

GOVERNMENT COLLEGE FOR WOMEN (A) KUMBAKONAM – 612 001

DEPARTMENT OF BOTANY
(Re – Accredited by NAAC with “B” Grade)

B.SC., BOTANY SYLLABUS

2018-2019 (ONWARDS)



GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF BOTANY
B.SC., BOTANY - REVISED COURSE STRUCTURE UNDER CBCS
(For the candidates admitted from the Academic year 2018 - 19 onwards)
(Current)

| Sem | Course code | Course Title | Inst, Hrs/ Week | Credits | Marks |
|------------|-------------|---|-----------------------|-----------|------------|
| I | 17GT1 | Part I Language Tamil | 6 | 3 | 100 |
| | 17GE1 | Part II Language English | 6 | 3 | 100 |
| | 18BOC101 | Part III Core Course 1 – Bacteria, Virus, Algae Fungi and Lichens | 6 | 5 | 100 |
| | 18BOC202P1 | Part III Core Course II - Bacteria, Virus, Algae Fungi and Lichens & Plant Pathology and Plant Protection (P) | 3 | - | - |
| | 182AZ1 | Part III Allied Course I | 6 | 4 | 100 |
| | 182AZ2P | Part III Allied Course II - Practical | 3 | - | - |
| | | Total | 30 | 15 | 400 |
| II | 17GT2 | Part I Language Tamil | 6 | 3 | 100 |
| | 17GE2 | Part II Language English | 6 | 3 | 100 |
| | 18BOC203 | Part III Core Course III - Plant Pathology and Plant Protection | 3 | 5 | 100 |
| | 18BOC202P1 | Part III Core Course II - Bacteria, Virus, Algae and Fungi, Lichens, Plant Pathology and Plant Protection (P) | 5 | 5 | 100 |
| | 182AZ2P | Part III Allied Course II - Practical | 2 | 3 | 100 |
| | 182AZ3 | Part III Allied Course III Theory | 4 | 3 | 100 |
| | 18UVE | Part IV Value Education Yoga | 2 | 2 | 100 |
| | UGCES | Part IV Environmental Studies | 2 | 2 | 100 |
| | | Total | 30 | 26 | 800 |
| | III | 17GT3 | Part I Language Tamil | 6 | 3 |
| 17GE3 | | Part II Language English | 6 | 3 | 100 |
| 18BOC304 | | Part III Core Course IV–Bryophytes, Pteridophytes, Gymnosperms and Pale botany | 6 | 5 | 100 |
| 18BOC405P2 | | Part III Core Course V – Bryophytes, Pteridophytes, Gymnosperms and Pale botany, Anatomy and Embryology (P) | 3 | - | - |
| 184ACH1 | | Part III Allied Course IV Practical | 5 | 4 | 100 |
| 184CH2P | | Part III Allied Course V Theory | 2 | - | - |
| 18BO3NMEC1 | | Part IV Non – Major Elective Biofertilizers and Biopesticides. | 2 | 2 | 100 |
| | | Total | 30 | 17 | 500 |

| Sam | Course code | Course Title | Inst, Hrs/ Week | Credits | Marks |
|-----|-------------|--|-----------------|-----------|------------|
| IV | 17GT4 | Part I Language Tamil | 6 | 3 | 100 |
| | 17GE4 | Part II Language English | 6 | 3 | 100 |
| | 18BOC405P2 | Part III Core Course V – Bryophytes, Pteridophytes, Gymnosperms and Pale botany, Anatomy and Embryology (P) | 2 | 5 | 100 |
| | 18BOC406 | Part III Core Course VI-Anatomy and Embryology | 5 | 4 | 100 |
| | 184ACH2P | Part III Allied Course IV Practical | 3 | 4 | 100 |
| | 184ACH1 | Part III Allied Course VI Theory | 4 | 3 | 100 |
| | SBHT | Part IV Skilled Base – Herbal Technology | 2 | 2 | 100 |
| | 18BO4NMEC2 | Part IV Non – Major Elective course Horticulture | 2 | 2 | 100 |
| | | Total | 30 | 26 | 800 |
| V | 18BOC507 | Part III Core Course VII –Cell and molecular biology | 6 | 6 | 100 |
| | 18BOC508 | Part III Core Course VIII –Genetics, Biostatistics and Evolution | 5 | 5 | 100 |
| | 18BOC509 | Part III Core Course IX –Morphology, Taxonomy and Economic Botany | 5 | 5 | 100 |
| | 18BOC10P3 | Part III Core Course X- Cell and molecular biology, Genetics, Biostatistics and Evolution & Morphology, Taxonomy and Economic Botany (P) | 5 | 5 | 100 |
| | 18BO5EC3 | Part III Elective Course I –Medical and Applied Botany | 5 | 5 | 100 |
| | SBBH | Part IV Skill Based Bio resources and human welfare | 2 | 2 | 100 |
| | SBMT | Part IV Skill Based Mushroom technology | 2 | 2 | 100 |
| | | Total | 30 | 30 | 700 |
| VI | 18BOC611 | Part III Core Course XI –Plant Physiology, Biochemistry and Biophysics | 6 | 5 | 100 |
| | 18BOC612 | Part III Core Course XII - Plant Ecology and Conservation | 6 | 5 | 100 |
| | 18BOC613P4 | Part III Core Course XIII - Plant Physiology, Biochemistry and Biophysics & Plant Ecology and Conservation (P) | 6 | 5 | 100 |
| | 18BO6EC4 | Part III Elective Course II – Plant Breeding, Horticulture and Landscaping. | 5 | 5 | 100 |
| | 18BO6EC5 | Part III Elective Course III –Plant Biotechnology and Bioinformatics | 6 | 4 | 100 |
| | | Extension Activities | - | 1 | - |
| | | Gender Studies | 1 | 1 | 100 |
| | | Total | 30 | 26 | 600 |

Total no of Papers : 38
 Total Hours : 180
 Credit : 140
Marks : 3800

CORE COURSE I

BACTERIA, VIRUSES, ALGAE, FUNGI AND LICHENS

Objectives:

1. To understand the structure, reproduction, culture, classification and economic importance of bacteria and viruses.
2. To study the classification, ecology, distribution, morphology, life-cycle and economic importance of Algae and Fungi.
3. To impart knowledge on distribution, classification, structure, physiology, reproduction and function of lichens and significance of ecto mycorrhiza and endo mycorrhiza.

Unit I Bacteria

Bacteria – Discovery, General characteristics and cell structure; Nutritional types of bacteria (based on carbon, nitrogen and energy sources); Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); techniques in sterilization, bacterial culture and staining (simple and differential); Economic importance.

Unit II Viruse

Viruses – Discovery, general structure, Symptoms of virus infection in plants; transmission of plant viruses; genome organization, replication of plant virus (tobacco mosaic virus); techniques in plant viruses – purification; structure and multiplication of bacterio phages; structure and multiplication of viroids. Economic importance.

