ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

NAGARJUNA NAGAR,

GUNTUR

ANDHRA PRADESH

PROGRAM PROJECT REPORT

01. MASTER OF SCIENCE (BOTANY)

Master of Science (Botany)

PROGRAMME CODE: 1

MISSION:

M. Sc. in Botany Programme provides a broad background in the biology of plants – from the molecular to the organism level.

OBJECTIVES :

The objective of this course is to build a strong background in plant biodiversity, ecology, and physiology, cell and molecular biology, cytogenetics, biochemistry, biotechnology, reproductive biology, morphogenesis and anatomy, metabolism of biomolecules and immunology, fungi and microbes. The programme includes research orientation from the first semester. It is also a foundation for entry into PhD programme which can produce intellectual and proficient botanists. It is done by this course through enhancing the abilities and skills of students for application of botany theories and expertise in the live problems faced by industry.

RELEVANCE :

The M.Sc. (Botany) programme offered through Open and Distance Learning mode is purely relevant and aligned with the goals and mission of CDE, ANU. This programme is structued inorder to equip the learners with core competence in research and analytical aspects of scientific evolution there by new areas will be unfolded. This programme is helpful for enhancing the employability skills with the global perspective and conforming to the vision and mission of ANU.

NATURE OF PERSPECTIVE TARGET GROUP OF LEARNERS :

Aim of open and distance eduation is to enhance the academic competence in those who were deprived of higher education for various socio-economic reasons. This programme is designed for candidates which is helpful in their career advancement, updating the knowledge, upgrading their qualification for school teachers, Scientists, Laboratories, for getting jobs in health and medical organisations, pursue for research, Biotechnology companies, Plant pathologist, Environmental consultant, Molecular biologist, Plant explorer etc.

SKILLS AND COMPETENCE OF THE PROGRAMME :

Inconsideration of the huge gap in education and industry and also in skill development now it is imperative on the part of every university to reach out every nooc and corner of the country where the institutions with significant infrastructure are not availble in order to elevate the status of the marginalised sections of the society especcially living in rural areas of the country. The only solution appears to be "open and distance education" and Acharya Nagarjuna University takes initiative by reaching out those unreached by ICT enabled blended mode of distance learning programmes. M.Sc. (Botany) propgramme is an innovative programme. The learning outcomes of this programme are as follows:

- Professional development of teachers.
- Incorporating generic transferrable skills and competencies
- To develop critical learning, anylitical skills and research skills.

INSTRUCTIONAL DESIGN: Course structure and detailed syllabi

ACHARYA NAGARJUNA UNIVERSITY : CENTRE FOR DISTANCE EDUCATION
Master of Science (Botany) - Program code: 01

Program Structure

Program code	Program	Internal assessment	External exams	Max. Marks	credits
SEMISTER 1					
101BO24	Plant Systematics	30	70	100	4
102BO24	Reproductive Biology of Angiosperms	30	70	100	4
103BO24	Biology and Diversity of Viruses, Bacteria, Algae and Fungi	30	70	100	4
104BO24	Outlines of Bryophytes, Pteridophytes, Gymnosperms and Plant Fossils	30	70	100	4
105BO24	**Practical-I**	30	70	100	4
106BO24	**Practical-II**	30	70	100	4
SEMISTER 2					
201BO24	Plant Ecology and Biodiversity	30	70	100	4
202BO24	Plant Physiology	30	70	100	4
203BO24	Compulsory Foundation – Cell Biology	30	70	100	4
204BO24	Plant Structure and Development	30	70	100	4
205BO24	**Practical-I**	30	70	100	4
206BO24	**Practical-II**	30	70	100	4
SEMISTER 3					
301BO24	Plant Pathology	30	70	100	4
302BO24	Plant Metabolism	30	70	100	4
303BO24	Ethnobotany and Ethnomedicine	30	70	100	4
304BO24	Molecular Biology of Plants	30	70	100	4
305BO24	**Practical-I**	30	70	100	4
306BO24	**Practical-II**	30	70	100	4
SEMISTER 4					
401BO24	Plant cell, Tissue and Organ Culture	30	70	100	4
402BO24	Genetic engineering and Bioinformatics	30	70	100	4
403BO24	Cytogenetics and Plant Breeding	30	70	100	4
404BO24	Horticulture and Landscaping	30	70	100	4
405BO24	**Practical-I**	30	70	100	4
406BO24	**Practical-II**	30	70	100	4

SEMESTER-I
Master of Science (Botany)
101BO24-PLANT SYSTEMATICS

UNIT-I

1. Systematics: Concepts and basic components;
2. Taxonomic structure; Taxonomic hierarchy- species to division;
3. International Code of Nomenclature (ICN) of algae, fungi and plants -
4. Principles, Rules and Recommendations, Ranks, Principle of Priority, Typification, Author citation, Effective and Valid publication.

UNIT-II

1. System of classification of Armen Takhtajan and its merits and demerits;
2. Angiosperm Phylogeny Group (APG) classification;
3. A brief account of selective clades like Basal angiosperms, Magnoliids, Monocots
4. (including Commelinids),
5. A brief account of selective clades like Eudicots, Rosids, Asterids.

UNIT-III

1. Taxonomic evidence: Morphology, Anatomy, Embryology, Palynology and Cytology in relation to taxonomy;
2. Data information systems;
3. Botanical Survey of India (BSI): Objectives, activities, organization and publications.

UNIT-IV

1. Process of Plant Identification: Construction, types and use of Taxonomic keys;
2. Herbarium methodology: Collection of plants, processing and preservation of
3. specimens;
4. mportant World and Indian herbaria;
5. Major botanical gardens of the World and India;
6. DNA barcoding in plants and its practical implications.

UNIT-V

1. Chemosystematics: Primary and Secondary metabolites, Semantides and Non-semantides etc. in plants;
2. Phylogenetic Systematics: operational units, characters, coding and construction of cladograms;
3. Serosystematics: Methodology and its applications in systematics;
4. Molecular Systematics: Gene sequences, Phylogenetic analysis, Restriction site
5. analysis, allozymes etc.

