. DNA replication in Eukaryotes – Histone dissociation, DNA replication and reassociation. Fidelity of DNA replication and inhibitors of DNA replication.

UNIT – II: RNA Biosynthesis:

Prokaryotic RNA polymerase – Core enzyme and σ factors ($\sigma 70$, $\sigma 32$). Promoter elements. Promoter–RNA polymerase interaction – DNase protection method and Foot-printing assays. Mapping of transcription start point (TSP). Upstream activating sequences and their role in regulation of transcription. Transcription elongation. Transcription termination – Rho-independent and Rho-dependent. Monosystronic and polycistronic mRNA.

Eukaryotic RNA polymerases – Transcription factors. Structure and functions of RNA pol I, II and III dependent promoters. Enhancer sequences. Processing of RNA (capping, tailing and splicing). Inhibitors of transcription.

Unit – III: Protein Biosynthesis:

Central dogma theory and flow of genetic information. Genetic code and its elucidation. Wobble hypothesis. Structure and composition of prokaryotic and eukaryotic ribosomes. Structures of mRNA and tRNA. Events of protein synthesis (amino acid activation, initiation, elongation and termination) in prokaryotes and eukaryotes, Post-translational modification of proteins, Inhibitors of translation. Protein trafficking – Concept of signal peptide transport. Membrane targeting of proteins – Sec pathway. Alternative protein transport mechanisms.

Unit-IV: Regulation of Gene Expression in Prokaryotes

Regulation of gene expression in prokaryotes- levels of control. Operon concept. Inducible and repressible expression systems. Regulation of gene expression in lactose, arabinose and tryptophan operon in *Escherichia coli*. Regulation of *nif* (nitrogen fixation) gene expression in *Klebsiella pneumonia*. Mechanism of switch from lytic to lysogenic cycle in bacteriophage lambda.

Unit-V: Regulation of Gene Expression in Eukaryotes

Regulation of gene expression in Eukaryotes- Transcription factor domains and their role in regulation of gene expression: helix-turn-helix motif, zinc-finger motif, leucine-zipper and helix- loop-helix motif. Yeast gal genes. Anti-sense RNA. Gene Silencing; Mechanism of RNAi-mediated gene silencing-siRNA pathway. Potential of RNAi for crop protection against pathogens and pests. Artificial miRNA and its advantages.

Text Books:

1. Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts, JA Steitz and AM Weiner, The Benjamin/Cummings Publ, Co. Inc, California.
2. Molecular Cell Biology (2nd Edn) J. Darnell, H. Lodish and D. Baltimore, Scientific American Books, Inc. USA 1994.
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E. Fritsch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000.
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd,
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers, Ltd., Oxford, 1991

KRISHNA UNIVERSITY :: MACHILIPATNAM DEPARTMENT
OF BIOSCIENCES AND BIOTECHNOLOGY **M.Sc. – BOTANY,**
II SEMESTER

Course Name	HORTICULTURE	L	T	P	C	IM	EM	TM
Course Code	25 BOT DSE 202	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

The course provides information about practice methods of Fruit yielding plants and various methods of pruning of fruit crops, different nursery techniques and their management.

❖ **Course Learning Objectives:**

- To study and practice methods of Fruit yielding plants Introduction and Principles of Horticulture.
- To learn different nursery techniques and their management.
- To practice various methods of pruning of fruit crops.
- To practice Propagation methods.

❖ **Course Learning Outcomes:**

- Students will understand how to propagate, plant, sustainably grow, manage and harvest a variety of plants in a diverse set of environmental.
- Students develop the skill to explore and utilize the crops' genetic potentials for conservation purposes and developing new varieties
- Students will come to gain Knowledge about Integrated Crop Management / Integrated Disease Management of Horticultural crops

❖ **Course Content**

UNIT-I: Fundamentals of Horticulture. Theory Introduction and Principles of Horticulture: Definition of Horticulture. Importance of horticulture in terms of economy, production, employment, generation, environmental protection and human resource development. Scope for horticulture in India. Nutritive value of horticultural crops.

Divisions of horticulture with suitable examples and their importance. Classification of horticulture crops based on soil and climatic requirements. Fruit and Vegetable zones of India and Andhra Pradesh.

UNIT-II : Definition of a nursery. Different types of nursery beds – flat beds, raised beds and sunken beds, their merits and demerits. Different nursery techniques and their management. Vegetable gardens, nutrition and kitchen garden, truck garden, Vegetable forcing, market gardens and roof gardens. Different steps in planning and layout establishment and management of orchards. Different systems of planting orchards - square, rectangle, quincunx, hexagonal and contour systems of planting – their merits and demerits. Calculation of planting densities in different systems of planting.

UNIT-III: Pruning: Definition, objectives. Principles and methods of pruning of fruit crops. Training: Definition, objectives. Principles and methods of training of fruit crops: Open centre, Closed centre and Modified leader systems, their merits and demerits.

Bearing habits in horticultural crops. Irrigation: definition, different methods of irrigation followed in horticultural crops, their merits and demerits. Manures and fertilizers: Definition, different methods of application of manures and fertilizers to horticultural crops. Pre-harvesting and Propagation of Horticultural Plants:

UNIT-IV : Cropping systems: Inter cropping and multi – tier cropping, their merits and demerits with suitable examples. Practical uses of growth regulators in horticulture . Fruitfulness and unfruitfulness: Definitions, Factors influencing the fruitfulness and unfruitfulness with suitable examples. Rejuvenation of old orchards, Importance of rejuvenation: Top working and Frame working. Maturity: Definition, Different methods to judge maturity in horticultural crops.

UNIT-V: Propagation: Definition, Methods (Cuttings, Layering & Grafting) advantages and disadvantages of each method. Plant propagation by grafting: Definition; methods of grafting: Attached scion methods of grafting, Simple inarching or approach grafting; Detached scion methods of grafting: Pre-curing of scion, Side grafting methods: Veneer grafting, Apical grafting methods, Epicotyle grafting, Soft wood grafting, Double working, Top working. Plant propagation by budding: Definition of budding; Methods of budding: T- budding and Inverted T- budding, patch budding and ring budding.

Suggested Practicals:

1. Study of tools and implements in horticulture.
2. Layout of different planting systems.
3. Layout of nutrition garden.
4. Preparation of nursery beds for sowing of vegetable seeds.
5. Digging of pits for fruit plants
6. Preparation of fertilizer mixtures and field application.
7. Identification and management of nutritional disorders in vegetables.
8. Study and practicing of different propagation methods by cutting, layering, division.
9. Study and practicing of different propagation methods by grafting and budding.

Text Books:

1. Fundamentals of Horticulture, Edmond, J.B., Sen., T.L., Andrews, F.S and Halfacre R.G, 1963. TataMcGraw Hill Publishing Co., New Delhi.
2. Introduction to Horticulture, Kumar, N. 1990. Rajyalakshmi Publications, Nagarcoil, Tamilnadu.
3. Basic Horticulture, Jitendra Sing, 2002. Kalyani Publishers, Hyderabad.
3. Fundamentals of Fruit Production, Garner V R, Bradford F C and Hooker Jr. H D, 1957. McGraw Hill Book Co., New York.
4. Plant Propagation. Principles and Practices, Hartman, HT and Kester, D.E. 1976, Prentice Hall of India Pvt. Ltd. Bombay.
5. Plant Propagation. Sadhu, M.K. 1996. New Age International Publishers, New Delhi.
6. Propagation of Fruit Crops, Mukherjee, S.K. and Majumdar, P.K. 1973. ICAR, New Delhi.
7. Propagation of Tropical Fruit Trees, Ganner, R.J. and Choudari, S.A. 1972. Oxford & IBH Publishing Co., New Delhi.
8. Propagation of Horticultural Crops: Principles and Practices, Sarma, R.R. 2002. Kalyani Publishers, New Delhi.

Course Name	MARINE BOTANY	L	T	P	C	IM	EM	TM
Course Code	25 BOTDSE203	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course provides the basic information on marine flora. It mainly focuses on marine ecology and productivity of marine flora. This course gives a clear picture of sea weed and their uses.

❖ **Course Learning Objective(s):**

- To make students to understand the marine plants especially marine angiosperms and their physiology, biochemistry, applications and conservation strategies.

❖ **Course Learning Outcome(s):**

- Student understands the basic concepts and can get motivated towards research in Marine Botany.

❖ **Course Content**

UNIT-I: Marine plant groups and Organisms– Brief account on Marine Phytoplankton, Nekton and Benthos. Seaweeds, Sea grasses and Mangroves Marine fungi, Actinomycetes, Lichens, marine Bacteria in brief. Corals and Fossil Mangroves– general account.

UNIT-II: Marine Ecology: Abiotic factors (Chemicals, Physical and Geological) . Biotic factors : floral and faunal components. Impact of climate Change in marine ecosystem: Algal blooms. Red tide. Ecological significance of Algae (Seaweeds), Mangroves, Sea grasses and Coral reefs.

UNIT-III: Photosynthesis of algae (Micro and macro) in sea – algal plastids – Photosynthetic pigments – carbon fixation – Photosynthetic rate – C3 and C4 characters in algae. Photosynthesis of mangroves – carbon fixation. Salinity regulation of Mangroves and their methods of regeneration.

UNIT-IV: Seaweed Polysaccharides–Commercial and economical products of Sea weed (Agar, Algin and Carrageenan) and Low molecular weight compounds in algae – Methods of collection and preservation of Marine algae –Commercial cultivation of seaweeds (Traditional and Recent methods) – Application and uses of Seaweeds –Economic importance of seaweeds.

UNIT-V: Seaweed, Sea grasses, Mangroves and Coral reefs research in India and World. Marine Pollution – human Impact - Conservation strategies of Marine vegetation - Use of Remote sensing techniques in mapping of marine vegetation with GIS.