Unit III Algae

General characteristics of various divisions; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae (F. E. Fritsch); Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Diatoms*, *Ectocarpus*, *Dictyota*, *Polysiphonia*. Economic importance of algae.

Unit IV Fungi

General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Alexopolous); True Fungi – General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Economic importance.

Unit V Lichens

Symbiotic Associations – Lichens: General account, occurrence, thallus organization, classification, structure, physiology, reproduction, and role in environmental pollution and uses; Mycorrhiza: ecto mycorrhiza and endo mycorrhiza and their significance.

Books:

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). *Introductory Mycology* (4th edition). John Wiley and Sons (Asia), Singapore.
2. Kumar, H.D. (1999). *Introductory Phycology* (2nd edition). Affiliated East- West Press Pvt. Ltd. Delhi.
3. Pandey, B.P. (2001). *College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta*. S. Chand & Company Ltd., New Delhi.
4. Sambamurthy, A.V.S.S. (2006). *A Textbook of Algae*. I.K. International Pvt. Ltd., New Delhi.
5. Sethi, I.K. and Walia, S.K. (2011). *Text book of Fungi & Their Allies*. MacMillan Publishers Pvt. Ltd., Delhi.
6. Tortora, G.J., Funke, B.R., Case, C.L. (2010). *Microbiology: An Introduction* (10th edition). Pearson Benjamin Cummings, U.S.A.
7. Vashishta, B.R. (1990). *Botany for Degree Students: Fungi*. S. Chand & Company Ltd., New Delhi.
8. Vashishta, B.R., Sinha, A.K. and Singh, V.P. (2008) *Botany for Degree Students: Algae*. S. Chand & Company Ltd., New Delhi.

Course Outcomes:-

1. To know about the General Structure of Bacteria and virus.
2. To mention about the production of Bacteria and Virus.
3. To know about the techniques in sterilization, bacterial culture, staining, plant virus purification, multiplication of Bacterio phages and Virus.
4. To give the Economic importance of bacteria, virus, Algae and Fungi.
5. To mention about the general characteristics of various divisions of algae and fungi.
6. To know about the ecology and significance of algae and fungi.
7. To know about thallus organization, and reproduction of Algae and fungi.
8. To mention about them or prolog and lifecycle of different algae and fungi.
9. To know about the structure, thallus organization, classification, reproduction and uses of lichen.
10. To mention about the mycorrhiza, types and its significance

CORE PRACTICAL II
BACTERIA, VIRUS, ALGAE, AND FUNGI AND LICHENS & PLANT
PATHOLOGY AND PLANT PROTECTION (P)

Tools and equipments used in microbiology: Spirit lamp, Inoculation loop, Hotair oven, Autoclave, Pressure cooker, Laminar air flow chamber, Incubator, etc.

Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.

EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.

Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Diatoms*, *Ectocarpus*, *Dictyota* and *Polysiphonia* through temporary preparations and permanent slides.

Rhizopus and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.

Alternaria: Specimens/photographs and tease mounts.

Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.

Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.

Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) Mycorrhiza:

ectomycorrhiza and endomycorrhiza (Photographs)

Field visit

1. Make suitable micro preparations and identify the diseases mentioned theory with due emphasis on symptoms and causative organisms.
2. A detailed study of diseased specimens included in the theory.
3. Identification of various plant protection appliances mentioned in the syllabus and their working mechanism.

Course Outcomes:-

1. To know about the tools and Equipment used in microbiology.
2. To know the different types of bacteria and viruses,
3. To know the vegetative and reproductive structures.
4. To know the different growth forms of lichens and types of micorrhiza
5. To know the various plant diseases, symptoms and the plant protection appliances through field visit

CORE COURSE III

PLANT PATHOLOGY AND PLANT PROTECTION

Objectives:

1. To understand plant pathogenesis, classification and host-parasite interaction.
2. To study plant diseases in crops and their management, significant contributions of plant pathologists and usage of various techniques in plant protection.
3. To impart knowledge on distribution, classification, structure, physiology, reproduction and function of lichens and significance of ectomycorrhiza and endomycorrhiza.

Unit I

Plant Pathology: History, losses due to pathogens, importance of study of Plant pathology; Classification of plant diseases based on; (a) Major causal agents - biotic and abiotic, (b) General Symptoms. Process of infection and pathogenesis: (a) Penetration and entry of pathogen into host tissue – mechanical, physiological and enzymatic. (b) Host-parasite interaction, enzymes and toxins in pathogenesis.

Unit II Plant Disease Management

Chemical means of disease control: Fungicides - Definition, classification, characters of an ideal fungicide; antibiotics and nematicides. Biological Control of Plant Diseases – Definition, Importance, Biological control agents and their role in plant disease control

Unit III Common Plant Diseases

Study of plant diseases with respect to symptoms, causal organism, disease cycle and their management: (a) Cereals: Rice – blast disease; (b) Vegetables: Brinjal – Little leaf; (c) Fruits: Banana – bacterial leaf blight, Citrus – bacterial canker; (d) Oil seeds: Groundnut – Tikka disease; (e) Sugar yielding: Sugarcane - red rot.

Research in Plant Pathology- Contribution of Indian Plant Pathologists: Rangasami, G Mahadevan, A., Bilgrami, K. S., and Mehrotra, R. S.), Contribution of Research institutes – IARI (Indian Agricultural Research Institute), ICRISAT (International Crop Research Institute for Semi-Arid Tropics)

Unit IV Plant Protection

Scope, Importance, equipments used in plant protection -Sprayers - dusters - soil injector - seed dressing drum; Seed treatment: objectives of seed treatment, Traditional and modern methods of seed treatment. Soil sterilization: Objectives, Traditional and modern methods of soil sterilization. Role of soil sterilization in Poly house farming.

Unit V Methods of Plant Protection

- a) Cultural – Tillage, sowing and planting dates, crop hygiene, crop rotation, trap crops, fertilizer.
- b) Mechanical – Field sanitation: For diseases – collection and destruction of diseased plant-debris; For pests – hand picking and destruction of egg masses; shaking of plants, rope dragging, netting, bagging, physical barriers, use of sticky bands, tin-bands and light traps.
- c) Physical – Heat and soil solarizations.
- d) Chemical– Brief account and uses of Bactericides, Fungicides, Insecticides, Nematicides, Acaricides, Molluscicides, Rodenticides and Herbicides.
- e) Biological– Introduction, biological control of Insect pests and diseases
- f) Legal (Plant Introduction, domestic quarantine, need of plant quarantine) quarantine in India

Books:

1. Bap Reddy, D. and Joshi, N.C. (1991). *Plant Protection in India* (Second Edition). Allied Publishers Ltd., New Delhi.
2. Bilgrami, K.S. and Dubey, R.C. (1985). *Text book of Modern Plant Pathology*. Vikas Publishing House Private Limited, New Delhi.
3. Mehrotra, R.S. (2003). *Plant Pathology* (Second edition). Tata McGraw-Hill Education, New Delhi.
4. Pandey, B.P. (2001). *Plant Pathology*. S. Chand & Company Limited, New Delhi.
5. Rangasami, G. and Mahadevan, A. (1998). *Diseases of Crop Plants in India*. Prentice Hall of India Ltd. New Delhi.