REFERENCE BOOKS:

1) **International Code of Nomenclature for algae, fungi, and plants** (Schenzhen Code), 2018. (online version) adopted by the *Nineteenth International Botanical Congress*, Chenzehen, China.
2) **Angiosperm Phylogeny group**, 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnaean Society* 181: 1-20.

3) **Judd,W.S. Campbell, C.S.,Kellogg, E.A.,Stevens, P.A. and Donoghue**, M.J.2016. *Plant Systematics: A Phylogetic Approach.* Sinauer Associates, Inc.,Massachusetts.
4) **Simpson, M. G.** 2006. *Plant Systematics*. Elsevier Academic Press, Canada.
5) **Sambamurthy, A. V. S. S.** 2005. *Taxonomy of Angiosperms*. I.K.International Pvt. Ltd, New Delhi.
6) **Crawford, D.J**.2003. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
7) **Gurcharan Singh**.1999. *Plant Systematics - Theory and Practice*. Oxford & IBH Publishing company Pvt. Ltd., New Delhi.
8) **Radford, A. E**. 1986. *Fundamentals of Plant systematics*. Harper & Row Publisher, New York.
9) **Davis, P. H.** and **Heywood**, **V. M.**1973. Principles of Angiosperm Taxonomy. Robert.Kereiger Publishers, New York.
10) **Gamble, J. S.** and **Fisher, C. E. C**. 1915-35. *Flora of Presidency of Madras*. 3 Volumes. BSMS, Dehradun.

SEMESTER-I

Master of Science (Botany)

102BO24-REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

UNIT-I

1. Historical account of Plant Reproduction.
2. Floral differentiation: Inflorescence and floral meristem, mutations affecting floral differentiation.
3. Male Gametophyte: Structure of anther, microsporogenesis, role of tapetum; pollen development; formation of vegetative and generative cells; pollen sterility; abnormal features of pollen.
4. Female gametophyte: Types of ovule, megasporogenesis, special features. Types of female gametophytes and their development, ultra structure of mature embryo sac; haustorialbehaviour of embryo sac, nutrition of embryo sac.

UNIT-II

1. Pollination: Pollen transfer, pollination mechanisms and vectors. Structure of style and stigma; pollen-pistil interaction.
2. Fertilization: Pollen germination and pollen-tube growth, path of pollen-tube, pollentube discharge; double fertilization.
3. Endosperm: Types of endosperms, cytology and functions of endosperm.

UNIT-III

1. Embryogenesis: Gene expression during embryogenesis.
2. Embryogeny in dicots and monocots.
3. Underdeveloped and reduced embryos; Nutrition of embryo.
4. Polyembryony: Causes of polyembryony, experimental induction of polyembryony, classification of polyembryony and its practical applications..

UNIT-IV

1. Apomixis: Vegetative reproduction, apospory, causes of apomixis, significance of apomixis.
2. Embryology in relation to Taxonomy:Importance of embryological characters in taxonomic. considerations, families with special embryological features.
3. Role of palynology in taxonomy.

UNIT-V

1. Experimental Embryology: Embryo culture: Embryo rescue, embryo culture,

2. microsurgical experiments and applications.
3. Somatic embryogenesis: Direct and indirect somatic embryogenesis, embryoids,
4. synthetic seeds, practical applications of somatic embryogenesis.
5. Endosperm culture: The technique of endosperm culture, histology and cytology of callus, triploid production and their practical applications.

TEXT BOOKS:

1) Maheswari, P. A. 1950. *Introduction to Embryology of Angiosperms*. McGraw Hill Book
2) company.
3) Shivanna, K.R. and John, B.M. 1989.*The Angiosperm Pollen structure and Function*, WileyEastern Ltd., New Delhi.
4) Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. *Comparative Embryology of*
5) *Angiosperms*, Vol.I& II, Springer Verlag.
6) Bhojwani, S.S. and Bhatnagar, S.P. 2000. *Embryology of Angiosperms* (revised edition), Vikaspublishing House, New Delhi.
7) Fosket, D.E. 1994. *Plant Growth and Development: A Molecular Approach*. Academic Press, New York.
8) Raghavan, V. 1997. Molecular Embryology of Flowering plants. Cambridge University Press, Cambridge.
9) Khasim, S. M. 2002. *Botanical Microtechnique: Principles and Practice*. Capital
10) Publishing company, New Delhi.

SEMESTER-I

Master of Science (Botany)

103BO24- BIOLOGY AND DIVERSITY OF VIRUSES, BACTERIA, ALGAE AND FUNGI

UNIT-I

1. Brief account of discovery of viruses; general properties.
2. Structure, cultivation, and purification of viruses
3. Transmission of viruses.
4. Brief account of bacteriophages and plant viruses; Economic importance.

UNIT-II

1. Morphology and ultra structure of bacteria.
2. Nutritional types (autotrophs and heterotrophs); Growth of Bacteria;
3. Recombination in bacteria (transformation, transduction and conjugation);
4. General characters of Actinomycetes, Archaebacteria, Mycoplasmas and Cyanobacteria; Economic importance.

UNIT-III

1. Distributionand thallus organization,
2. Classification and economic importance of algae;
3. Brief account of Chlorophyceae, Rhodophyceae, Phaeophyceae, and
4. Bacillariophyceae.
5. Algae as primary producers and commercial products. Algae as SCP. Algal blooms and toxins.

UNIT-IV

1. General charactersand Nutrition of Fungi
2. Reproduction of fungi;
3. Classification of Fungi (Ainsworth system);
4. Brief account of Zygomycotina, Ascomycotina, Basidiomycotina and Deteuromycotina.

UNIT-V

1. Ecto and endomycorrhizal associations;
2. Edible and poisonous mushrooms,
3. Mushroom cultivation;
4. Importance of Fungi in Agriculture and industry and Mycotoxins.