➤ **Textbooks:**

1. Laura Barsanti and Paolo Gudger. 2006. Algae-anatomy.
2. Biochemistry and Biotechnology. CRC Taylor and Francis, New York.
3. Jackson, D.F. 1972, Algae and Man. Plenum Press
4. Kannupandi, T. 1998. Coral reefs of India. State of Art report.
5. ENVIS Publication Series 2/98. Krishnamurthy, V. 1985. Marine Plants.
6. Seaweed Research and utilization Association, Madras
7. J.R. 1973. Handbook of Phycological methods. Cambridge University Press.
8. Swaminathan, M.S. 2003. Bioresources status in Selected Coastal Location. DBT.
9. Chapman, V.J. 1976. Coastal Vegetation. Pergamon press. New York.
10. Daves, C.J. 1985. Marine Botany Physiology and Ecology of Seaweeds.
11. Dawson. 1960. Marine Botany.

12. Naskar, Kumundrajan and Rathindranathmandal.1999. Ecology and biodiversity of Indian mangroves.Vol.IandII.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. –BOTANY, II SEMESTER

Course Name	BIOANALYTICAL TECHNIQUES AND PLANT ECOLOGY	L	T	P	C	IM	EM	TM
Course Code	25 BOTL201	0	0	6	3	30	70	100

➤ **Bioanalytical Techniques**

1. Separation of amino acids by paper chromatography.
2. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
3. Ultra violet absorption spectra of nucleic acids and proteins.
4. Gel filtration of proteins.
5. Ion exchange chromatography of amino acids.
6. Purification of enzyme by affinity chromatography.
7. Polyacrylamide gel electrophoresis of proteins.
8. Estimation of reducing sugars by Benedict's titrimetric method.
9. Estimation of total carbohydrates by anthrone method.
10. Estimation of proteins by Lowry and Bradford methods.
11. Estimation of ascorbic acid.

➤ **Plant Ecology**

- 1 Estimation of soil and water pH & Conductivity
- 2 To determine the Water Holding Capacity of Soils collected from different locations.
- 3 To estimate the Dissolved Oxygen content in Eutrophic and Oligotrophic Lake water samples by Azide modification of Winkler's method.
- 4 To determine minimum size and number of Quadrants.
- 5 Vegetation Analysis: Frequency, Density, Abundance & IVI
- 6 Vegetation Sampling Transects.

Filed study/ visit

1. Natural ecosystem:
Terrestrial: Grassland, and Forest Ecosystems. Aquatic:
Lake/Pond and Estuarine (Mangrove) Ecosystems.
2. Engineered Ecosystem: Aquaculture and Agricultural ecosystems.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY
M.Sc. –BOTANY, II SEMESTER

Course Name	BIOSYSTEMATICS OF ANGIOSPERMS AND PLANT MOLECULAR BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25 BOTL202	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **List of Experiments**

➤ **Biosystematics of Angiosperms**

1. Taxonomical identification and description of plants
2. Field trips minimum of 3 each with 2-3 days to acquaint with local flora. Submission of a report on field trips.
3. Study of about 50 wild taxa representing different families and identification to species level.
4. Preparation of 50 herbarium specimens of common wild plant taxa.
5. Study of flora of the college campus.
6. Construction of taxonomic keys.
7. Nomenclatural exercise.

➤ **Plant Molecular Biology**

1. Isolation of genomic DNA from bacteria.
2. Determination of purity of the isolated DNA by UV spectrophotometry.
3. Colorimetric method (Diphenylamine reagent).
4. Thermal denaturation of DNA and demonstration of hyperchromic effect.
5. Isolation of RNA by Trizol methods.
6. Estimation of RNA.
7. Determination of melting temperature (T_m) and estimation of GC content.
8. Isolation of plasmids from *E.coli* and separation of CCC, Open circular and linear forms of Plasmids.
9. Agarose gel electrophoresis – Separation and molecular size determination of DNA.
10. Isolation and separation of proteins by SDS- PAGE.
11. Western blot.
12. Purification of DNA fragment from agarose gels.



KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY
M.Sc Botany, II-SEMESTER

Course Name [Add on]	Foundations of Quantum Science for Life Sciences	L	T	P	C	IM	EM	TM
Course code	25BOTOM201	0	4	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks,
 TM-Total Marks

➤ **Objective:** This course introduces the fundamental principles of quantum science and their relevance to atoms,

molecules, and biomolecules. It aims to help life science students understand how quantum concepts explain biological processes such as photosynthesis, vision, and enzyme action. The course also explores emerging applications of quantum technologies in medicine, nanobiotechnology, and healthcare innovation.

➤ **Out comes:**

- ✓ Students will gain a clear understanding of the basic principles of quantum science relevant to life sciences.
- ✓ Students will be able to describe how quantum phenomena influence biological systems and processes.
- ✓ Students will learn to apply quantum concepts in interpreting spectroscopic and molecular techniques.
- ✓ Students will recognize the scope of quantum technologies in advancing biotechnology, medicine, and healthcare.

Course Outline:

Unit 1:

Introduction to Quantum Science: Origin and development of quantum theory, Key concepts: wave– particle duality, quantization of energy, Basic postulates of quantum mechanics, Applications of quantum principles in biology and chemistry

Unit 2:

Quantum Physics of Atoms and Molecules: Structure of atoms: quantum numbers and orbitals, Chemical bonding from quantum perspective, Molecular orbitals and energy levels, Quantum basis of spectroscopy (UV, IR, fluorescence, NMR basics)

Unit 3:

Quantum Chemistry in Biological Systems: Quantum description of biomolecules (proteins, nucleic acids, pigments), Hydrogen bonding and electron transfer mechanisms, Quantum tunneling in enzymes, Photosynthesis and light absorption at quantum level

Unit 4:

Quantum Dynamics in Life Processes: Quantum coherence and entanglement in biology, Quantum effects in vision (rhodopsin and photon absorption), Magnetoreception in birds (radical pair mechanism), Role of quantum mechanics in drug–receptor interactions.

Unit 5:

Emerging Applications of Quantum Science in Life Sciences: Quantum dots and nanobiotechnology, Quantum sensors in medical diagnostics, Quantum computing in biological data analysis, Future perspectives: quantum biology and healthcare innovation

Recommended Books:

1. Al-Khalili, J. & McFadden, J. (2014). Life on the Edge: The Coming of Age of Quantum Biology. Bantam Press, UK.
2. Mohseni, M., Omar, Y., Engel, G.S., & Plenio, M.B. (2014). Quantum Effects in Biology. Cambridge University Press, UK.
3. Abbott, D., Davies, P.C.W., & Pati, A.K. (2008). Quantum Aspects of Life. Imperial College Press, London.
4. Chandra, A.K. (2006). Quantum Chemistry. 4th Edition, Tata McGraw-Hill Education, New Delhi.
5. Prasad, R.K. (2014). Quantum Chemistry. 4th Edition, New Age International Publishers, New Delhi
6. Chattopadhyay, Arpita (2018). Molecular Biophysics. Universities Press (India) Pvt. Ltd., Hyderabad.
7. Bawa, R.K. & Mishra, M. (2015). Nanoscience and Nanotechnology. Narosa Publishing House, New Delhi.
8. Banwell, C.N. & McCash, E.M. (2017, Indian Reprint). Fundamentals of Molecular Spectroscopy. McGraw-Hill Education India, New Delhi.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, III Semester

Course Name	PLANT REPRODUCTION	L	T	P	C	IM	EM	TM
Course Code	25BOT301	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ Course Description and Purpose:

Plant Reproduction is a course that focuses on the study of the reproductive mechanisms of plants. The course aims to provide students with an understanding of the basic principles of plant reproduction, including the structure and function of reproductive organs, the processes of pollination and fertilization, and the development of seeds and fruits. Through lectures, laboratory exercises, and field trips, students will explore the diversity of reproductive strategies used by different plant species and gain a comprehensive understanding of the ecological and evolutionary implications of these strategies.

❖ Course Learning Objective(s):

- To make students to understand the process of Plant reproduction
- Explain the basic concepts of plant reproduction, including the structure and function of reproductive organs, pollination and fertilization, and the development of seeds and fruits.

❖ Course Learning Outcome(s):

- Student will gain knowledge on the Process of Plant reproduction.
- Student will be able to know the Pollination and its applications.
- Student will be able to know about the application of embryology in horticulture and taxonomy.

❖ Course Content

UNIT – I: Flower: Floral reproductive parts(Calyx, Corolla ,Androecium and Gynoecium). Microsporangium Microsporogenesis: anther wall, Epidermis, Endodermis, Tapetum (types & functions) ,Sporogenous tissue & rare features. Male Gametophyte: pollen development (Formation of vegetative and generative cells), sperm dimorphism; pollen embryo sacs and pollen wall.

Palynology: Pollen apertures, NPC system & EDP system. Pollen wall features. Scope of Palynology. Palynology in Taxonomy.

UNIT – II: Megasporangium and Megasporogenesis: Ovule, types of Ovules, integuments and Nucellus. Megasporogenesis and special features. Female Gametophyte: Types of embryo sacs, ultra-structure of the embryo sac, embryo sac haustoria and nutrition of embryo sac.

Pollination: Floral characters, Pollination types (self and Cross pollinations) and vectors (abiotic and biotic). Pollination: Anther Dehiscence. Artificial Pollination. Pollen storage. Pollen viability tests.

UNIT – III: Fertilization: Pollen germination and pollen tube growth and guidance (entry of pollen tube into the embryo sac and pollen tube discharge) syngamy and double fertilization.

Endosperm: Types of endosperms (Nuclear, cellular and Helobial endosperms), Ruminant Endosperm and Cytology of endosperm. Functions of Endosperm. Improvement of the nutritive value of Endosperm by genetic engineering.

UNIT – IV: Embryogeny: Zygote, Development of embryo. Embryogeny in Dicotyledons. Embryogeny in Monocotyledons. Structure and functions of Suspensor. Under developed and reduced embryos. Nutrition of embryo (*In vivo & In vitro* studies).