Course Outcomes:-

1. To know the history and importance of study of plant pathology.
2. To mention about the classification and the general symptoms of plant diseases.
3. To know the process of infection and pathogenesis.
4. To know the chemical means of disease control.
5. To mention about the biological control of plant diseases.
6. To mention about the various plant diseases symptoms, causal organism, disease cycle and their management.
7. To mention about the research in plant pathology and contribution, of Indian plant pathologists and research institutes.
8. To mention the importance and equipments used in plant protection.
9. To know the traditional and modern seed treatment, soil sterilization and its role.

CORE PRACTICAL II
BACTERIA, VIRUS, ALGAE, AND FUNGI AND LICHENS & PLANT
PATHOLOGY AND PLANT PROTECTION (P)

Tools and equipments used in microbiology: Spirit lamp, Inoculation loop, Hotair oven, Autoclave, Pressure cooker, Laminar air flow chamber, Incubator, etc.

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Course Outcomes:-

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2. To know the different types of bacteria and viruses,
3. To know the vegetative and reproductive structures.
4. To know the different growth forms of lichens and types of micorrhiza
5. To know the various plant diseases, symptoms and the plant protection appliances through field visit

CORE COURSE III

BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Objectives:

1. To understand the salient features of Bryophytes, Pteridophytes and Gymnosperms.
2. To study the structure and reproduction of various genera mentioned in the syllabus.
3. To understand the salient features and importance of fossils and fossilization process in tracing evolution.

Unit I

Bryophytes – General Characteristics, Classification– Liverworts (Stotler et. al., 2009), hornworts (Renzaglia et al., 2009), and Mosses (Goffinet et al., 2009); Morphology, Structure, Reproduction and life history of the following genera: *Riccia*, *Marchantia*, *Anthoceros* and *Polytrichum*.

Unit II

Pteridophytes– General characteristics and classification by Smith; Morphology, Structure, Reproduction and life-history of the following genera: *Psilotum*, *Lycopodium*, *Selaginella* and *Equisetum*.

Unit III

Morphology, structure, Reproduction and life-history of *Adiantum*, *Marsilea*; Stellar evolution in Pteridophytes; Heterospory and origin of seed habit.

Unit IV

Gymnosperms– General characteristics and classification of Gymnosperms by Sporne; Morphology, structure, mode of reproduction and life-history of the following genera: *Cycas*, *Pinus* and *Gnetum*.

Unit V

Paleobotany– fossils and methods of fossilization – Geological time–scale – an elementary knowledge of the computation of the age of fossils – Radio-Carbon dating technique. A brief study of the following fossil forms: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* & *Williamsonia*.

Books:

BRYOPHYTES

1. Chopra, R.N. and Kumara, P.K. (1988). *Biology of Bryophytes*. Wiley Eastern Ltd., New Delhi.
2. Jeyaraman, (1978). *Indiyavin liverwortugal* (In Tamil). Tamil Nadu Textbook society, Madras.
3. Palaniyappan, S. (1988). *Bryophyta* (In Tamil). T.K. Publishing House, Chennai.
4. Prem, P. (1981). *Bryophytes: Morphology, Growth and differentiation*. Atma Ram and Sons, New Delhi.
5. Rashid, A. (1998). *An Introduction to Bryophyta*. Vikas Publishing House (P) Ltd., New Delhi.
6. Smith, G.M. (1955). *Cryptogamic Botany Vol. II Bryophytes and Pteridophytes* (2nd edn.). Tata McGraw Hill Publishing Co., New Delhi.

7. Srivastava, N.N., (1996). *Bryophyta*. Pradeep Prakashan, Meerut.
8. Vashista, B.R. (1983). *Botany for Degree Students – Bryophyta*. S. Chand and Company Ltd., New Delhi.

PTERIDOPHYTES

1. Rashhed, A. (1999). *An Introduction to Pteridophyta*. Vikas Publishing House (P) Ltd., New Delhi.
2. Sharma, O.P. (1990). *Textbook of Pteridophyta*. MacMillan India Ltd., New Delhi.
3. Smith, G.M. (1955). *Cryptogamic Botany Vol. II Bryophytes and Pteridophytes* (2ndEdn.). Tata McGraw-Hill Publishing Co., New Delhi.
4. Sporne, K.R. (1970). *The Morphology of Pteridophytes* (The Structure of Ferns and Allied Plants). Hutchinson University Library, London.
5. SundaraRajan, S. (1994). *Introduction to Pteridophyta*. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
6. Vashista, P.C. (1997). *Botany for Degree Students Pteridophyta*. S. Chand and Company Ltd., New Delhi.

GYMNOSPERMS

1. Bhatnagar, S.P. and Alok M. (1997). *Gymnosperms*. New Age International (P) Ltd., Publisher, New Delhi.
2. Coulter, J.M. and Chamberlain, C.J. (1964). *Morphology of Gymnosperms*. Central Book Depot, Allahabad.
3. Sharma, O.P. (1997). *Gymnosperms*. Pragati Prakashan, Meerut.
4. Sporne, K.R. (1971). *The Morphology of Gymnosperms* (The Structure and Evolution of Primitive seed Plants). Hutchinson University Library, London.
5. Srivastava, H.N. (1998). *Gymnosperms*. Pradeep Publications, Jalandhar.
6. Vashishta, P.C. (1996). *Botany for Degree Students-Gymnosperms* (2ndEdn.). S. Chand and Company Ltd., New Delhi.

PALEOBOTANY

1. Delavoryas, T. (1962). *Morphology and Evolution of Fossil Plants*. Holt, Rinehart and Winston, New York.
2. Scott, D.H. (1962). *Studies in Fossil Botany* (Vol. I and Vol. II). Hafner Publishing Co., New York.
3. Seward, A.C. (1959). *Plant Life Through the Ages*. Hafner Publishing Co., New York.
4. Shukla, A.C. and Misra, S.P. (1975). *Essentials of Paleobotany*. Vikas Publishing House (P) Ltd., New Delhi.
5. Stewart, W.N. (1983). *Paleobotany and the Evolution of Plants*. Cambridge University Press, Cambridge, London.
6. Venkatachala, B.S., Shukla, M. and Sharma, M. (1992). *Plant Fossils-a Link with the Past (A Birbal Sahni Birth Centenary Tribute)*. Birbal Sahni Institute of Paleobotany, Lucknow.