TEXTBOOKS:

1) An Introduction to Fungi: by Webster, J. (1985). Cambridge Univ. Press.
2) Brock Biology of Microorganisms: by Madigan. Mordinko and Parker (2000).
3) Prentice Hall.
4) Introduction to Plant Viruses: by Mandahar. C.I. (1978). Chand & Co., New Delhi.
5) Introductory Phycology by Kumar, H.D. (1988). Affiliated East-West Press. Ltd,
6) New Delhi.
7) An Introduction to the Algae by Morris. J. (1986). Cambridge University' Press,
8) U.K
9) Microbiology: by Prescott, L.M., Harley, J.P. and Klein, D.A. (1992), WCB
10) Publishers.
11) Introductory Mycology: by Alexopoulos, C.J. Mims, C.W. and Blackwell, M.
12) (1996). John Wiley & Sons.
13) The Biology of Algae by Round. F.E. (1986). Cambridge University Press. U.K.

SEMESTER-I

Master of Science (Botany)

104BO24- OUTLINES OF BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PLANT FOSSILS

UNIT-I

1. Classification, general characters, range of thallus organization and reproduction in Hepaticopsida,
2. Classification, general characters, range of thallus organization and reproduction in Anthocerotopsida
3. Classification, general characters, range of thallus organization and reproduction in Bryopsida.
4. Evolutionary trends in gametophytes and sporophytes of Bryophytes.

UNIT-II

1. General characteristics and classification of pteridophytes;
2. Study of morphology, anatomy andreproduction of Psilopsida, Psilotopsida,
3. Lycopsida, Sphenopsida and Pteropsida.
4. Origin and phylogeny of pteridophytes.
5. 1.4.2.4 Evolution of stele in Pteridophytes. Heterospory and seed habit inpteridophytes.

UNIT-III

1. Classification, distribution and economic importance of Gymnosperms.
2. Structure and reproduction in living (modern) Cycads, Coniferopsida and Gnetopsida.
3. Wood of gymnosperms;
4. Male and female gametophytes of gymnosperms.

UNIT-IV

1. Principles of Paleobotany; Geological time scale;
2. Determination of age of plant fossils; process of fossilization; types of fossils;
3. Comprehensive account of fossil algae, fossil bryophytes,
4. Fossil pteridophytes and gymnosperms.

UNIT-V

1. Ecological, economic, evolutionary and industrial applications of Bryophytes,

2. Ecological, economic, evolutionary and industrial applications of Pteridophytes, 1.4.5.3 Ecological, economic, evolutionary and industrial applications of Gymnosperms
3. Plant Fossils. Recent trends and model plants from Bryophyte and Pteridophyte plants.

REFERENCE BOOKS:

1) Agashe, S.N. 1995. Palaeobotany. Oxford & IBH, New Delhi
2) Arnold, C.A. 1947. An introduction to Palaeobotany, New York
3) Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd. NewDelhi.
4) Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
5) Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central
6) BookDepot,Allahabad.
7) Puri, P. 1980. Bryophytes.Atma Ram & Sons, New Delhi.
8) Sporne, K.R. 1991. The Morphology of Pteridophytes.B.I.Publication. Pvt. Ltd.
9) Sporne, K.R. 1965. The Morphology of Gymnospermae.B.I.Publications, NewDelhi.

****

SEMESTER-2

Master of Science (Botany)

201BO24- PLANT ECOLOGY AND BIODIVERSITY

UNIT-I

Levels of Ecological Organization; Population characteristics and dynamics; Communities characteristics and their analysis; Structure and function of ecosystem; Energy flow in ecosystem; Homeostasis of ecosystem; Biomes and their types.

UNIT-II

Soils: Soil properties and types of soils; Global biogeochemical cycles of Carbon and Sulfur; Dynamic Phytogeography: Basic principles, Age and area theory; Centre of origin; Endemism, Migration and Continental drift.

UNIT-III

Biodiversity: Current concepts, Levels of Biodiversity like Species, Ecosystem and Genetic diversities, IUCN categories of threat; Causes of biodiversity loss; Keystone species; Biodiversity hotspots of India and world; Organizations involved in biodiversity conservation: IUCN, WWF,UNEP and UNESCO.

UNIT-IV

Strategies for *in situ* conservation: Protected areas: Sanctuaries, National Parks, Biosphere Reserves and Mangroves; Strategies for *ex situ* conservation: Botanical Gardens, Seed Banks, Field Banks, Gene Banks, *in vitro* preservation;

UNIT-V

Air pollution and climate change; Sustainable development; Phytoremediation; Application of Remote sensing and Geographical Information System (GIS) in biodiversity studies.

TEXT BOOKS:

1. **Marchese**,**C**, 2014. *Biodiversity hot spots : A shortcut for more complicated concept.Global Ecology and conservation*. http://dx.doi.org/10.10.16/j.gecco.2014.12.008.
2. **Odum, E.P**. and **Gary W. Barrett**, 2011. *Fundamentals of Ecology* (5th Edition), Saunders ISBN.
3. **Russel, P.J**., **Wolfe,S**. **L.,Hertz, P. E., Starr, C.** and **Mc Million B.**, 2008. *Ecology*, Cengage Learning India PvtLtd.,New Delhi.

4. **Wilkinson, D.A**. 2007. *Fundamental Processes in Ecology: An Earth system Approach*. Oxford.
5. **Chapman, J.L.** and **Reiss, M.J.,** 2003. *Ecology: Principles and Applications*, (2nd Edition) Cambridge University Press, UK.
6. **Ambasht, R.S.** and **Ambasht, N.K**., 1999. *A Text Book of Ecology*, CBS Publishers and Distributers, New Delhi.
7. ***IUCN** Red List of threatened species* Version 2019.1.
8. **Chauhan, S.S.** 2014. *Status of Biodiversity in India: Issues and Challenges.* Indian Journal of Plant Sciences 3(1) : 35-42.
9. **Wood,A.,Pamela,S.E.** and**Johanna,M**. 2000. *The root causes of biodiversity loss*. United Kingdom: Early-Scan Publications.
10. **Richard B. Primack**, 1993. *Essentials of Conservation Biology* (6th Edition) Oxford University Press.
11. **Heywood, V.M.** and**Watson,R.T**. 1985. Global Biodiversity Assessment, Cambridge University Press, Cambridge.
12. **Swaminathan M.N. &Jam R.S.**, 1982. *Biodiversity: Implications for Global Security*, Macmillan.