Polyembryony: Causes of Polyembryony, Experimental induction of Polyembryony, Classification of Polyembryony and Practical value of Polyembryony. Apomixis: Vegetative reproduction, causes of Apomixis, techniques to screen Apomicts and significance of Apomixis.

UNIT – V: Seed : Seed development. Classification of seeds. Importance of seeds. Seed dispersal. Seed Dormancy.

Embryology in relation to Taxonomy: Important Embryological Characters in taxonomic considerations. A few families that stand out due to their embryological characteristics. Embryology's role in taxonomy.

Reference books:

1. Leins, P., Tucker, S.C. and Endress. P.K. 1988. Aspects of Floral Development. J. Cramer, Germany
2. Procter, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London;
3. Pulliah, T., Lakshminarayana, K. and Hanumantha Rao, B., 2008. Plant Reproduction, Scientific Publishers, Jodhpur, India;
4. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge;
5. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer – Verlag, New York;
6. Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops, Academic Press, London
7. Shivanna, K.R. and Swahney, V.K. (Eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge;
8. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology, A Laboratory Manual. Springer-Verlag, Berlin;
9. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen Structure and Function, Wiley Eastern Ltd., New Delhi;
10. The Plant Cell. Special Issue on Reproductive Biology of plants, Vol.5 (10) 1993. The American Society of Plant Physiologists, Rockville, Maryland, USA.
11. Dazhong Zhao, Kang Chong, Ravishankar Palanivelu. 2017. Molecular and cellular reproduction.

- **E- content / E-books (optional)**

KRISHNA UNIVERSITY: : MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, III SEMESTER

Course Name	PLANT PHYSIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE301	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description & Purpose:** This course provides the basic information on the plant and water relation as well as relation to the water retention in soil and root absorption. It will provide the information about transport of various solute molecules in between plant cells. It provide information about respiration as well as assimilation of nutrients into macromolecules, photosynthesis process and carbon assimilation into micromolecules, biosynthetic process of starch, sucrose other plant carbohydrates different plant products of acids and to know the secondary metabolites for plant protection.

❖ **Course Learning Objectives:**

- To make students to understand the Water relation of a plant cell,
- It will give information of Solute Transport, ion transport in the plant cell.
- To get concepts of respiration as well as assimilation of mineral nutrients in the plant.
- It will give information of photosynthetic process and carbon assimilation.
- To get knowledge on biosynthetic pathway of carbohydrate molecules and secondary metabolites.

❖ **Course Learning Outcomes:**

- Students gain knowledge of plant physiology and metabolism,
- Students got information about to understand the various biochemical pathways.
- Attain knowledge on respiration and photosynthesis pathways
- Students acquired information about carbohydrate biosynthesis and secondary metabolites.

❖ **Course Content**

UNIT – I : Plant and water relation

Plant and water Introduction to concepts of Physiology: Water relation of a plant cell-Laws of diffusion and Permeability, Concept of chemical potential Surface tension and capillary rise Water potential and its component, Soil Plant Atmosphere continuum-Water movement in soil and root, root pressure, Cohesion theory of water uptake, Hydraulic lift Aquaporins.

UNIT – II: Solute transport

Solute Transport, Nernst potential and Goldman equation, Membrane transport-active and passive transport. Channels, carriers and pumps, Potassium transport, Calcium transport, Phosphate transport, Nitrogen transport, Iron transport, Zinc transport, Sulfate transport, Micro and macronutrients and mineral deficiency symptoms.

UNIT – III: Respiration

Respiration: Glycolysis in plants and its regulation, Pentose Phosphate Pathway and TCA Cycle and its Regulation, Regulation of electron transport chain and role of alternate oxidase system. Assimilation of Mineral Nutrients: Nitrate Assimilation, Ammonium Assimilation, Sulfur Assimilation

UNIT – IV: Photosynthesis

Photosynthesis-Types of chlorophylls and biosynthesis. Organization of the Photosynthetic Apparatus, Mechanisms of Electron Transport, Proton Transport and ATP Synthesis in the Chloroplast, Carbon assimilation: C₃ Cycle and photorespiration, C₄ cycle and CAM Pathway and its Regulation.

UNIT-V: Carbohydrate metabolism

Carbohydrate Metabolism–Biosynthesis of starch and sucrose and its regulation, Synthesis and degradation of cellulose, pectin biosynthesis and enzymes involved in pectin degradation. Organic acid metabolism–Metabolism and roles of oxalic acid, ascorbic acid and malic acid. Secondary metabolites: Terpenes, Phenolic Compounds, Nitrogen-Containing Compounds

Text books:

1. Plant Physiology, Sixth Edition" by Lincoln Taiz and Eduardo Zeiger Biochemistry & Molecular Biology of Plants by Bob Buchanan, Gruissen W and Jones R L. Bidwell, R. C. S. (1979): Plant Physiology.
2. Edwards, G., Walker, D. W. (1983): C₃- C₄ mechanism and cellular environmental regulation of photosynthesis.
3. Govindjee, H. (1982): Photosynthesis Vol. I & II.
4. Hopkins, W. C. (1995): Introduction to Plant Physiology.
5. Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development.
6. Marschner, H. W. (1986): Mineral nutrition of Higher Plants.
7. Miller, P (1973) : Phytochemistry Vol. I, II and III.
8. Moore, T.C. (1974): Research experience in Plant Physiology, a laboratory manual.
9. Mukharjee, S.P. and Ghosh A.N. (1996): Plant Physiology.
10. Noggle, G.R. and Fritz, G. J. (1976): Introductory Plant Physiology.
11. Randhir Singh and Sawhney, S. K. (1988): Advances in frontier Areas of Plant Biochemistry.
12. Sadashivam and Manikam (1996): Plant Biochemical methods.
13. Salisbury, F. B. and Ross, C.W. (1992): Plant Physiology IV ed.
14. Sinha S.K., Sane P.V., Bhargava S.C. and Agarwal P.K. (1990): Proceeding of International
15. Congress of Plant Physiology Vol. I & II.
16. Smith, H. (1975): Phytochrome and Photomorphogenesis.
17. Steward F.C. (1976): Growth and Organization in plant.
18. Stump, P.K. and Conn, E. (1980) : Biochemistry of Plants. A Comprehensive Treatise.
19. Bonner, J. and Varner, E. (1976): Plant Biochemistry
20. Taiz, L. and Ziegler, F. (1998): The Plant Physiology.
21. Pessarkli, M. (2004): Handbook of Plant and Crop Physiology, Marcel Dekkar Inc. NY.
22. Pessarkli, M. (2005): Handbook of Photosynthesis.
23. Wilkins, M. B. (1976): Physiology of Plant Growth and Development.
24. Annual reviews of Plant Physiology and Molecular Biology.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, III SEMESTER

Course Name	PLANT GENETIC ENGINEERING	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE302	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

- To acquire knowledge on tools and techniques in genetic engineering.
- To gain knowledge in choice of host for cloning, methods of gene transfer and screening procedure.
- To understand the principles and application of PCR techniques, DNA sequencing methods.
- To learn about genetically modified organisms and their benefits.
- To realize ethical issues on genetic engineering.

❖ **Course Learning Outcomes:**

- Technical know-how on versatile techniques in recombinant DNA technology.
- An understanding on application of genetic engineering techniques in basic and applied experimental biology.
- Proficiency in designing and conducting experiments involving genetic manipulation.
- Manipulating DNA sequences with versatile DNA modifying enzymes.
- Designing cloning experiments using routine and specialized vectors for such applications as plant transformation, protein expression and genomic DNA library construction etc.
- Editing genomic sequences using site-directed mutagenesis.
- Employing PCR, nucleic acid hybridization and sequencing technologies for detection and diagnostics.

UNIT-I

Genetic Engineering Basic concepts - Overview of recombinant DNA technology. Isolation and purification of genomic DNA and Plasmid DNA. Detection and quantification methods of nucleic acids. DNA sequencing (Chemical and Enzymatic) methods. Solid phase synthesis of a gene.

UNIT-II

Enzymes used in genetic engineering. Restriction endonucleases - Classification, nomenclature and properties. Restriction mapping. DNA polymerase-I. Polynucleotide kinase. Terminal nucleotide transferase. Reverse transcriptase - structure, mechanism and functions. Alkaline phosphatase. S1 nuclease. DNA Ligases and ligation of foreign DNA to vectors - cohesive and blunt end methods.

UNIT – III

Vectors - Salient features of cloning vectors. Types of cloning vectors - plasmids, cosmids, phages (lambda and M13 phage vectors), animal (SV40, Baculo) and plant (CMV) viral vectors. Yeast Artificial chromosomes (YACs). Techniques of gene transfer - transformation, transfection, micro-injection, electroporation, silicon carbide fiber method. Liposome mediated Gene transfer (lipofection). Biolistic Transformation (Gene gun method).

UNIT – IV

Selection of Recombinant cells after Gene transfer - Selection of r-DNA clones and their expression. Marker genes and reporter genes. Nucleic Acid Probes. Colony hybridization. Fluorescent in-situ hybridization. Polymerase Chain Reaction and its applications. Real-Time PCR. Reverse Transcription PCR. DNA microarray

technology. Construction of genomic and cDNA libraries.

UNIT – V: Applications of genetic engineering

Role of Gene Silencing in Crop Improvement. need for sustainable technological interventions to address concerns., Different strategies used to control the plant fungal pathogens, need for GM crops and foods, role of biotechnology in Agriculture, transgenic plant production, RNA interference & Crop Improvement. Insect Resistance, Enhanced fungal resistance, Virus Resistance, RNAi and Abiotic Stress Tolerance.