Course Outcomes:-

1. To mention about the General characteristics, classification and structure of bryophytes, Pteridophytes and Gymnosperms.
2. To know the reproduction and life history of various Bryophytes, Pteridophytes, and Gymnosperms.
3. To know the Fossils and methods of fossilization.
4. To mention about the different fossils forms – Rhynia, Lepidodendron, Lepidocarpon, Calamites & Williamsonia.

CORE PRACTICAL II

BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY & ANATOMY AND EMBRYOLOGY

Practical for Core Course IV: A study of both vegetative and reproductive Structures (wherever available) of Genera included in the theory.

Practical for Core Course VI: A study of the morphology and anatomy of both vegetative and reproductive parts of the living genera and fossil forms of the following Genera.

PTERIDOPHYTES

| | | |
|--------------------|---|-------------------------------------|
| <i>Psilotum</i> | - | Demonstration only |
| <i>Lycopodium</i> | - | Stem and Cone only |
| <i>Selaginella</i> | - | Stem and Cone only |
| <i>Equisetum</i> | - | Stem, cone slide Demonstration only |
| <i>Adiantum</i> | - | Rachis, Sorus |
| <i>Marsilea</i> | - | Stem, Sporocarp slides |

GYMNOSPERMS

| | | |
|---------------|-------------------------|---|
| <i>Cycas</i> | Rachis, Leaflet | -T.S.; Coralloid root, male cone microsporophyll, |
| | Megasporophyll | - Demonstration only |
| <i>Pinus</i> | | - Needle –T.S., Young stem – T.S.; |
| | Male & Female cone | - Demonstration only |
| <i>Gnetum</i> | | - Stem –T.S.; |
| | Male & Female Strobilus | - Demonstration only |

PALEOBOTANY

Rhynia, Lepidodendron, Lepidocarpon, Calamites (slides), *Williamsonia*

Course Outcomes:-

1. To know the vegetative and reproductive structures of Pteridophytes:-
2. To know the morphology, Anatomy of both vegetative and Reproductive parts of Gymnosperms and Fossils–

NON-MAJOR ELECTIVE I BIOFERTILIZERS AND BIOPESTICIDES

Objectives:

1. To understand the basics of biofertilizers and their cultivation
2. To study about mycorrhiza and their isolation and production
3. To impart knowledge on pesticides and their control by biopesticides, including their production and commercialization

Unit I

Biofertilizers – Definition, kinds of microbes as biofertilizers, Rhizobium-legume Symbiotic association – mass cultivation and carrier materials.

Unit II

Cultural method of *Azospirillum*, *Azotobacter*, *Azolla* and *Anabaena*, carrier materials.

Unit III

Mycorrhiza – VAM association, types, isolation and inoculum production.

Unit IV

Pesticides – Introduction – Biological Magnification concept. Biopesticides – Viral origin, fungal origin.

Unit V

Biopesticides – Bacterial origin, *Bacillus thuringiensis* mechanism of action and application. Advantages of biopesticides and commercialization.

Books:

1. SubbaRao, N.S. (2000). *Soil Microbiology*. Oxford and IBH Publishing Co. Ltd., New Delhi.
2. Varma, A. and Hock, B. (1995). *Mycorrhiza*. Springer-Verlag, Berlin.
3. Wicklow, D.T. and Soderstrom, B.E. (1997). *Environmental and Microbial Relationships*. Springer-Verlag, Berlin.
4. Yaakov (1994). *Azospirillum/Plant Associations*. CRC Press, Boca Raton, FL.

Course Outcomes:-

1. To know the Biofertilizers and kinds of microbes as Biofertilizers.
2. To mention about the cultural methods of various microbes, and carrier materials.
3. To know the types, Isolation and inoculum production of micorrhiza.
4. To mention about the pesticides, Biopesticides and its origin.
5. To give the advantages of Biopesticides and commercialization.

CORE COURSE VI ANATOMY AND EMBRYOLOGY

Objectives

1. To inculcate the basics of tissues and anatomical features of plants.
2. To impart the knowledge about the various aspects of morphogenesis.
3. To understand the key aspects of embryology of Angiosperms

Unit I

Anatomy: Plant tissue– classification, Meristems, definition, differentiation, redifferentiation and dedifferentiation. Classification of meristems-apical meristems and lateral meristems intercalary meristem, various Concepts of apical meristem theories, apical cell theory, Tunica – Corpus and Histogen theory.

Unit II

Epidermal tissue system, stomatal types. Permanent tissue – simple– Parenchyma, collenchyma and sclerenchyma. Complex Permanent Tissues: Xylem – Components, Ontogeny and Phylogeny; Phloem– Components, Ontogeny and Phylogeny. Laticifer types.

Unit III

Primary structure of root, stem and leaf in dicots and monocots. Normal Secondary growth in stem and root-annual rings – heart Wood, sapwood. Periderm formation.

Anomalous secondary growth in dicot stems: *Nyctanthes* and *Boerhaavia* and monocot stem-*Dracaena*. Nodal anatomy – uni and trilacunar types.

Unit IV

Embryology – Structure and development of anther. Microsporogenesis; Microgametogenesis; Ultrastructure of pollen wall – structure, development and types of ovules, megasporogenesis, Megagametogenesis (*Polygonum* type of embryosac development), Fertilization.

Unit V

Endosperm – Nuclear, cellular and helobial and Ruminant types. Development of embryo – dicot and Monocot. Basic concepts of apomixis, apospory, Polyembryony and Parthenogenesis

Books:

ANATOMY

1. Cutter, E.G. (1978). *Plant Anatomy Part-I: Cells and Tissues* (2ndEdn.), *Plant Anatomy Part-II: Experiments and Interpretations*. Edward Arnold, London.
2. Esau, K. (1965). *Vascular Differentiation in Plants*. Holt, Rinehart and Winston, New York.
3. Esau, K. (1980). *Plant Anatomy* (2nd Edition). Wiley Eastern Ltd., New Delhi.
4. Fahn, A. (1997). *Plant Anatomy*. Pergamon Press, Oxford.
5. Foster, A.S. (1960). *Practical Plant Anatomy*. Van Nostrand and East-West Press, New Delhi.
6. Govindarajulu, A. (1980). "*Marangal*" (*Trees*) (In Tamil). Tamilnadu Textbook Society, Chennai.
7. Krishnamurthy, K.V. (1980). *Wood*. Tetrahedron Publications, Tiruchirappalli.
8. Vasishta, P.C. (1977). *A Text Book of Plant Anatomy*. S. Nagin and Co., New Delhi.