SEMESTER-2

Master of Science (Botany)

202BO24- PLANT PHYSIOLOGY

UNIT - I

Membrane transport and translocation of water and solutes**:** The structure and properties of water; water transport processes (diffusion, bulk flow, osmosis, water potential, components of water potential); Mechanism of water transport through xylem; Solute transport by active and passive mechanisms. Structure and properties of membrane transport proteins.

UNIT - II

Water loss by transpiration; Mechanism of stomatal movements; antitranspirants. Sensory Photobiology: Historical discovery of phytochromes, structure and function of phytochrome, photochemical and biochemical properties of phytochrome, phytochrome induced plant responses, molecular mechanism of action of phytochrome in gene expression, Cryptochrome and its role in photomorphogenesis.

UNIT - III

The flowering process- Photoperiodism and its significance, initiation of flower primordia, flowering stimulus, vernalization, endogenous clock and its regulation. Plant growth regulators: Physiological effects and mode of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonic acid and salicylic acid.

UNIT-IV

Signal transduction: Over view, receptors and G proteins, second messengers, two component sensor regulator system in bacteria and plants, signal transduction and gene expression. Essential nutrients, deficiencies and plant disorders.

UNIT - V

Stress Physiology: Water stress, salt stress, temperature stress (HSP), biotic stress (HR and SAR), heavy metal stress; Stress avoidance and tolerance mechanisms; Structural, physiological, biochemical and molecular responses of plants to environmental stress; Reclamation of saline and heavy metal contaminated soils.

REFERENCE BOOKS:

1) Devline and Witham, 1986. Plant Physiology.CBSPubis.and Distributors. New Delhi.
2) Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., New York, USA.

3) Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, USA.
4) Singhal *et al*. 1999. Concepts in Photobiology. Photosynthesis and Photo-morphogenesis, Narosa Pub. House. New Delhi.
5) Taiz and Zeiger, 1998. Plant Physiology. Sinauer Associates Inc., Publishers, Sunderland.
6) Salisbury F.B & C. W. Ross, 1992. Plant Physiology, 4th Edition. Wadsworth Publishing Co., Belmount, California.

SEMESTER-2

Master of Science (Botany)

203BO24- CELL BIOLOGY

UNIT- I

Eukaryotic cell : Organelles – Chloroplast, Mitochondria, Ribosomes, Endoplasmic reticulum, Peroxisomes, Golgi apparatus, Lysosomes and plant vacuoles and Cytoskeleton.

UNIT- II

Nucleus; Ultrastructure of prokaryotic and eukaryotic chromosome; chromosome banding; Karyotype; Euchromatin and heterochromatin. Special types of Chromosomes: Polytene, Lamp-brush, B-chromosomes, and Sex- chromosomes,

UNIT- III

Phases of Cell cycle: G1, S, G2 and M phases, Check points in cell cycle - Role of cyclins; Cyclin dependent kinases; Cell division; significance of meiosis.

UNIT- IV

Apoptosis –mechanism and significance , oncogene and tumour suppressor genes. Genomes of mitochondria and chloroplasts. Endosymbiotic theory.

UNIT-V

Structural alteration in chromosomes - Origin, Duplications, Deletions, Inversions and Translocations.

Numerical alteration in chromosomes: Origin, Occurrence of haploids, polyploids and aneuploids.

TEXT BOOKS:

1) **Arun Kumar Sharma**and**Archana Sharma**,1980. *Chromosome Techniques. Theory and Practice.*Third Edition, Butterworth -Heinemann, London.
2) **Brown, W.V.**and**Berke,E. M.** 1975.*Text Book of Cytology*, Saint Louis: C V Mosby Company, USA.
3) **Darlington, C.D**. 1903. *Recent Advances in Cytology*, Blakiston`sSon& Co., Philadelphia.
4) **De Robertis, E. D. P.** and **De Robertis, E. M. F**. 2010.*Cell and Molecular Biology,* 8th Edition, Wolters Kluwer, USA.
5) **Jean Brachet** and Mirsky, **Alfred E. (**Eds.): **The Cell**, Academic Press, Inc. New York, USA.

6) **Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick,** 2018. Lewin1s , B. 2018.

7) *Genes***.** 12th Edition, Jones& Bartlett Learning, Burlington, MA 01803.

8) **Stebbins, G.L.,** *Chromosomal Evolution in Higher Plants*, Edward Arnold Publications, London.

9) **Roy, S.C.** and **Kalyan Kumar De.,** 1977. *Cell Biology***,** New Central Book Agency, Calcutta.

10) **Wolfe, Stephen L.** 1993. *Molecular and Cellular Biology*. Wordsworth Publishing Company, California. USA.

SEMESTER-2

Master of Science (Botany)

204BO24- PLANT STRUCTURE AND DEVELOPMENT

UNIT-I

Types and functions of meristems, organization and regulation of Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM), floral meristems and MADS-Box genes.

UNIT-II

Structure and function of vascular cambium; wood- heart wood and sap wood, porous and nonporous wood, reaction wood; secondary growth in Dicots and Monocots; Anomalous secondary growth in Dicots and Monocots; structure and functions of simple and complex tissues.

UNIT-III

Structure and development of leaf, stomata, nodes their and evolution; special anatomical adaptations of Kranz and CAM anatomy features.

UNIT–IV

Plant embryo development, stages, cell division and pattern formation in embryo**,** cell polarity In embryo, genetic and hormonal regulation of embryo development. Seed germination and factors influencing the germination and seedling growth.

UNIT- V

Seed Dormancy- types, factors causing seed dormancy, mechanism of breaking seed dormancy, Programmed Cell Death (PCD); Senescence types and biochemical changes associated with leaf senescence; applications of anatomy in taxonomy and pharmacognosy.