Text books:

1. Desmond S. T. Nicholl ,An Introduction to Genetic Engineering, Cambridge University press,2018.
2. Mariana Ianello Giasseti, Tatjana Brankov, Genetic Engineering Principles And Methods, Scitus Academics,2019
3. T.A.Brown. An Introduction to Gene cloning & DNA analysis, 7th edition, Wiley balckwell, US. 2016.
4. Bernard R.Glick and Cheryl L.Patten, Principles and Applications of Recombinant DNA - Molecular Biotechnology,5th Edition, ASM Press, United states, 2017.
5. T.A.Brown, Genomes 4, Publisher Taylor and Francis, New York, 2018.
6. Bernard R. Glick, Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 5th Edition Publisher, 2017.
7. Isil Aksan Kurnaz, Techniques in Genetic Engineering, Publisher CRC Press, 2021.
8. Walter E. Hill, Genetic Engineering A Primer, Publisher CRC Press, 2019.

e-Reference links

1. <https://www.pdfdrive.com/molecular-biotechnology-principles-andapplications-of-recombinant-dna-4th-edition-e162050162.html>
2. <https://www.pdfdrive.com/molecular-biotechnology-principles-andapplications-of-recombinant-dna-e156918014.html>
3. <https://www.pdfdrive.com/recombinant-dna-technology-molecular-biologyand-paradigms-e11385991.html>
4. <https://www.pdfdrive.com/recombinant-dna-principles-and-methodologie-e185941491.html>

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc. – BOTANY, III SEMESTER

Course Name	PLANT TISSUE CULTURE	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE303	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Course objectives:

1. To study the plant tissue culture basic concepts and its applications
2. To understand the preparation of culture medium, basic components, Phyto hormones and its effects.
3. Study the techniques and applications of cryopreservation and germplasm storage
4. Study the methods of production of haploids, dihaploids, somatic embryos and artificial seeds.
5. Understanding the procedures of cell cultures, making protoplasts and genetic transformation through protoplasts and its applications

Course Specific objectives:

1. Students learn about basic concepts and protocols of different types of tissue culture
2. Students learn about totipotency, morphogenesis and cell differentiation.
3. Students learn about how to produce secondary metabolites in large scale and hybrids, new varieties in crop improvement using protoplast and haploid cultures.
4. Students learn about applications of tissue culture in crop improvement
5. Student can learn about conservation of natural bio diversity resources

Unit 1

Plant cell and tissue culture: introduction, history, scope. Basic concepts of tissue of culture: tissue culture cycle, types of cultures. Concept of cellular differentiation, totipotency. Culture media: composition and effects of media components, phytohormones – effects in tissue culture. Sterilization methods

Unit 2

Pathways of regeneration – biochemical and molecular aspects of tissue culture cycle. Technique and applications of cryopreservation and germplasm storage. Organogenesis and adventitious embryogenesis.

Unit 3

Fundamental aspects of morphogenesis, somatic embryogenesis. Methods of androgenic and gynogenic haploid production-dihaploids and application in agriculture. Embryo rescue. Cell culture: establishment, plating efficiency, induction and selection of mutants.

Unit 4

Free cell cultures: production of secondary metabolites/natural products. Somatic hybridization: protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements, limitations, merits and demerits. Cybrids. Protoplasts in genetic transformation.

Unit 5

Applications of plant tissue culture: clonal propagation, artificial seeds and its applications, somaclonal

variation and its applications. Plant tissue culture in forestry

Reference Books

1. Collin HA and Edwards S. 1998. Plant Cell Culture. Bioscientific Publishers, Oxford, UK.
2. Callow JA, Ford-Lloyd BV and Newbury HJ. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, UK.
3. Raghavan V. 1997. Molecular Biology of Flowering plants. Cambridge University press, New York, USA.
4. Bhojwani SS and Razdan MK. 1996. Plant tissue culture: Theory and Practice. (A revised edition). Elsevier Science Publishers, New York, USA.
5. Jain SM, Sopory SK and Velleux RE. 1996. In Vitro Haploid production in Higher Plants. Volumes 1-5. Fundamental aspects and Methods Kluwer Academic Publishers, Dordrecht, Netherlands.
6. Vasil IK and Thorpe TA. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, Dordrecht, Netherlands.
7. Bhojwani SS. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
8. Raghavan V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York, USA.
9. Karth KK. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA

KRISHNA UNIVERSITY::MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc. Botany

Course Name	Cytogenetics	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE304	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

➤ **Course Description and Purpose:**

The subject involves the fundamentals of Cytogenetics like scope, Course

Learning Objective(s):

Upon completion of the course, the student shall be able

1. To make students to understand the concepts of Genome, structural variations of Chromosomes.
- To get concepts of classical and molecular cytogenetics approaches.

❖ **Course Content:**

Nucleus and chromosome territories

Classification, methods of production, meiotic pairing, phenotypic effects and breeding behaviour of various chromosome structural changes

Physical mapping of genes on chromosomes

❖ **Course Content:**

UNIT I: Nucleus and chromosome territories: A and B chromosomes, NOR, Rabl configurations and Bouquet Chromosome pairing: Rabl configurations and its role in pairing, biochemical basis. Chromosome banding techniques Chromatin remodeling.

UNIT II: Duplications and deficiencies. Translocations, Inversions: methods of production, identification, meiotic pairing and crossing over in different regions breeding behaviour of inversion heterozygote, role in evolution.

UNIT III: Haploidy: Classification (monoploids, polyhaploids and aneuhaploids), methods of production (anther culture and chromosome elimination), identification, androgenic and gynogenetic, and parthenogenic haploids, meiotic pairing utility (hybrid sorting and DH breeding). Polyploidy: Classification (autopolyploids, allopolyploids), methods of production, cytological and genetic methods for identification, polyploid genetics (chromosome and chromatin segregation), meiotic pairing (autotetrasomes and allotetrasomes), diploidizing system (Ph1 locus) and role in evolution utility in crop improvement, segmental polyploidy, synthetic polyploids, brief idea of ancient polyploidy.

UNIT IV: Trisomics and tetrasomics (Hyperploids), Monosomics and nullisomics (Hypoploids): Classification (primary secondary and tertiary trisomics), methods of production, identification, meiotic pairing, breeding behaviour of trisomics trisomic and tetrasomic ratios, utility in chromosome mapping. alien addition/substitution lines.

UNIT V: Physical mapping of genes on chromosomes: In situ hybridization with DNA probes (FISH, McFISH, GISH,

fibre fish); deletion mapping. Apomixis: Cytogenetic basis of apomixis, meiotic behaviour in apomicts, autogamy and pseudogamy, agamospermy (apospory and diplospory) and other modes of apomixis.

➤ **Text books :**

1. Burnham, C.R. (1962). Discussions in Cytogenetics: Burgers, Minneapolis.
2. Fukui K and Nakayama S (eds.) (1996). Plant Chromosomes-Laboratory Methods. CRC Press, London
3. Gupta, P.K. (1999). Cytogenetics. Rastogi & Co., Meerut.
4. Gupta, P.K. and Tsuchiya, T. 1991. Chromosome Engineering in Plants: Parts A & B, Elsevier Publishers, the Netherlands.
5. Gupta PK, Singh SP, Balyan HS, Sharma PC and Ramesh B (1998). Genetics and Biotechnology in Crop Improvement. Rastogi Publications, Meerut
6. Hawes C and Satiat-Jennemaitre (eds.). (2001). Plant Cell Biology 2nd Ed. Oxford University Press, New York
7. Khush GS (1973). Cytogenetics of Aneuploids. Academic Press, New York
8. Singh RJ (2003). Plant Cytogenetics (Second Edition). CRC Press, Taylor & Frances group.
9. Singh RJ and Prem P. Jauhar (Eds.) (2005). Genetic Resources, Chromosome Engineering, and Crop Improvement: Grain Legumes, Volume I. CRC Press, Taylor & Frances group
10. Swaminathan, M.S., Gupta, P.K. and Sinha, U. (1983). Cytogenetics of Crop Plants. Macmillan India, New Delhi.
11. Swanson, C.P., Merz, T. and Young, W.J. (1982). Cytogenetics. Prentice-Hall of India (Pvt.) Ltd., New Delhi.
12. Sybenga, J. (1972). General Cytogenetics. North-Holland publishing Co. Amsterdam.
13. Sybenga, J. (1992). Cytogenetics in Plant Breeding. Springer-verlag, Berlin.

Reference books:

E content / E-books (optional)

KRISHNA UNIVERSITY::MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.Botany

Course Name	ETHNOBOTANY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE305	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ **Course Description and Purpose:**

- The focus of Ethnobotany, as a scientific discipline that comprises the study of human interaction with plants to study of a region's plants along with the practical knowledge of those plants with the help of the traditional knowledge of local people and their culture.
- These studies are important in highlighting the value of native plant species, e.g., for discovering novel drugs.

❖ **Course Learning Objective(s):**

-

❖ **Course Learning Outcome(s):**

- Students will be able to explain the basic principles of ethnobotany.
- Students will learn a variety of skills necessary for isolation of active principles necessary for bioactivities

❖ **Course Content**

UNIT – I: International case studies and traditional knowledge.

Hoodia case, Shaman Pharmaceuticals Case, Collecting Traditional Medicines in Nigeria, INBio-Merck Agreement, Brazzein Berries Case, The Enola Bean Patent

Indian Cases: The Turmeric Patent Case, Neem Patent Case, Basmati Rice Patent Case, Wheat Patent Case, Benefit-Sharing Arrangements with the Kani Tribes of Kerala

UNIT – II: Herbal Remedies & Phytochemical Finger Printing

Toxicity and Regulations: Herbals vs Conventional drugs. Efficacy of Herbal medicine products. Validation of herbal therapies. Phytochemical Finger Printing HPTLC and LCMS/GCMS applications in the characterization of herbal extracts Structure elucidation of phytoconstituents.

UNIT – III: Raw material Resources & Collection , Primary health care and herbs: Method and time of

collection, Processing and value addition methods : Underground parts : Roots, tubers, Bark, Leaves, Flowers, Seed & Fruits, Exudates & gums, Wood & wood extracts .

Examples to be studied as under Undergroundparts: roots, tubers, suckers

Asparagus racemosus, *Asparagus adscendens*, *Chlorophytum tuberosum* , *Chlorophytum borivilianum*, *Dashmool (Ideal vs. Reality)*, *Shemal musli: bombax malabarica*, *Boerhavia diffusa* , *Tephrosia purpurea*, *Withania somnifera* .