EMBRYOLOGY

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). *The Embryology of Angiosperms* (4th Edition). Vikas Publishing House (P) Ltd., UBS Publisher's Distributors, New Delhi.
2. Johri, B.M. (1982). *Experimental Embryology of Vascular Plants*. Springer – Verlag, Heidelberg.
3. Maheswari, P. (1985). *An Introduction to the Embryology of Angiosperms*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Maheswari, P. (1963). *Recent Advances in the Embryology of Angiosperms*. International Society of Plant Morphologists, University of Delhi.
5. Rogland, A. (2000). *Developmental Botany (Embryology of Angiosperms)*. Saras Publications, Nagercoil.
6. Swamy, B.G.L. and Krishnamoorthy, K.V. (1980). *From Flower to Fruit*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Course Outcomes:-

1. To know the classification and types of plant tissues.
2. To know the basic, types and concept of meristems.
3. To mention about the primary Structure of monocot and Dicots – Roots, Stem and Leaf.
4. To know the normal and anomalous secondary growth of dicot stem and monocot stem.
5. To give the Nodal anatomy of uni and trilacunar types.
6. To mention about the structure and development of Anther, Ovule and Fertilization.
7. To know the types of Endosperm.
8. To mention about the development of dicot and monocot embryo and its basic concepts.

**SKILLED BASED
HERBAL TECHNOLOGY**

Objectives: Objectives:

1. To be Familiar with the basic concepts and principles of Herbal medicine.
2. Learn the importance of plant Herbal technology.
3. To expose the students a fundamental of various techniques uses in Herbal technology.

UNIT I

History and Development of Gardening. Principles of desiring a garden, Importance of gardening.

UNIT II

Garden-Types of Garden – Terrace garden garden, Rock garden Hydroponics, Terrarium, Arches, Pergolas, Bonsai and lawn.

UNIT III

Home Garden-Interior decoration-Decorating the Home with the plant-(Foliage plants and Flowering plant – window sill, balcony and roof garden.

UNIT IV

Garden aspects of cultivation of commercial flowers in India. Scope and Importance of commercial flower. Cut flowers and their maintenance.

UNIT V

Flower arrangement. Commercial Floriculture, Cultural practices of Rose, Jasmine, Chrysanthemum, Crossandra and Polyanthus.

Course Outcomes:-

1. Understand the various step involved in the basic functioning of Herbal medicine and the medicinal value of it.
2. Understand of the basic principles of Herbal use including identification patterns from data, nomenclature and the inference of evolutionary.
3. Understand the organization of photo steroid genome .

NON-MAJOR ELECTIVE II HORTICULTURE

Objectives

1. To study the importance of horticultural crops and their propagation methods
2. To understand the types of gardens and their establishment
3. To educate floriculture and fruit culture, greenhouse and nursery management

Unit I

Horticulture: Importance and scope of Horticulture, Classification of horticultural crops – fruits, vegetables crops, climate, soil, water, nutrition needs of horticultural crops,

Unit II

Plant propagation methods, cutting, layering, grafting, budding, stock-scion relationship. Use of plant regulators in horticulture.

Unit III

Garden designs, types of gardens – formal, informal and kitchen garden, units of garden, hedge, border, popiary arches and lawn maintenance.

Unit IV

Floriculture, cultivation of commercial flowers – rose and jasmines. Cultivation of important fruit trees – Mangoes and Banana.

Unit V

Green house, Indoor gardening – Bonsai – flower arrangements – nursery management and maintenance.

Books:

1. Bose, T.K. and Mukherjee, D. (1972). *Gardening in India*. Oxford & IBH Publishing Co., Kolkatta.
2. Edmond, J.B., Musser, A.M. and Andrews, F.S. (1951). *Fundamentals of Horticulture*. McGraw-Hill Book Company, Inc., New York.
3. Jitendra Singh. (2014). *Basic Horticulture*. Kalyani Publishers, Chennai.
4. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
5. Lex Lauries and Victor, H.R. (1950). *Floriculture – Fundamental and Practices*. McGraw Hill Publishers, New York.
6. Naik, K.C. (1963). *South Indian Fruits and Their Culture*. Vardhachary & Co., Madras.
7. Randhawa, G.C. (1973). *Ornamental Horticulture in India*. Today & Tomorrow Publishers, New Delhi.
8. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., New Delhi.
9. Sundararajan, J.S., Muthuswamy, J., Shanmugavelu, K.G. and Balakrishnan, R. *A Guide to Horticulture*. Thiruvankadam Printers, Coimbatore.

Course Outcomes:-

1. To mention about the scope and importance of Horticulture and classification of crops.
2. To give the various propagation methods and uses of plant regulators.
3. To know the garden designs and types of gardens.
4. To mention about the Floriculture, cultivation of commercial flowers and fruit trees,
5. To mention about the Green house, Indoor Gardening, Bonsai, Flower arrangement, Nursery management and maintenance.

CORE COURSE VII CELL AND MOLECULAR BIOLOGY

Objectives:

To enable the students

1. To study microscopy, cell organelles of Prokaryotic and Eukaryotic cells, chromosomes, cell divisions, DNA and RNA.
2. To understand gene regulation and chloroplast and mitochondria genome organization.

Unit I

Basic principles of microscopy. Differentiating features of Prokaryotic and Eukaryotic cells – Ultra structure and functions of plasma membrane – Ultra structure of cell organelles – Plastids, Mitochondria, Golgi bodies, Endoplasmic Reticulum, Lysosomes, Cell Inclusions.

Unit II

Nucleus – Nucleolus - Structure of euchromatin and heterochromatin – Special types of chromosomes – Lamp brush chromosomes and polytene chromosomes. Cell cycle, Cell Division: Mitosis and meiosis.

Unit III

Nucleic acids – DNA and RNA – Differentiating features – Griffith Experiment - Structure, properties (C-Value Paradox) & replication of DNA- Hershey and Chase experiment– RNA–Structure and functions of rRNA, mRNA and tRNA.

Unit IV

Gene regulation in Prokaryotes (*Lac* operon concept) and Eukaryotes – Initiation, Elongation and termination of Transcription and Translation. Gene regulation in prokaryotes and eukaryotes – Differences.

Unit V

Chloroplast and mitochondrial genome organization – Basic mechanism of signal transduction–Programmed Cell Death(PCD).

Books:

1. De Robertis, E.D.P. and De Robertis, E.M.F. Jr. (1980). *Cell and Molecular Biology* (7thEd). Saunders College/Holt, Rinehart and Winson, Philadelphia.
2. Grierson, D. and Convey, S.N. (1989). *Plant Molecular Biology*. Blackie Publishers, New York.
3. Lea, P.J. and Leegood, R.C. (1999). *Plant Biochemistry and Molecular Biology*. John Wiley and Sons, London.
4. Old, R.W. and Primrose, S.B. (1994). *Principles of Gene Manipulation*. Blackwell Science, London.
5. Power, C.B. (1984). *Cell Biology*. Himalaya Publishing Co., Mumbai.