REFERENCE BOOKS:

1) Atwell, B.J. Kriederusann, P.E. and Jumbull, C.G.N. (Eds.), 1999. **Plant in action**:
2) **Adaptation in nature, Performance in cultivation**, MacMillan Education. Sydney.
3) Bewley, J. D. and Black, M. 1994. **Seeds: Physiology of Development and Germination**,
4) Plenum Press, New York.
5) Burgess, J. 1985. **An Introduction to Plant Cell Development**, Cambridge University Press,
6) Oxford.
7) Fahn, A. 1982. **Plant Anatomy** (3Td Ed.), Pergamon Press, Oxford.

8) 5.Fosket, D.E. 1994. **Plant Growth and Development** - A Molecular approach, Academic
9) Press, Oxford.
10) Lyndon, R.F. 1990. **Plant Development-The Cellular basis**, Unnin Hyman, London.
11) Raghavan, V. 1999. **Developmental Biology of Flowering Plants**, Springer-Verlag, New
12) York.
13) Steeve, T.A. and Sussex, I.M. Patterns in Plant Development (2r Ed.), Cambridge University
14) Press, Cambridge.
15) Singh, V., Pande, P.C and D.K.Jain (2ed.). Anatomy of Seed Plants. Rastogi Publications,
16) Meerut, India.

SEMESTER-3

Master of Science (Botany)

301BO24- PLANT PATHOLOGY

UNIT-I

Concept of disease in plants; Definitions of plant disease; Historical development of Plant Pathology. Methods of studying Plant disease; collection, preservation, isolation of pathogens and proving Koch postulates. Symptoms caused by plant pathogenic fungi, bacteria and viruses. Classification of plant diseases.

UNIT-II

Entry of pathogens into the host. Role of enzymes, toxins and phytoalexins in plant pathogenesis. Physiological changes in diseased plants.Plant disease forecasting.

Genetics of disease resistance.

UNIT-III

Detailed study of symptoms, etiology, epidemiology and control of the following fungal diseases of plants; late blight of potato, *Taphrina* leaf spot of turmeric, powdery mildew of cucurbits, black stem rust of wheat, blast of rice, tikka disease of groundnut, red rot of sugarcane.

UNIT-IV

Detailed study of the following bacterial and viral diseases: bacterial leaf blight of rice, angular leaf spot and black arm of cotton, citrus canker, tobacco mosaic disease.

UNIT-V

Principles of plant disease control: Plant quarantine, seed treatment, cultural practices chemical control, development of disease resistant varieties. Biological control of plant diseases. Integrated Pest Management - concept, system, benefits and limitations.

TEXT BOOKS:

1) Agrios, G.N. 1997. Plant Pathology, Academic Press, London.
2) Tar, S.A.J. 1972. Principles of Plant Pathology.
3) Singh, R.S. 1991. Plant diseases, 6thEdn., Oxford & IBH Co., New Delhi.
4) Singh, R.S. 1988. Principles of Plant Pathology, 3rdEdn., Oxford & IBH Co.,
5) New Delhi.
6) Mehrotra, R.S. 1980. Plant Pathology, Tata-McGraw Hill Publishing Company,
7) New Delhi.
8) Rangaswami, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India, 4th
9) Edition, Printice Hall of India Publications.

SEMESTER-3

Master of Science (Botany)

302BO24- PLANT METABOLISM

UNIT-I

Energy and Enzymes:Energy flow through living systems, principles of the thermodynamics, free energy and chemical potential, free energy of oxidation–reduction reactions, redox potential, types of phosphorylations, structure and functions of ATP. Enzymes: General aspects, nomenclature and classification of enzymes, mode of enzyme action, Michaelis – Mention equation and its significance, regulation of enzymes, enzymes inhibition and isoenzymes.

UNIT-II

Photochemistry and Photosynthesis:General concepts of photosynthesis, photosynthetic pigments, structure of photosynthetic apparatus, photosynthetic electron transport (Non-cyclic, cyclic), proton transport and ATP synthesis. Carbon assimilation:The carbon cycle, photorespiration and its significance, C_4 and CAM pathways and their physiological and ecological significance. Biosynthesis of starch and sucrose, translocation by phloem, phloem loading and unloading.

UNIT-III

Respiration:Over view of plant respiration, glycolysis, pentose phosphate pathway, TCA cycle, electron transport chain (ETC), chemiosmotic hypothesis of ATP synthesis, alternative oxidase system, Alcohol and Lactic acid fermentations.

UNIT-IV

Nitrogen metabolism:Sources of nitrogen to plants, biological nitrogen fixation, nodule formation and nod-factors, mechanism of nitrate uptake and reduction, ammonium assimilation (reductive amination, transamination and GS-GOGAT).

Sulfate metabolism: Uptake, transport and assimilation.

UNIT-V

Lipid metabolism: Structure and function of lipids, classification of lipids, fatty acids and their biosynthesis. Synthesis of phospholipids and storage lipids; catabolism of lipids; glyoxylate cycle.

REFERENCE BOOKS:

1) Dennis et al., 1997. Plant Metabolism (2nd ed.), Longman, Essex, England.
2) Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons, Inc., New York, USA.
3) Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology, Academic Press, San Diego, USA.
4) Taiz and Zeiger, 1998. Plant Physiology(2nd ed.)
5) Voet and Voet, 1992. Biochemistry, John Wiley & Sons, Inc., New York, USA.
6) Raghavendra, S. 1988 Photosynthesis, A comprehensive Treatise, Cambridge
7) University press, Cambridge, UK.

SEMESTER-3

Master of Science (Botany)

304BO24- MOLECULAR BIOLOGY OF PLANTS

UNIT-I

Evidence for DNA as genetic material, physical and chemical structure of DNA, mechanism of DNA replication, DNA damage and DNA repair mechanisms. C value and C value paradox. Cot curves.

UNIT-II

Transcription in prokaryotes and Eukaryotes, mRNA processing and other RNA processing events, mechanism of Translation, RNA splicing, genetic code, protein biosynthesis. Protein sorting and targeting of proteins to the organelles.