Bark: *Terminalia arjuna*, *Tecomella undulate*, *Moringa oleifera*,

Leaves: *Justicia adhatoda*, *Centella asiatica*, *Ocimum sanctum*, *Vitex negundo* , *Cassia angustifolia*, *Abrus precatorius*,

UNIT – IV: Phyto-Pharmacological Screening:

Preliminary screening of herbal raw material, quantitative and qualitative studies, Isolation of active principle and *in vitro* studies, cell line studies. In vivo evaluation techniques for Anti-inflammatory, Antiulcer, Anticancer.

UNIT – V: Molecular studies of Herbal drugs.

RFLP, RAPD, rDNA, Chloroplast DNA finger printing analysis .Identification of Adulterants.

Text books:

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy - G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
4. Pharmacognosy-Tyler, Brady, Robbers, Lee & Fetiger.
5. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, Nirali Prakashan.
8. Text Book of Pharmacognosy by T.E. Wallis, J & A Churchill Ltd., London.
9. Quality control of herbal drugs by Pulok K Mukherjee, Business Horizons Pharmaceutical Publishers, New Delhi.
10. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
11. Textbook of Pharmacognosy and Phytochemistry by Vinod D. RangarI, Part I & II, Career Publication, Nasik, India.
12. Plant drug analysis by H.Wagner and S.Bladt, 2nd edition, Springer, Berlin.
13. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal ,Vol.I, Eastern PublisherS, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M.Blumenthal.
15. Natural Products from Plants (2006) by Leland J. Cseke, CRC Press
16. Natural Products from Plants (1999) by Peter B. Kaufman et al., CRC Press LLC
17. Chemicals from Plants: Perspectives on Plant Secondary Products (1999) by N.J. Walton, Diane E. Brown, Imperial College Press and World Scientific Publishing Co. Ltd.
18. Biochemistry & Molecular Biology of Plants by Bob Buchanan, Gruissen W and Jones R L
19. Peer reviewed publications from Journals/Periodicals online/Scopus indexed
20. Textbook of Ethnobotany (Trivedi P. C.)

Reference books:

- E- content / E-books (optional)

KRISHNA UNIVERSITY::MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.Botany

Course Name	PALEOBOTANY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE306	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Course Description and Purpose: Paleobotany is the scientific study of ancient plants, using plant fossils found in sedimentary rocks. These fossils can be impressions or compressions of the plants

❖ **Course Learning Objective(s):**

The primary goals of paleobotany are to discover the earliest appearances of various groups of plants, and to understand the evolutionary relationships among these taxa.

❖ **Learning Outcomes:**

- Being able to understand the evolution of plants in geological epochs.
- Being able to understand the importance of fossil plants in conservation.

❖ **Course details**

UNIT I: Introduction and scope of Paleobotany, Geological eras. Conditions favouring preservations of fossil plants. Classification of fossil plants. The naming of fossil plants, Process of fossilization.

UNIT II: Non-vascular plants- Bacteria, algae, Algal lime-stones, fossil bryophytes and their evolution. Early vascular plants - Psilophytales, Ancient Lycopods, Equisetales Rhyniales, Sphenophyllales with their evolutionary evidences; fossil ferns foliage, ancient ferns and their evolution.

UNIT III: Pteridospermales Study of morphology, anatomy and evolutionary trends of following groups of plants. Lepidodendrales - Sigillariales Sphenophyllates - Psilophytales. Marattiales – Filicales.

UNIT IV: Medullosales Bennettitales, Williamsonsals Cycalales Cordiaitales - Coniferales Indian fossil flora, Glossopteris flora, Rajamahall Hill flora, Deccan Intertrappean flora, Paleopalynological techniques, Coal maceration, Lignite maceration.

UNIT V: Applied palaeobotany: a) Fundamentals of palaeofloristics, palaeogeography, palaeoecology and palaeoclimatology. b) Life as fuel maker: Organic deposits of commercial value- coal, petroleum-their origin and depositional environment; coal and petroliferous basins of India.

1. Arnold CA. (1947) An introduction to Paleobotany. New York: McGraw Hill Book Company, Inc
Agashe, S. N. (1995).
2. Paleobotany, Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi.
3. Banks HP. (1970) Evolution of plants of the past. Belmont, CA: Wadsworth Publishing Company;
Fundamentals of Botany Series.
4. Kenrick P. Davis P. (2004) Fossil plants. The Natural History Musuem. London.
5. Meyen, S. (2012). Fundamentals of palaeobotany. Chapman and Hall N. Y Springer Science & Business
Media

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. –BOTANY, III SEMESTER

Course Name	PLANT REPRODUCTION & PLANT PHYSIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOTLAB301	0	0	6	3	30	70	100

➤ **List of Experiments**

➤ **Plant Reproduction**

1. Types of Ovules
2. Embryo sac Structure
3. Types of endosperms
4. Anther types & structure
5. Study of Microsporogenesis and gametogenesis in sections of anthers.
6. Tests for pollen viability using stains and invitro germination.
7. Embryo sac development through examination of permanent stained serial sections.
8. Study of nuclear and cellular endosperm through dissections and staining.
9. Isolation of different stages of embryo development from suitable seeds.
10. Pollination types

➤ **Plant Physiology:**

1. Determination of water potential.
2. Demonstration of osmosis.
3. Determine chlorophyll a / chlorophyll b contents in C3 and C4 plants by Spectrophotometric method.
4. Estimation of plant Polyphenols.
5. Isolation of Starch from potato
6. Study of Phosphorus distribution in different plant parts.
7. Determination of amylase activity
8. Estimation of Ascorbic acid.
9. Estimation of Cellulose.
10. Extraction and separation of chloroplast pigments by paper chromatographic method
11. Determination of root pressure.
12. Determination of rate of Aerobic respiration by continuous current method

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	PLANT GENETIC ENGINEERING & PLANT TISSUE CULTURE	L	T	P	C	IM	EM	TM
Course Code	25BOTLAB302	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **List of experiments**

➤ **Genetic Engineering Experiments**

1. Isolation of DNA from Bacteria
2. DNA amplification by PCR
3. Restriction digestion of genomic or lambda DNA
4. Ligation
5. Preparation of competent cells, transformation of E.coli and screening of transformants

➤ **Plant Tissue culture experiments**

1. General out lay of plant tissue culture laboratory.
2. Preparation of media.
3. Callus induction – carrot.
4. Clonal propagation through meristem cultures.
5. Embryo culture – groundnut.
6. Anther culture – Datura/tobacco.
7. Establishment of cell cultures and determination of growth pattern.
8. Determination of plating efficiency of cell cultures.
9. Protoplast isolation and culture.
10. Protoplast fusion.
11. Observation of different developmental stages of somatic embryo in embryogenic callus.
12. Preparation of artificial seeds

References

1. M.R.Green and J. Sambrook (2012) Molecular cloning, A Laboratory Manual Vol. III. Fourth edition, Cold Spring Harbor Laboratory Press.
2. Abbas et al. Cellular and Molecular Immunology. Elsevier. 9th ed. 2018.
3. Fred M. Ausubel et al. editors Current Protocols in Molecular Biology. John Wiley and Sons, Inc, 2017.
4. M.R.Green and J. Sambrook. Molecular cloning, A Laboratory Manual Vol. III. 4th Edition, Cold Spring Harbor Laboratory Press,2012.
5. Fred M. Ausubel. Current Protocols in Molecular Biology. John Wiley and Sons, Inc,2017.

KRISHNA UNIVERSITY::MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. BOTANY, IV Semester

Course Name	PLANT BREEDING	L	T	P	C	IM	EM	TM
Course Code	25BOT401	4	0	3	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ **Course Description and Purpose:**

- Plant breeding is the science driven creative process of developing new plant varieties that goes by various names including cultivar development, crop improvement, and seed improvement.
- It deals with the Improvement of agronomical characters by classical, molecular genetic engineering methods.

❖ **Course Learning Objective(s):**

To get knowledge on various methods of crop improvement

❖ **Course Learning Outcome(s):**

- Students will be able to explain the basic principles of Plant breeding.
- Students will learn a variety of skills necessary for the development of new agronomically improved variety.

❖ **Course Content**

UNIT-I: General introduction of Agronomically improved characters. Classical and modern methods of crop breeding and improvement: Genetic variability in crop plants, Heterosis, Methods of breeding in self and cross pollinated and vegetatively propagated crops.

UNIT-II: Molecular plant breeding, Molecular marker systems, RFLP, RAPD, Importance of molecular marker assisted plant breeding, Marker assisted selection or genetic selection, Marker assisted backcrossing (MABC), Marker-assisted recurrent selection (MARS), Genomic selection.

UNIT-III: Post-transcriptional gene silencing (PTGS): VIGS and RNAi and their use in functional genomics and crop improvement.

UNIT- IV: Transgenic Plants (i) Transgenic plants for crop improvement (dicots and monocots), Insect resistance, insecticide, Resistance to virus, Resistance to other diseases, Recombinant DNA techniques for the production of transgenic plants, Procedure and protocols of producing transgenic plants. Transgenics for quality, Transgenics for improved storage, Transgenics for male sterility, Transgenics for flower color and shape, Transgenics for terminator seed.

UNIT-V: Aspects of Molecular breeding: Genotyping and creating molecular maps, Phenotyping phenomics, QTL mapping or association mapping.
Construction of molecular maps (using F2, DH, RILs); gene tagging using bulked segregant analysis (BSA) and near isogenic lines (NILs)

➤ **References:**

1. Mitra Sandhya 1994 Genetics a blueprint of life. Tata McGraw- Hill Publishing Company Ltd New Delhi.
2. Roy Darbeshwar 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers New Delhi.
3. Russell P. J. 1998. Genetics Fifth edition Benjamin / Cummings Publishing Company Canada.
4. Sharma J. R. 1998 Statistical and Biometrical techniques in Plant Breeding New Age International Publishers New Delhi.
5. Sharma, A. K. and Sharma, A. 1980. Chromosome techniques- Theory and practice. Butterworth and Co. (Publishers) Ltd., London.
6. Sharma, J. R. Principles and practice of plant breeding. Tata McGraw Hill Publ. Co. Ltd., New Delhi.
7. Singh, B. D. 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.