6. Sharma, N.S. (2005). *Molecular Cell Biology*. International Book distributors, Dehradun.
7. Verma, P.S. and Agarwal, V.K. (1986). *Cell Biology and Molecular Biology (Cytology)*. S. Chand and Company Ltd., New Delhi.

Course Outcomes:-

1. To give the basic principles of microscopy and differentiating features of prokaryotic and Eukaryotic cells.
2. To know the ultra-structure and functions of cell organelles.
3. To mention about the special types of chromosomes and cell divisions.
4. To know the structure, properties types and functions of DNA and RNA.
5. To know the gene regulation techniques and differences of prokaryotes and Eukaryotes.
6. To mention about the genome organization of chloroplast and mitochondria.

CORE COURSE VIII GENETICS, BIostatISTICS AND EVOLUTION

Objectives:

1. To study Mendelian genetics, recombination of chromosomes, structure and function of genes and their various units
2. To educate on mutation
3. To impart knowledge on biostatistics and its applications biological experiments
4. To understand the mechanism of evolution and study of population genetics

Unit I

Genetics: Mendel's laws, monohybrid, dihybrid, back cross and test cross. Allelic interactions: Incomplete dominance and co-dominance – complementary factor hypothesis, epistasis (Dominant and recessive), Non-allelic interaction – Lethal factor, Multiple factor hypothesis

Unit II

Recombination – Linkage & crossing over in *Lathyrus odoratus*, eye colour in *Drosophila* and colour blindness in man. Cytoplasmic inheritance. Sex determination in plants and *Drosophila*.

Functional units of gene – cistron, recon, muton, codon and operon concept (lac). Mutation – classification, types, mechanism (physical and chemical mutagens) and application (role of mutation in evolution)

Unit III

Biostatistics: Definition and scope. Sampling techniques: Sample, population, Random and non – random sampling techniques. Data – Types of data. Presentation of data – Graphical methods: Histogram, Bar and Pie diagrams.

Unit IV

Measures of central tendency – Mean, median and mode. Measures of dispersion – range, variance, Standard Deviation and Standard Error. Chi Square analysis. Correlation and its types: Probability Distribution – normal, binomial and Poisson distribution.

Unit V

Evolution – Evolutionary concepts – Theories of Lamarck, Charles Darwin and the modern synthetic theories. Population genetics – gene pool, gene frequency and Hardy–Weinberg law. Factors affecting gene frequencies.

BOOKS: GENETICS

1. Adrin, M.S.R.B., Owen, R.D. and Edger, R.S. (1979). *General Genetics*. In: Mendelism. Eurasia Publishing House (P) Ltd., New Delhi.
2. Agarwal, V.K. (2000). *Simplified course in Genetics* (B.Sc., Zoology). S. Chand & Company Ltd., New Delhi.
3. Ahluwalia, K.B. (1990). *Genetics*. Wiley Eastern Ltd., Madras.
4. Chandrasekaran, S.N. and Parathasarathy, S.V. (1965). *Cytogenetics and Plant Breeding*. P. Varadhachari & Co., Madras.
5. Daniel Sundararaj, D. and Thulsidas, G. (1972). *Introduction to Cytogenetics & Plant Breeding* (3rd Ed.). Popular Book Depot, Madras.
6. Gardner, E.J. and Snusted, D.P. (1984). *Principles of Genetics* (7th edition). John Wiley & Sons, New York.
7. Gupta, P.K. (2000). *Genetics*. Rastogi Publishers, Meerut.
8. Herskowitz, I.H. (1977). *Principles of Genetics* (2nd Ed.). MacMillan Publishing Co. Inc., New York.
9. Hexter, W. and Yost, H.T. Jr. (1977). *The Science of Genetics*. Prentice Hall of India (P) Ltd., New Delhi.
10. Jain, H.K. (1999). *Genetics-Principles, Concepts & Implications*. Oxford & IBH Publishing Co., (P) Ltd., New Delhi.
11. Lewin, B. (1990). *Genes IV*. Oxford University Press, Oxford.
12. Meyyan, R.P. (2000). *Genetics & Evolution*. Saras Publication, Nagercoil.
13. Palaniyappan, S. (1987). *Marabiyal* (Genetics - In Tamil). V.K. Publishing House, Madras.
14. Pandey, B.P. (2012). *Cytology, Genetics and Molecular Genetics*. Tata McGraw-Hill Education Private Ltd., New Delhi.
15. Renganathan, T.K. and Shanmugavel, S. (1996). *Genetics & Genetic Engineering*. Commercial Offset Printers, Sivakasi.
16. Sandhya Mitra (1994). *Genetics - A Blue Print of Life*. Tata McGraw-Hill Education Private Ltd., New Delhi.
17. Sarin, C. (1994). *Genetics*. Tata McGraw-Hill Education Private Ltd., New Delhi.
18. Singleton, R. (1963). *Elementary Genetics*. D. Van Nostrand Co., Ltd. Inc., New York.
19. Sinha, U. and Sinha, S. (1989). *Cytogenetics, Plant Breeding & Evolution*. Vikas Publishing House, New Delhi.
20. Sinnott, E.W., Dunn, L.C. and Dobshansky, J. (1958). *Principles of Genetics* (5th Edition) McGraw Hill Publishing Co., New York.
21. Strickberger, M.W. (1976). *Genetics* (2nd Ed.). MacMillan Publishing Co. Inc., New York.
22. Watson, J.D. (1977). *Molecular Biology of the Gene*. W.A. Benjamin Inc., California.

23. Winchester, A.M. (1958). *Genetics* (3rdEd.). Oxford & IBH Publishing House, Calcutta.
24. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999). *Instant Notes in Genetics*. Viva Books (P) Ltd., New Delhi, Mumbai, Chennai.

BIOSTATISTICS

1. Nageswara Rao, G. (1983). *Statistics for Agricultural Science*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Olive, J.D. (1995). *Basic Statistics - A Primer for the Biomedical Sciences*. John Wiley and Sons, New Delhi.

EVOLUTION

1. Gottlieb, LD. and Jain, S.K. (1988). *Plant Evolutionary Biology*. Chapman & Hall, London.
2. Savage, J.M. (1969). *Evolution* (2ndEd.). Amerind Publishing (P) Ltd., New Delhi.
3. Shukla, R.S. and Chandel, P.S. (1996). *Cytogenetics, Evolution & Plant Breeding*. S. Chand & Company Ltd., New Delhi.
4. Sproule, A. (1998). *Charles Darwin Scientists who have changed the world*. Orient Longmans, Hyderabad.
5. Verma, P.S. and Agarwal, V.K. (1999). *Concepts of Evolution*. S. Chand & Company Ltd., New Delhi.