UNIT-III

Principles of gene regulation in prokaryotes (lactose and tryptophan operons), role of chromatin remodeling and DNA methylation in gene regulation.Transposons, mechanism of transposition and genetic consequences of transposition. Cis-acting and trans-acting factors in eukaryotic gene regulation.

UNIT-IV

RNA Biology and Genome editing: RNA world hypothesis. Small RNA (Micro RNA) mediated transcriptional and translational regulation. Gene knock-down using RNAi. TALENS, ZFNs and CRISPR-CAS9 based genome editing technologies. Applications of Genome Editing Technologies in plant biology.

UNIT-V

Next generation DNA sequencing methods. Atomic Force Microscopy, Cryo-EM and Confocal Microscopy. Principles and types of electrophoretic techniques. LC-MS, and Labeled tracers.

REFERENCE BOOKS:

1) Alberts, B., Bray, D., Lewis, I Rail, M., Roberts, K. and Watson. J.D, Molecular biology of the cell, Garland Publishing Inc., New York.

2) Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. arid D1iei1, J 2000. Molecular Cell Biology. W.H. Freeman and Co., New York, USA.
3) Richard, M., Twyman and Wisden, W. 1999. Advanced Molecular Biology, Viva Books Pvt. Ltd.
4) Turner, P.C., Mclenann, A.G., Bates, A.D. and White, M.R.H. 2001 Instant notes on molecular biology. 5. Snustad Peter, D. Michael J. Simmons. Principles of Genetics, John Wiley Sons.
5) Robert H. Tamarin. Principles of Genetics, Tata McGraw Hill Company.
6) Benjamin Lewin. Genes VIII, Prentice Hall. 8. West head, D.R. J.H. Parish & R.M. Twyman.Bioinformatics. Viva Books.
7) Adams, R. L. P., Knowler, J. T. and Leader, D. P. 1994.The Biochemistry of the Nucleic acids.Chapman& Hall.
8) Brown, T. A. 1999. Genomes 3. John Wiley & Sons, New York, USA.
9) Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R. 2004 Molecular biology of the Gene (5^{th} Ed.) Benjamin Cummings.
10) Robert F. Weaver.2008. Molecular Biology. Mc Graw Hill Higher Education.
11) Buchanan, B. B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. Am. Society of Plant Physiologists, Maryland, USA.
12) Upadyaya, A., Upadyaya, K., and Nath, N. Biophysical Chemistry-Principle and Techniques,Himalaya Publishing House, New Delhi
13) Keith Wilson and John Walker (Editors) 2005.Principles and Techniques of Biochemistry and Molecular Biology (6th Ed.)Cambridge University Press, New York.

SEMESTER-4

Master of Science (Botany)

401BO24- PLANT CELL, TISSUE AND ORGAN CULTURE

UNIT-I

Plant tissue culture laboratory organization and requirements.Various explant and non-explant sterilizationtechniques.Tissue culture media: Composition and preparation of different types of media.

UNIT-II

Basic concept of regeneration: Concept of Cellular Totipotency and Differentiation. Fundamental aspects of Morphogenesis.Organogenesis- direct &indirect.Role of plant growth regulators and factors governing *in vitro* behavior of cultures.

UNIT-III

Propagation and variation: stages and applications of micropropagation. Photoautotrophic micropropagation and acclimatization of tissue culture plants.Production of pathogen free plants and their application.Somatic embryogenesis, role of physical and chemical factors in the induction of synthetic seed-production and their uses.Somaclonal variations and their applications.

UNIT-IV

Somatic hybridization: Protoplast isolation, fusion and culture, selection and characterization of hybrids. Symmetric, asymmetric hybrids and cybrids, significant achievements and limitations of Protoplast research, production of test tube plants. Callus and embryo culture, production of seedless fruits.

UNIT-V

Applications of plant tissue culture: production of haploids and its significance in crop improvement. Secondary metabolite production through cell and organ culture (Hairy roots). Cryopreservation and conservation of Germplasm. Gene Banks.

TEXT BOOKS

1) Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice (a revised edition). Elsevier Science Publishers, New York, USA.

2) Bojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations, Elsevier Science Publisher, New York, USA.
3) Vasil, I.K. and Thorp e, T.A. 1994. Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
4) Razdan, M.K. 1994. An Introduction to Plant Tissue Culture: Oxford & IBH Publishing Company Private Limited, New Delhi.
5) Chawla, H.S. 2003. Introduction to Plant Biotechnology.Oxford& IBH, New Delhi.
6) George, E.F., Vol-I (1986) and Vol II (1993) Plant propagation by Tissue culture.
7) Kartha, K.K. 1985. Cryopreservation of plant cells and organs. CRC Press, Boac Raton, Florida, USA.
8) Reinert, J. Bajaj, YPS (Eds.). 1977. Applied and fundamental aspects of plant cell, tissue, and organ culture. Springer-Verlag, New York.

SEMESTER-4

Master of Science (Botany)

401BO24- GENETIC ENGINEERING AND BIOINFORMATICS

UNIT-I

Recombinant DNA technology: Tools and methods involved in generating r-DNA molecules, gene cloning-techniques, and identification of clones by screening procedures,

UNIT-II

Construction and screening of genomic and c-DNA libraries; PCR, types and its applications; Principles, types and applications of Blotting techniques.

UNIT-III

Genetic Engineering of plants: Plant transformation with Ti-plasmid of *Agrobacterium tumefaciens,* physical methods of transferring genes to plants, reporter genes and use of different promoters. Transgenic plants. Bio-safety and Bio-ethical issues of GM crops, and IPRs.

UNIT-IV

Bioinformatics: definition, introduction, scope and applications. Databases – CBI GenBank, PDB, OMIM, EMBL. Literature Databanks – Pub Med, Med line. Sequence Alignment based on Matrices (BLOSUM and PAM), Tools for sequence alignment – BLAST, FASTA. Pair wise and Multiple sequence alignment and phylogenetic analysis.