➤ **Reference books:**

➤ **E- content / E-books (optional)**

KRISHNA UNIVERSITY::MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, IV Semester

Course Name	PLANT RESOURCES AND UTILIZATION	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE401	4	0	3	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ Course Description and Purpose:

This course on Plant Resources and Utilization provides an in-depth exploration of the diverse range of plant resources available and their practical applications. Students will gain comprehensive knowledge of various plant species, their characteristics, and their roles in ecosystems. The course also focuses on the sustainable utilization of plant resources for food, medicine, energy, and other industrial purposes.

The purpose of this course is to familiarize students with the vast array of plant resources and their utilization, highlighting their importance in various aspects of human life. By studying the characteristics, cultivation, and utilization of plants, students will develop a deeper understanding of sustainable practices and ethical considerations. This course aims to equip students with the knowledge and skills necessary to make informed decisions regarding the responsible management and utilization of plant resources for the benefit of society and the environment.

❖ Course Learning Objective(s):

- To make students to understand the origin of domestic plants, economic importance of Algae Fungi, Bacteria and green revolution.
- Uses of Food crops, fiber crops, medicinal crops and timber yielding plants Principles of conservation

❖ Course Learning Outcome(s):

- Student will gain knowledge on the Origin of Agriculture and World Centers of Primary Diversity of Domestic Plants .
- Student will be able to know the uses of plants and conservation of plants. - Student will be able to know about the role of organization in plant biodiversity protection.

❖ Course Content

UNIT – I: . Concept of Candolle. Vavilov's Eight Centre of Origin. Plant Introduction and Secondary Centers of cultivated plants. Economic importance of Algae and Bacteria. Green revolution: benefits and adverse circumstances.

UNIT – II : Origin, evolution, Botany, cultivation and uses of Food crops : Wheat and Rice. Vegetable crops : Tomato & Chillies. Distribution, description and uses of Fiber Crops: Cotton & Jute. Distribution, description and uses of Oil yielding crops : Groundnut and Coconut.

UNIT – III: Distribution, description and uses of Medicinal and aromatic crops: *Catheranthus* and *Withania*. Distribution, description and uses of Timber yielding plants: *Tectona*, *Dalbergia* and *Rosewood*.

UNIT – IV: Principles of conservation, extinction, environmental status of plants based on International Strategies for conservation – in situ conservation : International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, Wetlands, mangroves and coral reefs for conservation of wild biodiversity. Role of Remote sensing in natural resources conservation.

UNIT – V: Strategies for ex-situ conservation: Principles and practices; botanical gardens, field gene banks, in vitro repositories, cryobanks; general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Department of Science & Technology (DST) and the department of Biotechnology (DBT) for conservation and germplasm conservation.

➤ **Text books :**

1. Sambamurthy AVSS and Subramanyam NS. 2000. Economic Botany of Crop Plants. Asiatech Publishers, Inc., New Delhi.
2. Conway G. 1999. The Doubly Green Revolution: Food for All in the 21st Century. Comstock Publishing Associates, New York.
3. Pinstrup – Anderson P. et al. 1999. World Food Prospects: Critical Issues for the Early 21st Century. International Food Policy Research Institute, Washington DC, USA.
4. Kocchar SL. 1998. Economic Botany of the Tropics. 2nd Edition. Mac Millan India Ltd., Delhi.
5. Plant Wealth of India 1997. Special Issue of Proceedings Indian National Science Academy B-63.
6. Sharma OP. 1996. Hills Economic Botany. (Late Dr. A.F. Hill, adapted by O.P. Sharms). Tata McGraw Hill Co., Ltd., New Delhi.
7. Frankel OH, Brown AHD and Burdon JJ. 1995. The conservation of Plant Diversity. Cambridge University Press, Cambridge, UK.
8. Paroda RS and Arora RK. 1991. Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o. NBPGR Pusa Campus, New Delhi.
9. Swaminathan MS and Kocchar SL (ed). 1989. Plants and Society. Mac Millan Publication Ltd., London.
10. Thakur RS, Puri HS and Hussain A. 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants. CSIR, Lucknow.
11. Council of Scientific & Industrial Research 1986. The useful plants of India. Publications and Information Directorate. CSIR, New Delhi.
12. Baker HG. 1978. Plants and Civilization. 3rd Edition. C.A. Wadsworth, Belmont.
13. Chrispeels MJ and Sadava D. 1977. Plants, Food and People. W.H. Freeman and Co., San Francisco USA.
14. Schery RW. 1972. Plants for Man. 2nd Edition. Englewood Cliffs, New Jersey.
15. Raw materials I - XII Revised Vol. I-III (1985-1992) supplement (2000).

➤ **Reference books:**

1. Baker HG. 1978. Plants and Civilization. 3rd Edition. C.A. Wadsworth, Belmont.
2. Chrispeels MJ and Sadava D. 1977. Plants, Food and People. W.H. Freeman and Co., San Francisco, USA.
3. Schery RW. 1972. Plants for Man. 2nd Edition. Englewood Cliffs, New Jersey.

4. Raw materials I - XII Revised Vol. I-III (1985-1992) supplement (2000).

➤ **E- content / E-books (optional)**

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, IV SEMESTER

Course Name	SUSTAINABLE AGRICULTURE	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE402	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ **Course Description and Purpose:** This course is an introduction to the issues, concepts and practices associated with sustainable agriculture. Agriculture is a complex social-ecological system which integrates a wide range of economic, environmental and social aspects. This course is structured to provide the student with opportunities to connect the principles of sustainable agriculture covered in classroom with experiential learning activities that take place in the local food system (e.g. via field trips to farms and food related businesses). Sustainability also requires that agricultural enterprises have a firm economic basis, regardless of whether they are structured as for-profit or non-profit organizations.

❖ **Course Learning Objective(s):**

- Students will learn to assess the ecological processes that underpin agriculture and the management practices which influence the function of crop and livestock production systems.
- Since agriculture involves more than just production systems or business enterprises, students will also explore the important role that agriculture plays in strengthening local communities and society at large.
- To make students to understand modern methods which will less cost to implement.
- Impacts of modern agriculture forming and Benefits of Organic farming, Biofertilizers and Biopesticides.

❖ **Course Learning outcomes:**

- Understand what is meant by “sustainable” agriculture and apply this description to crop and livestock production systems.
- Identify appropriate cultural practices to enhance biodiversity on the farm, increase soil organic matter, and limit negative environmental impacts from crop and livestock production.
- Incorporate and quantify ecosystem services at work in production systems.
- Describe resources for and constraints on contemporary farm production systems (ecological, social, economic)
- Outline the social, economic and political forces that have shaped and can shape sustainable agriculture and food systems.
- Implement food safety best management practices to promote human health in food production.

❖ **Course Content:**

UNIT – I: Sustainable Agriculture

Concept of Sustainable Agriculture. Methods of Sustainable Agriculture: Crop rotation and Mixed Farming. Biofertilizers and Biopesticides. Modern Agricultural Practices and their impacts on soil: Pesticides and Biomagnification. Fertilizers and Eutrophication. 38

UNIT – II: Organic Farming

Organic Farming Definition, Concept, Merits and Demerits; Developing organic farms – important steps and methods ; Brief idea about manure. Organic manure, green manure, liquid manure. Importance of Organic farming in Agriculture.

UNIT – III: Vermiculture

Vermiculture and Vermitechnology–Introduction– Vermicompost Preparation, Advantages of Vermicomposting Earthworms: Ecological types of Earthworms–Vermicomposting and their application in organic culture-Preparation of enrich compost, vermiwash.

UNIT – IV: Biofertilizers

Biofertilizers-Introduction-Types of Biofertilizers-Applications of Biofertilizers-Nitrogen fixing microorganisms (symbiotic and asymbiotic) Rhizobium biofertilizer, Azotobacter biofertilizer, Azospirillum biofertilizer, Blue green algae etc-Phosphate solubilising microorganisms-Fungi, Mycorrhizae (AM Fungi).

UNIT – V: Biopesticides

Types of Biopesticides and application of *Bacillus thuringiensis*, entomopathogenic fungi, *Beauveria bassiana*, *Trichoderma sp*, pheromones, Integrated Pest Management-(IPM)- introduction, importance, concepts, principles. IPM Methods- Cultural methods, Mechanical methods, Physical and Biological methods. Natural enemies- parasites, predators and microorganisms used in pest control.

Text books:

1. Lampin N. 1990. Organic Farming. Press Books, Ipswich, UK.
2. Palaniappan SP & Anandurai K. 1999. Organic Farming–Theory and Practice.
3. Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
4. Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
5. Trivedi RN. 1993. A Text Book of Environmental Sciences, Anmol Publ.
6. Veeresh GK, Shivashankar K & Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture
7. Hand Book of Agriculture by Indian Council of Agricultural Research
8. Srivastava, P. D. and Singh, R. P. 1997. An Introduction to Entomology, Concept Publishing Company, New Delhi.
9. Dhaliwal, G. S. and Ramesh Arora. 1998. Principles of Insect Pest Management .Kalyani Publishers, New Delhi.
10. Hand Book Of Biofertilizers & Vermiculture, by Eiri Board, Engineers India Research Institute (1 January 2009).
11. Biofertilizers and Biopesticides By A. M. Deshmukh · 1998, Technoscience Publications

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, IV SEMESTER

Course Name	PLANT BIOCHEMISTRY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE403	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Content**

UNIT – I:

Plant cell: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins stomatal movement, transpiration, photoperiodism and biological clocks, plant movement.

UNIT – II:

Photosynthetic apparatus, pigments of photosynthesis, Calvin cycle (C3 plants), Hatch slack (C4 plants) & CAM pathways of carbon reduction and its regulation, Structure, function and regulation of RUBISCO, Photorespiration photorespiration pathway and significance, cyanide resistance, relationship between photosynthesis photorespiration.