Course Outcomes:-

1. To mention about the Mendel's Laws and Allelic interactions.
2. To give the Recombination, Cytoplasmic inheritance and functional units of gene.
3. To know the scope, Techniques, types and presentation of data in Bio statistics.
4. To mention about the Evolutionary concepts and Population Genetics in Evolution.

CORE COURSE IX
MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Objectives:

To enable the students

1. To study morphological features of vegetative, inflorescence, fruits and seed characters.
2. To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications.
3. To understand the systematics of the selected families of the flowering plants with their economic importance.
4. To have knowledge on the economically important plants with their systematic treatment.

Unit I

Morphology: vegetative, floral and fruit parts –Inflorescence –Types – racemose, cymose, mixed and special types. Fruit -simple, fleshy, dry dehiscent and dry indehiscent, aggregate and multiple fruits.

Unit II

Binomial nomenclature – ICBN rules –taxonomic types. Systems of Classification – Bentham and Hooker classification – Merits and demerits. Herbarium techniques.

Unit III

A detailed study of the following families with their economic importance – Annonaceae, Capparidaceae, Tiliaceae, Rutaceae, Anacardiaceae, Leguminosae (Papilionaceae, Cesalpinaceae and Mimosaceae) and Cucurbitaceae.

Unit IV

A detailed study of the following families with their economic importance – Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Solanaceae, Verbenaceae, Euphorbiaceae, Orchidaceae and Poaceae.

Unit V

Economic Botany: A brief study of the following economically important plants:

Food – Cereals (*Oryza sativa*, *Eleusinecoracana*); Pulses – Black gram (*Phaseolusmungo*), Edible – Gingelly oil (*Sesamumindicum*); Root tubers – Tapioca (*Manihot esculenta*); Sugar – Sugarcane (*Saccharum officinarum*).

Fibres – Textiles (*Gossypium*); Others– *Crotalaria*, *Agave*. Medicinal Plants – *Ocimum*, *Phyllanthus*, *Solanum*.

Forest Products – Timber: Teak (*Tectona grandis*), Jack (*Artocarpus heterophyllus*). Tannins, Gums, Resins, Turpentine.

BOOKS:

TAXONOMY

1. Gurcharan Singh (1999). *Plant Systematics - Theory & Practice*. Oxford & IBHPublishingCo.(P)Ltd.,NewDelhi.
2. Jaques, H.E. (1999). *Plant Families-How to know them?*. Agro Botanical Publishers (India),Bikaner.
3. Jefferey, C. (1968). *An Introduction to Plant Taxonomy*. J.A. Churchill, London.
4. Lawrence, G.H.M. (1953). *Taxonomy of Vascular Plants*. Oxford & IBH Publishers, NewDelhi.
5. Lawrence, G.H.M. (1955). *An Introduction to Plant Taxonomy*. The Central Book Depot,Allahabad.
6. Mathews, K.M. (1987-90). *Flora of Tamilnadu Carnatic (1-4vols.)* Rapinat Herbarium,Trichy.
7. Mathur, R.C. (1970). *Systematic Botany (Angiosperms)*. Agra Book Stores, Lucknow.
8. Mitra, J.N. (1964). *An Introduction to Systematic Botany & Ecology*. The World Press (P) Ltd.,Calcutta.
9. Naik, V.N. (1996). *Taxonomy of Angiosperms (9thEd.)*. Tata McGraw-Hill Publishing Co., (P) Ltd., NewDelhi.
10. Narayanaswamy, R.V. and Rao, K.N. (1976). *Outlines of Botany*. S. Viswanathan Printers & Publishers,Chennai.
11. Palaniyappan, S. (2000). *Angiospermgalin Vagaippadu (Taxonomy of Angiosperms)*. V.K. Publishing House,Chennai.
12. Pandey, B.P. (1997). *Taxonomy of Angiosperms*. S. Chand & Company Pvt. Ltd., NewDelhi.
13. Porter, C.L. (1967). *Taxonomy of flowering Plants*. Eurasia Publishing House, NewDelhi.
14. Ramaswami, S.N., Lakshminarayana, S. and Venkateswaralu, V. (1976). *Taxonomy (Systematic Botany) for Degree Course*.Maruthi Book Depot, Guntur,Hyderabad.
15. Sharma. O.P. (2007). *Plant Taxonomy*. Tata McGraw–Hill Publishing Co., NewDelhi.
16. Singh, V. and Singh, D.K. (1983). *Taxonomy of Angiosperms*. Rastogi Publications,Meerut.
17. Sivarajan V.V. (1993). *Introduction to the Principles of Plant Taxonomy (2ndEdn.)*. N.K.P. Robson (Ed.). Oxford & IBH PublishingCo. (P) Ltd., New Delhi.
18. Subramaniam, N.S. (1999). *Laboratory Manual of Plant Taxonomy (2ndEd.)*. Tata McGraw-Hill Publishing Co., NewDelhi.
19. Vashista,P.C.(1997).*Taxonomy of Angiosperms*.S.Chand&CompanyPvt. Ltd., NewDelhi.

ECONOMIC BOTANY

1. Ashok Bendre and Ashok Kumar (1998-99). *Economic Botany*. Rastogi Publications, Meerut.
2. Govinda Prakash and Sharma, S.K. (1975). *Introductory Economic Botany*. Jai Prakash Nath, Meerut.
3. Gupta, S.K. and Kaushik, M.P. (1973). *An Introduction to Economic Botany*. K. Nath & Co., Meerut.
4. Hill, A.W. (1952). *Economic Botany*. Tata McGraw-Hill Publishing Co., New Delhi.
5. Pandey, B.P. (2000). *Economic Botany*. S. Chand & Company Ltd., New Delhi.
6. Sambamurthy, A.V.V.S. and Subrahmanyam, N.S. (1989). *A Text Book of Economic Botany*. Wiley Eastern Ltd., Madras.
7. Sen, S. (1992). *Economic Botany*. New Central Book Agency, Calcutta.
8. Verma, V. (1974). *A Text Book of Economic Botany*. Emkay Publications, New Delhi.

Course Outcomes:-

1. To know the morphological features and types of Vegetative, Inflorescence and Fruits.
2. To mention about the ICBN rules, Classification and Techniques of Herbarium.
3. To give the detailed study of various families and its economic importance.
4. To mention about the brief study of some economically important plants.

CORE PRACTICAL X

CELL AND MOLECULAR BIOLOGY & GENETICS, BIOSTATISTICS AND EVOLUTION & MORPHOLOGY, TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

CELL AND MOLECULAR BIOLOGY

1. Observation of plant cells in Onion peeling and *Rheo* leaf
2. Non-living inclusions: Raphides, cystolith and Starchgrains
3. Celldivision:MitosisandMeiosis–Squashtechniqueinoniontoottipsand *Tradescantia/Rheo*flower bud respectively
4. Isolation of cell organelles through differential centrifugation
5. Photographs: Ultra Structure of cell organelles

GENETICS, BIOSTATISTICS & EVOLUTION

- Problems on simple monohybrid and dihybrid ratios. Simple problems on interaction on factors included in the theory.
- Simple experiments to determine the mean, median and mode. Illustration of graphic representation of data using simple analysis.