UNIT-V

The biological databases and types; Sequence databases; Structural databases; Prediction of genes and gene function. Translation of gene into protein; Protein secondary structure prediction; Prediction of domains, motifs and profiles of proteins.

REFERENCE BOOKS

1) Purohit, S.S. 2000. Biotechnology; Fundamentals and Applications, Agrobios, New Delhi.
2) Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Waston, J.D. 1989. Molecular Biology of the Cell, Garland Publishing Inc., New York.

3) Gupta, R.K. Molecular Biology & Generic Engineering, Rastogi Publication.
4) Adrian Slater, Nigel Scott, and Mark Fowler (2006). Plant Biotechnology
5) Brown, T.A.2001.Gene cloning and DNA Analysis- An introduction (5th Ed.), Blackwell Scientific Publications, Oxford, U.K.
6) Arthur M. Lesk. 2002. Introduction to Bioinformatics. Oxford University Press, USA
7) Mount, D., 2004. Bioinformatics: Sequence and Genome Analysis. (2nd Ed.) Cold Spring Harbor Laboratory Press.
8) Bioinformatics. A practical guide to analysis of genes and proteins. 1998. Baxevanis and Quellette.
9) Bioinformatics: A biologist's guide to biocomputing and the internet. 2000. Stuart M. Brown.

Bioinformatics: Sequence and genome analysis. 2001. David W. Mount

SEMESTER-4

Master of Science (Botany)

403BO24- CYTOGENETICS AND PLANT BREEDING

UNIT-I

Principles of plant breeding- Objectives and achievements; Breeding methods in clonally propagated, self-pollinated and cross-pollinated crops; Selection-types of selection and significance; Hardy-Weinberg Law.

UNIT-II

Plant genetic resources and centers of origin; Heterosis- theories and importance; Hybridization-types, Hybrids- production and significance; Male sterility (**MS**)- classification (GM, CMS, CGMS and chemically induced MS) and its importance in breeding; Polyploidy-types, polyploidy breeding and its significance.

UNIT-III

Mutation breeding- mutation types, mutagens, procedure and significance of mutation breeding in crop improvement; Breeding methods for resistance- to biotic (Fungi, Viruses, Insect and Pests) and abiotic (Drought and Salt) stresses.

UNIT-IV

Markers - Morphological, biochemical and molecular (RFLP, RAPD) markers and their applications in plant breeding; Marker assisted selection (MAS); Molecular maps- Genetic and physical maps, QTL maps and linkage maps. National and International plant organizations associated with crop improvement programmes.

UNIT-V

Molecular Cytogenetics **-** FISH, GISH, Flow Cytometry and applications of molecular Cytogenetics; Microdissection and Microcloning techniques. Introduction to statistical constants- Mean, Mode, Median, Variance, Standard Deviation and Standard Error, Normal distribution curve, ANOVA, Students **t**-test and **F**-test.

TEXT BOOKS:

1) Russel, P.J. 1998. **Genetics.** The Benjamin/Cunnings Publishing Co., Inc., USA.
2) Khush, G.S. 1973. **Cytogenetics of Aneuploids,** Academic Press, London.
3) Gupta, P.K. 2005. **Molecular Biology and Genetics Engineering**

4) Snustad, D.P. and Simmons, M.J. 2000. **Principles of Genetics.**
5) Chahal, G.S. and Gosal, S.S. **Principles and Procedures of Plant Breeding –**
6) **Biotechnological and Conventional Approaches,** Narosa Publishing House, New Delhi.
7) Darbeshwar Roy, 2000. **Plant Breeding: Analysis and Exploitation of variation,** Narosa
8) Publishing House, New Delhi.
9) Singh, P. 2001. **Essentials of Plant Breeding,** Kalyani Publishers, Hyderabad.
10) Primrose, S.B. 1994. **Molecular Biotechnology** (2nd ed) Blackwell Sci. Publ. Oxford.
11) Balasubramanian, D. 2005. **Concepts of Biotechnology**
12) 10.Old, A. and Primrose, S.B. 2002. **Principles of gene manipulation**.BlackwellPubl.Oxford.
13) Singh, R.J.(2014).**Plant Cytogenetics**,CRC Press.

SEMESTER-4

Master of Science (Botany)

404BO24- HORTICULTURE AND LANDSCAPING

UNIT-I

Importance of horticulture; Nursery and types of nursery beds; Orchard plan and systems of planting; Propagation of plants by asexual methods (cutting, layering, grafting and budding).

UNIT-II

Commercial floriculture: Propagation and production of flower crops like Roses, Chrysanthemum and Jasminum; Pomology: Nutritive value of fruits, Cultivation practices and production of fruit crops like Mango, Banana and Guava.

UNIT-III

Olericulture: Importance of vegetables in human nutrition, Types of vegetable gardens. A brief study of inter-cultivation practices of major vegetable crops of regional importance.

UNIT-IV

Importance and scope of landscape gardening; Principles of landscape design; Garden adornments; Garden features: Wall, Fencing, Steps, Garden, Garden drives and Paths, Hedges, Arches, Pergola, Lawn, Carpet bedding, Flower beds, Shrubbery, Borders, Rockery, Water gardens, Bonsai, Topiary; Garden types: Indoor garden, Outdoor garden; Garden styles: Formal gardens, Informal gardens and Free style gardens.

UNIT-V

Site analysis; Elements in landscape design: Land form, Water garden furniture, Lights, Paving etc.; Study of different trees, shrubs, herbs, ground cover, indoor plants etc., suitable for landscaping and their identification; Landscaping of historical monuments and places of Tourist importance.

TEXT BOOKS:

1) Gardner V R, Bradford F C and Hooker Jr. H D, 1952. *The Fundamentals of Fruit Production,* Mac Graw Hill Book Co., New York.
2) Hartman H T, Kester D E, Davies,Jr,FTand Geneve R L 1976. *Plant Propagation : Principles and Practices* (8th Edition) . Prentice Hall, USA.