UNIT – III:

Phytohormones: Biosynthesis, transport, physiological effects, mode of action and signal transduction of auxins gibberlic acid, abscisic acid, ethylene and cytokinins in germination, embryogenesis, growth and development of plant.

UNIT – IV:

Nitrogen metabolism: Nitrogen fixation, nitrogenase complex, biochemistry and genetics of nitrogen fixation and ammonium assimilation, structure of 'NIF' genes and its regulation, structural features of nitrate reductase and nitrite reductase, regulation of nitrate and sulphate assimilation. Secondary plant metabolites: Nature, distribution biosynthesis and function of plant metabolites, biosynthesis of nicotine. Biochemistry of plant toxins phytohemagglutinins, lathrogens, nitriles, protease inhibitors, protein toxins, role of secondary metabolites in chemical defence.

UNIT – V:

Plant stress physiology: Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling anaerobiosis, heavy metals, radiations and their impact on plant growth and metabolism, mechanisms of resistance to biotic stress and abiotic stress, antioxidative defence mechanism. Plant defence: Genetic basis of plant-pathogen interactions, antio R-Avr gene interactions and isolation of R genes, hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR).

Text books:

- 1 Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford, 1983.
- 2 Plant Physiology, 5th Edition, by Lincoln Taiz and Eduardo Zeiger, Amazon press, 2012
- 3 Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford. Buchanan BB, Grissem W & Jones RL. 2000.
- 4 Biochemistry and Molecular Biology of Plants. 2nd Ed. John Wiley. Dey PM & Harborne JB. 1997.
- 5 Plant Biochemistry. Academic Press. Heldt HS. 1997. Plant Biochemistry and Molecular Biology. Oxford Univ. Press.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, IV Semester

Course Name	PLANT PATHOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE404	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ **Course Description and Purpose:**

Plant pathology is a specialized field of study that focuses on the scientific study of plant diseases caused by pathogens, environmental factors, and other related issues. This course will introduce students to the fundamental concepts and principles of plant pathology, including the causes, symptoms, and management of plant diseases. The course will also cover topics such as the mechanisms of pathogenesis, the host- pathogen interaction, and the principles of disease control and management. The purpose of this course is to provide students with a comprehensive understanding of the fundamental concepts and principles of plant pathology. Students will learn how plant diseases are caused, how they spread, and how they can be prevented or controlled. The course will equip students with the knowledge and skills necessary to identify, diagnose, and manage plant diseases, and to develop effective strategies for disease prevention and control.

❖ **Course Learning Objective(s):**

To make students to understand fundamental concepts and principles of plant pathology, including the causes, symptoms, and management of plant diseases - Explain the basic concepts of mechanisms of pathogenesis, the host-pathogen interaction, and the principles of disease control and management.

❖ **Course Learning Outcome(s):**

- Student will gain knowledge on the plant diseases.
- Student will be able to know the process of infection and factors affecting the spread of the disease.
- Student will be able to know about the control of plant diseases.

❖ **Course Content**

UNIT–I: Importance of plant diseases. History of Plant Pathology (Indian Context) classification of plant diseases, causes of plant diseases. Methods, symptoms and identification of plant diseases. Dispersal of plant pathogens- Active and passive.

UNIT – II: Pathogenesis: Infection phenomena – pre penetration, penetration and post penetration. Factors affecting infection. Effect of environment on plant disease development – Temperature, humidity and light.

UNIT – III: Enzymes and toxins: Enzymes involved in disease development; toxins and their role in plant health. Disease resistance: (i) Protection (structural, chemical, absence of nutrients and common antigens) (ii) Defence (histological defence, chemical-polyphenols, prohibitins, inhibitins, phytoalexins and lectins.

Disease control: Cultural practices, chemical methods (insecticides, fungicides), biological control: introduction, biological control of insects and pests, use of resistant varieties, integrated management for disease control.

UNIT – IV: Symptoms, etiology, epidemiology & control measures with reference to the following: Fungal diseases – Damping off of seedlings. Leaf spot of turmeric, Ergot of bajra, Powdery mildew of Cucurbits, Grain smut of Sorghum, Blast disease of Rice, Wilt of Cotton, Tikka disease of ground nut and red rot of sugarcane.

UNIT – V: Symptoms, etiology, epidemiology & control measures with reference to the following: Bacterial diseases – Citrus Canker, Bacterial leaf Blight of rice and Brown rot of potatoes.

Brief account, structure, disease cycle and control of the following Plant viral diseases. Tobacco mosaic Virus, leaf curl of Papaya, Yellow Mosaic of Bhindi, and Bunchy disease of Banana.

➤ **Text books :**

1. Bhojwani, S.S. and Bhatnagar, S.P and Dantu P.K. The Embryology of Angiosperms (6th Revised edition), 2015. Vikas Publishing Pvt. Ltd.
2. Maheswari, P. A Introduction to Embryology of Angiosperms, 1950.
3. Shivanna, K.R. and John, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd., Publications, 1989.
4. John, B.M. Ambegaokar, K.B. and Srivastava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, Springer Verlag.

➤ **Reference books:**

1. Leins, P., Tucker, S.C. and Endress. P.K. 1988. Aspects of Floral Development. J. Cramer, Germany.
2. Procter, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
3. Pulliah, T., Lakshminarayana, K. and Hanumantha Rao, B., 2008. Plant Reproduction, Scientific Publishers, Jodhpur, India.
4. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
5. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer – Verlag, New York.
6. Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops, Academic Press, London.
7. Shivanna, K.R. and Swahney, V.K. (Eds.) 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
8. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology, A Laboratory Manual. Springer-Verlag, Berlin.
9. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen Structure and Function, Wiley Eastern Ltd., New Delhi.
10. The Plant Cell. Special Issue on Reproductive Biology of plants, Vol.5 (10) 1993. The American Society of Plant Physiologists, Rockville, Maryland, USA.
11. Dazhong Zhao, Kang Chong, Ravishankar Palanivelu. 2017. Molecular and cellular reproduction.

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BOTANY, IV SEMESTER

Course Name	BIO MEMBRANES & BIOENERGETICS	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE405	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Learning Objectives:**

- To familiarize the students with the fundamental concepts of cellular membranes, their structures and the chemical composition that are responsible for the unique functions of biomembranes with emphasis on membrane transport
- To help the students understand the concept of chemical thermodynamics and how they apply within cells.
- To make the students understand the various energy transductions that occur within the cell.

❖ **Course Learning Outcomes:**

- The students will learn basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation.
- They will understand composition and structure of biomembranes, transport mechanisms across biological membranes and will learn the concept and mechanism of ATP synthesis.

❖ **Course Content**

UNIT – I: Bioenergetics

Bioenergetics-basic principles; enthalpy, entropy, spontaneous and non-spontaneous thermodynamic reactions equilibrium constant and concept of free energy, standard reduction potential and its calculations, relation of Gibbs free energy and standard reduction potential, Nernst equation, principles of metabolic regulation, thermodynamic consideration of committed steps in metabolic reactions. High-energy compounds. energy charge, ATP cycle phosphorylation potential. Standard energy of hydrolysis of ATP, PEP, 1,3 BPG and thioesters. Redox reactions standard redox potentials and Nernst equation. Universal electron carriers.

UNIT – II: Biomembranes

Biomembranes: Historical background, membrane models. Membrane functions. Composition of biomembranes Lipids -Phospholipids, Glycolipids, sterols; Proteins - Peripheral Proteins, Integral Membrane Proteins and Lipid-Anchored proteins, and carbohydrates. Comparison of the composition of various cellular and subcellular membranes. Role of Flippase, Floppase and Scramblase.

UNIT – III: Model systems to Study membranes

Model systems to study membranes: Lipid Monolayers, Planar Bilayer and Liposome, and their application Polymorphic Lipid-Water Systems. The various determinants of polymorphic phases: CMC, lipid shape, critical packing parameter. Membrane fluidity: lateral, transverse and rotational motion of lipids and proteins. Factors affecting membrane fluidity- composition, barriers (tight junctions), cytoskeleton interactions, microdomains – rafts, caveolae. Fence and gate model.

UNIT – IV: Techniques to study membrane dynamics

Techniques to study membrane dynamics: FRAP, TIRF, SPT. Transport across membranes: Simple diffusion and facilitated diffusion. Passive transport glucose transporter and anion transporter. Primary active transporters- P type

ATPases, V type ATPases, F type ATPases. Secondary active transporters – lactose permease, Na⁺ - glucoselymporter. ABC family of transporters – MDR and CFTR. Bacteriorhodopsin. Ion channels: voltage-gated ion channels (Na⁺ /K⁺ voltage-gated channel) and ligand-gated ion channels (acetyl choline receptor), and aquaporins. Ionophores: valinomycin, gramicidin.

. UNIT – V: Oxidative phosphorylation

Oxidative phosphorylation: The electron transport chain - its organization and function. Sequence of electron transport, Peter Mitchell's chemiosmotic theory and Proton gradient. FoF₁ ATP synthase, mechanism of ATP synthesis. Transporters in mitochondria. Regulation of oxidative phosphorylation, Photophosphorylation, Hill reaction. Photosynthetic pigments and light harvesting complexes in plants. Photosystem I and Photosystem II. Z-scheme of photosynthetic electron flow Photophosphorylation, Cyclic and non-cyclic photophosphorylations and its significance.

Text books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / I SBN : 10:1-4641- 0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H. Amon, A. and Scott, M.P.. W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
4. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

e References:

1. <https://www.ncbi.nlm.nih.gov/books/NBK21475/>
<https://www.ncbi.nlm.nih.gov/books/NBK21054/?term=molecular%20biology%20of%20cell>

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M.Sc. – BOTANY, IV Semester

Course Name	PHARMACOGNOSY	L	T	P	C	IM	EM	TM
Course Code	25BOTDSE406	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

❖ **Course Learning Objective(s):**

Upon completion of the course, the student shall be able

- To know the techniques in the cultivation and production of crude drugs
- To know the crude drugs, their uses and chemical nature
- To know the evaluation techniques for the herbal drugs
- To carry out the microscopic and morphological evaluation of crude drugs

❖ **Course Content:**

UNIT-I: Introduction to Pharmacognosy: Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum-resins).

UNIT-II: Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs.

UNIT-III: Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT-IV: Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.

UNIT-V: Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs Plant Products:

Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens Primary metabolites: General introduction, therapeutic uses and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: Carbohydrates: Æacia, Agar, Tragacanth, Honey Proteins and Enzymes:

Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool.

➤ **Text Books:**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007 .
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae .
9. Anatomy of Crude Drugs by M.A. Iyengar.

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M.Sc. –BOTANY, IV SEMESTER

Course Name	PLANT BREEDING	L	T	P	C	IM	EM	TM
Course Code	25BOTL401	0	0	6	3	30	70	100

➤ **List of Experiments**

1. Smear preparations in *Allium cepa*, *Zea mays*, *Delphinium malbaricum*, *Coix lacrimajobi*.
2. Meiotic analysis in plants (Stages, chiasma, chiasma terminalization by using photographs) Pachytene analysis.
3. Meiotic studies in structural hybrids (*Rhoeo*, *Setcreatia Cynotis*).
4. Study of aneuploidy and chromosome mapping in barley.
5. Study of B chromosome in Maize/ *Drimia*.
6. Induction of polyploidy using Colchicine.
7. Cytological analysis of polyploidy in plants.
8. Genome analysis in wheat/ *Gossypium*.
9. Study of life cycle in *Drosophila melanogaster*.
10. Special type of chromosome in *Drosophila melanogaster*.
11. Study of Apomictic Chromosome.

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Course Name	MUSHROOM CULTIVATION	L	T	P	C	IM	EM	TM
Course Code	25BOTSEC401	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course deals with Mushroom cultivation Techniques, Cultivation, Composting Technique and Bio-fertilizers and their Production Introduction

❖ **Course Learning Objective(s):**

- To help the students to learn mushroom cultivation, bio-composting and biofertilizer production through hands- on- experience.
- To enable the students to become self- employed/ entrepreneur.

❖ **Course Learning Outcome(s):**

- Mushroom Cultivation; Training on sterilization techniques (Glass wares, Medium, and Laboratory). Microscopical observation of Mushrooms. Media preparation; Isolation and purification of mushroom fungus Spawn preparations Cultivation of mushroom – conditions for cultivation of mushroom Spawn running for *Pleurotus* spp and *Calocybe* spp.
- Harvesting and preservation. Determination of nutritional value: Proteins, sugars, lipids, crude fibre and ash contents.
- Composting of solid waste generated in mushroom cultivation.
- Biofertilizer Production
- Isolation and mass cultivation of the following i. *Rhizobium* ii. *Azospirillum* iii. Blue green alga (*Anabaena* /*Nostoc*)
- Packaging of biofertilizers with carrier material.

❖ **Course Content**

UNIT-I: Mushroom Biology Morphology - classification: edible and poisonous mushrooms. Life cycle of Basidiomycetes fungi- Breeding and Genetic improvement of mushroom strains. Medicinal and Nutritional value of mushrooms.

UNIT-II: Mushroom cultivation Techniques Cultivation conditions for tropical and temperate countries. Isolation, spawn production, growth media, spawn running and harvesting of mushrooms (*Volvariella* spp., *Pleurotus* spp., *Agaricus* spp., *Calocybe* spp., and *Lentinus* spp). Diseases / contamination; Post Harvest Technology: Freezing, drying, freeze drying and canning

UNIT-III: Economics of Mushroom Cultivation Economics of the production of oyster mushroom, milky mushroom and paddy straw mushroom cultivation : Infrastructure facilities, expenditure on fixed assets, plant and machinery, cost of the project, recurring expenditure , interest and depreciation of the expenditure, cost of production and profit. Entrepreneurship in mushroom cultivation.

UNIT-IV: Composting Technique Introduction- history of composting – compost - composting processes - microbiology of composting - fate of pathogens - ingredients in composting - various methods of composting: vermi- composting and home composting - steps in composting.

UNIT-V: Bio-fertilizers and their Production Introduction - Types: Microbes as biofertilizer, Green manure, importance of macronutrients ;Biofertilizers vs Chemical fertilizers; Nitrogen fixers – types and examples; Phosphate solubilizers – role of bacteria and Mycorrhizae - Mass cultivation and Application of the following biofertilizers: i) Rhizobium ii) Azospirillum iv) Cyanobacteria v) Mycorrhizae Quality control; Challenges and opportunities; Biofertilizer Entrepreneurship

➤ **Text Books:**

1. Mushroom Cultivation in India by B.C. Suman, V.P. Sharma
2. Mushroom Cultivation Technology by R. Gogoi, Y. Rathaiah, T.R. Borah
3. Mushroom: cultivation, processing and uses by B. C. Suman, V. P. Sharma

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Course Name	OLERICULTURE	L	T	P	C	IM	EM	TM
Course Code	25BOTSEC402	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

This course deals Growing vegetables, Solanaceous and Leafy vegetables. Root and Tuber crops and Leguminous vegetables

❖ **Course Learning Objective(s):**

- Able to Study of different varieties of vegetable crops.
- Able to study the Importance, morphology and taxonomy, varieties, climate and soil

❖ **Learning Outcomes:**

On successful completion of this course, the students will be able to:
Distinguish the growing of vegetables according to season and climate, Get detailed knowledge on cultivation aspects of different vegetables, Understand and explain the special intercultural operations done in vegetable crops, Study of morphology and taxonomy of different vegetable crops, Study of different varieties of vegetable crops, Identify the diseases and pests of vegetable crops and their management.

❖ **Course Content:**

UNIT-I: Introduction to vegetable crops: Distribution, Importance and Production of vegetable cultivation in India and Andhra Pradesh. Classification and Nutritive value of vegetables. Export and import potential of vegetables in India. Constraints in vegetable production and remedies to overcome them.

UNIT- II: Solanaceous and Leafy vegetables:

Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Brinjal (b) Tomato (c) Capsicum (d) Spinach (e) Coriander and (d) Mentha.

UNIT- III: Root and Tuber crops:

Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Carrot (b) Beet root (c) Tapioca and (d) Colocasia.

UNIT-IV: Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Cabbage and (b) Cauliflower.

UNIT-V: Leguminous vegetables:

Importance, morphology and taxonomy, varieties, climate and soil, seeds and sowing, manuring, irrigation, intercultural operations, diseases and their control, harvesting and yield of following crops: Cultivation of (a) Cluster bean (b) Cow pea and (d) Dolichos.

➤ **Text Books:**

1. Olericulture In India By M. K. Rana
2. Production Technology of Vegetable Crops By K. G. Shanmugavelu

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Course Name	SEED TECHNOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BOTSEC403	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

- This course deals with high quality seed in increasing and sustaining crop production, Genetic purity of varieties.

❖ **Course Learning Objective(s):**

- Mainly focuses on Methods of maintenance of genetics purity and techniques of maintenance breeding.

❖ **Course Learning Outcome(s):**

Students able to learn

- The Study of inflorescence, flower structure, seeds of important crops and vegetables. Study of the prolophynous, protandrous nature of flowers (cotton, castor pigeonpea, sunflower, maze, etc)
- Emasculation of various crops e.g. Maze, Cotton and Wheat.
- Study of pollen grains, morphology, and fertility and in vitro and in vitro germination, pollination, fertilization.
- Seeds productions practice of cereals, pulses, oilseeds and fiber crops.
- Visit of nucleus, seed plots and study of maintenance of varieties, visit of foundation and certified seed plots and techniques of seed production should be based on the mapping as well as laboratory work on the rock samples collected during the fieldwork.

❖ **Course Content:**

UNIT-I: General Introduction: Seed Definition – Difference between seed and grain, Seed as a basic input in agriculture, Role of high quality seed in increasing and sustaining crop production. Seed quality concept, quantity control in seed production characteristics of sowing quality seeds. Mode of reproduction in relation to seed production – classification of corps plants in relation of mode reproduction and choice of methods for seed production.

UNIT-II: Development & Training of varieties: System of breeding and testing of crop varieties and hybrids in self, often and cross-pollinated crops. System of release and notification of varieties for general cultivation. Varietals purity and its maintenance: maintenance: maintenance: maintenance: Genetic purity of varieties – concepts. Life span of varieties and factors responsible for their deterioration. Methods of maintenance of genetics purity and techniques of maintenance breeding. Generation system of seed multiplication. System and methods of production of nucleus, breeder, foundation and certified seed.

UNIT-III: Flowering & Seed Production: Production Flowering in crop plants, its modification for hybrid seed production. Factors affecting seed set – temperature, relative humidity, day length, wind velocity and directions of flowering, anthesis, pollen viability, stigma receptivity, nutrition and irrigation. Male Sterility & Self Incompatibility: Incompatibility: Incompatibility: Incompatibility: Malesterility, its genetics and use in hybrid seed production. Self-incompatibility – its genetics and use in hybrid seed production.

UNIT-IV: Pollination: Pollination & Seed Production: Production: Production: Production: Improvement of pollination and seed production forage legumes – tripping process and vegetables. Improvement of pollination for hybrid seed production.

UNIT- V: Seed Production System & Management: Management: Management: Management: System of seed production in India. Agencies responsible for seed production. Indian and International seed industry. Planning, organizing and managing a seed production programme.

➤ **Text Books:**

1. Fundamentals of Plant Breeding and Hybrid Seed Production By Ratan Lal Agrawal
2. Principles of Seed Science and Technology by Lawrence O. Copeland, Miller F. McDonald

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Course Name	MOOCS	TOTAL CREDITS
Course Code	25BOTMOOCS401	4

shall be suggested to the students during the third semester and/or at the beginning of the IV semester, which