3) Sadhu M K ,1996. *Plant Propagation*, New Age International Publishers, New Delhi.
4) Mukherjee S K and Majumder P K, 1973. *Propagation of Fruit Crops.* ICAR, New Delhi.
5) Bose T K and Yadav L P 1989. *Commercial Flowers,* Nayaprakash, Calcutta.
6) Mitra S.K. Rathore D S and Bose T K, 1992. *Temperate Fruits*, Horticulture and Allied Publishers, Calcutta.
7) Chaudhary B, 1992. *Vegetables*, National Book Trust, New Delhi.
8) Randhawa, M.S. 1971. *Beautiful Gardens*, ICAR, New delhi.
9) Nambisan K M P 1992. *Design Elements of Land Scape Gardening*, Oxford & IBH Publishing Company., New Delhi.
10) Hemla Naik B, Chandrashekhar SY and Jawaharlal M, 2017. Principles of Landscape Gardening, ICAR eCourse PDF Book, New Delhi.
11) Walker TD, 1991. *Planting Design* (Second Edition), John Wiley& Sons, Inc. New York.

Duration of the Programme:

Minimum: Two Academic Years from the year of joining of the course (Four Semesters). **Maximum:** Five Academic Years from year of joining of the course for securing First Class or Second Class.

INSTRUCTIONAL DESIGN :

Instructional delivery mechanism: University has its own faculty for M.Sc. Botany department and all the faculty members will act as resource persons. Our University has blended mode delivery mechanism i.e., ICT and Conventional modes.

Media of delivery mechanisms:

- **Printing:** The study material delivery media include Printing of books which are issued to the students who are enrolled for the programme.

- **Online:** On line PDF format content is also given access to the students who wish to study through online mode.

- **Interactive sessions, and Discussion boards:** In distance Education, face to face contact between the learners and their tutors is relatively less and therefore interactive sessions are conducted. The purpose of such interactive session is to answer some of the questions and clarify doubts that may not be possible in other means of communication. This programme provides an opportunity to meet other fellow students. The Counsellors at the study centres are expected to provide guidance to the students. The interactive sessions are conducted during week ends and vacations to enable the working students to attend.

- **Student support services**: Student support services include Internet enabled student support services like e-mails, SMS and even an app is planned. Student feed back mechanism is created and feed back is designed. Student Learning Managemnet Sysyem (LMS) is customized to every student. For every student customized examination management system (EMS) is also created facilitationg self evaluation, demo tests, model question papers and periodical Internal Assessments.

- **Credit System**: University has adopted Choice Based Credit System (CBSE) under semester mode from 2013. The same has been approved by relevant Statuatory boards in Distance mode also.

- **Admission procedure:** In M.Sc. (Botany) programme candidates can take admission directly. For this purpose, CDE, ANU will advertise for admissions. Then candidates should apply in prescribed format of the CDE after publication of the advertisement.

- **Eligibility Criteria**: The eligibility for admission into this course is a pass in B.Sc. with Botany as one of the subjects of study.

- **Fee Structure:** The total course fee is Rs.29,900/-.

- **Policy of programme delivery:** Our University has blended mode delivery mechanism i.e., ICT and Conventional modes. In conventional mode printed material is given and also online mode of delivery with learning management system is adopted.

• **Activity planner**: There is an yearly academic plan and as per plan interactive sessions, assignments, examinations etc are conducted to the candidates.

• **Evaluation System:** Periodical progress of learning is evaluated by web based *feed back* mechanism in the Learning Management System. Evaluation of learner progress is conducted as follows:

(i) The examination has two components i.e., continuous evaluation by way os assignments (30 %) and term end University Examination (70 %).

(ii) Each student has to complete and submit assignment in each of the theory paper before appearing to the term end examination. The term end examination shall be of 3 hours duration.

(iii) Minimum qualifying marks in each paper is 40 % indivually in internal and term end examination. The candidates who get 60 % and above will be declared as passin First Division, 50 % to below 60 % as Second Division and 40 % to below 50 % as Third Division.

(iv) THe Centre for Distance Education, Acharya Nagarjuna University will conduct the examinations, evaluations and issue certificates to the successful candidates.

(v) All the term end examinations will be conducted at the examination centres fixed by the CDE.

(vi) Qualitatively the examinations conducted for the students of the Distance Education are on par with the examinations conducted for the regular University students.

LIBRARY SUPPORT AND LIBRARY RESOURCES :

The M.Sc. (Botany)) program is based on the theory and practical papers. Laboratory support is available to students. Further, entire University Library is accessble to all the students of distance education. Additionally every department in the University has a well equipped library which is accessable to all the students. CDE also provides a compendium of web resources to every student to support learning.

COST ESTIMATE :

The Programme fee for I year is Rs.14,300/-, and II year is Rs. 15,600/-. The university will pay the remuneration to Editors and lesson writers as per university norms. DTP charges, Printing of books and Examination fees will be paid by the ANUCDE as per prescribed norms. This institution is providing high quality programmes at low cost.

QUALITY ASSURANCE :

Quality assurance comprises the policies, procedures and mechanisms which that specified quality specifications and standards are maintained. These include continuous revision and monitoring activities to evaluate aspects such as suitability, efficiency, applicability and efficacy of all activities with a view to ensure continuous quality improvement and enhancement. The programme is designed with a focus on the proposed learning outcomes aimed at making the learner industry ready also for career advancement, enterprenureal development, and as wealth creators. There is a continuous evaluation of learning and of competence internally and also by ICT enabled feed back mechanism and Centre for Internal Quality Assurance (CIQA). The University ensures maintaining quality in education provided through open and diatance learning mode. As per the need of the information society and professional requirement, the University ensures to change the mechanism from time to time along with enhancement of standard in course curriculum and instructional design. Therefor, the outcomes of the programme can meet the challenges in the changing society.

DIRECTOR
Centre for Distance Education
Acharya Nagarjuna University
Nagarjuna Nagar,
GUNTUR-522 510.

REGISTRAR
ACHARYA NAGARJUNA UNIVERSITY
NAGARJUNA NAGAR-522 510.
GUNTUR (A.P.) INDIA.