MORPHOLOGY, TAXONOMY & ECONOMIC BOTANY

Training in dissection, observation, identification and sketching of floral parts of plants belonging to the families mentioned in the syllabus along with floral diagrams and floral formula.

Description of plants in technical terms.

Field study flora.

Submission of 25 Herbarium specimens.

Economic plants covered in theory part in taxonomy and economic botany and their importance.

Course Outcomes:-

1. To know how to observe the plant cells and types of cell division by peeling and squash technique.
2. To know the non-living inclusions and ultra-structure of cell organelles through photographs.
3. To know how to solve the problems on simple monohybrid, dihybrid ratios and interaction on factors.
4. To know how to do the graphic representation of data using simple analysis.
5. To give the training in dissection, observation, identification and sketching of floral parts of the plants.
6. To know the Economic plants and their importance.
7. To know how to describe the plants in technical names and preparation of Herbarium specimens.

MAJOR-BASED ELECTIVE I
MEDICAL AND APPLIED BOTANY

Objectives:

1. To understand the importance of the medicinal plant wealth in India and the role of Medicinal plants in human healthcare.
2. To know the medicinally useful plants, Herbal medicine preparation for common diseases and adulterants.
3. To understand the importance of biofertilizers and biopesticides
4. To understand the techniques involved in the cultivation of edible mushrooms

Unit I

Medical Botany: Importance and relevance of herbal drugs in Indian Systems of Medicine. Pharmacognosy—aim, scope and branches. Phyto chemicals— reserve materials, secretory materials and excretory materials.

Unit II

Cultivation and marketing of Medicinal plants: *Aloe vera*, *Cassia senna*, *Catharanthus roseus*, *Gloriosa superba* and *Withania somnifera*.

Poisonous plants – action and treatments for different types of plant poisons, rejuvenating herbs and medicinal uses of non-flowering plants

Unit III

Adulteration and substitution of crude drugs – methods, types and identification; botanical description and active principles in the drugs of roots, rhizomes, woods and bark, leaves, flowers and seeds (two examples each/plant part).

Unit IV

Biofertilizer Technology: biofertilizers – types and importance. Mass cultivation of *Azospirillum*, *Azolla* and *Anabaena*. Rhizobium-legume symbiotic association – mass cultivation and carrier materials. Mycorrhiza – types and importance.

Biopesticides – importance; bacterial (*Bacillus thuringiensis*); Viral (NPV); Fungal (*Trichoderma*).

Unit V

Mushroom Technology: types and identification of edible and poisonous mushrooms; nutritive value; cultivation of button (*Agaricus bisporus*) and oyster mushroom (*Pleurotossajorcaju*); harvest and storage methods; mushroom research centres in India.

BOOKS:

1. Agarwal, O.P. (2014). *Organic Chemistry Natural Products, Vol. II*. Krishna Prakashan Media (P) Ltd., Meerut.
2. Alice, D., Muthusamy and Yesuraja, M. (1999). *Mushroom Culture*. Agricultural College, Research Institute Publications, Madurai.
3. Chopra, R.N., Badhuvar, R.L. and Gosh, G. (1965). *Poisonous Plants of India*. CSIR Publications, New Delhi.
4. Chopra, R.N., Chopra, I.C., Handa, K.L. and Kapur, L.D. (1994). *Indigenous Drugs of India*. IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Gamble, J. S. and Fisher, C.E.C. (1915-1938). *Flora of the Presidency of Madras*. Adlard & Son Ltd., London.
6. Marimuthu, T. (1991). *Oyster Mushroom*. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
7. Mathew, K.M. (1988). *Flora of the Tamilnadu Carnatic*. Rapinat Herbarium, Tiruchirappalli.
8. Nair, N.C. and Henry, A.M. (1983). *Flora of Tamil Nadu, India*. Botanical Survey of India.
9. Nita Bhal (2000). *Handbook on Mushrooms Vol. I and II* (2nd Ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
10. Pathak, V.N. and Yadav, N. (1998). *Mushroom Production and Processing Technology*. Agrobios, Jodhpur.
11. Somasundaram, S. (1997). *Medicinal Botany (Maruthuva Thavaraviyal)* (Tamil Medium Book). Elangovan Publishers, Tirunelveli.
12. Srivastava, A.K. (2006). *Medicinal Plants*. International Book distributors, Dehradun.
13. Subba Rao, N.S. (2000). *Soil Microbiology*. Oxford and IBH Publishing Co. Ltd., New Delhi.
14. Tripathi, D.P. 2005. *Mushroom Cultivation*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
15. Varma, A. and Hock, B. (1995). *Mycorrhiza*. Springer-Verlag, Berlin.
16. Yaaco Vokan (1994). *Azospirillum/Plant Associations*. CRC Press, Boca Raton, FL.

Note: No Practical for this paper.

Course Outcomes:-

1. To know the importance of herbal drugs pharmacognosy and phytochemicals.
2. To mention about the cultivation and marketing of medicinal plants and treatments for plant poisons.
3. To give the adulteration, substitution and principles of drugs of various plant parts.
4. To know the types importance and cultivation of Bio-Fertilizers and Mushrooms.
5. To give the importance of Bio-pesticides.

**SKILL BASED
BIO-RESOURCES AND HUMAN WELFARE**

Objective:

1. Students to learn about the uses of microorganisms (eg) Single cell protein, Antioxidants, Vitamins, Enzyme.
2. To know about the plant sources like Coffee, Poppy, Cotton, Oil, and Rubber.
3. Understand the Traditional Medicines and their Economic Importance.

Unit I

Useful products from microorganisms – Single cell proteins from fungi (yeast), algae (Spirulina), antioxidants from Dunaliellasalina, Vitamins, enzymes, organic acids, antibiotics and alcohol (With one example each)

Unit II

Useful products from Gymnosperms – Wood (Pine), Drugs (Turpentine, taxol, Ephedrine)

Unit III

Study of plants for the source and application of the following products, beverage (coffee), narcotics (poppy) fiber (Cotton), oil-seeds (sesame), latex (rubber), start up for plant based industries in Tamilnadu

Unit IV

Importance and application areas: biomass production - food (single cell proteins); bio-fertilizers. Environmental Biotechnology: Waste treatment – solid (compost), Liquid (industrial effluents), sewage treatment (domestic sewage).

Unit V

Traditional and economically important wood plant species of India. Acacia, Albizzia, Bambusa, Dalbergia, Tectonagrandis, Terminalia

References:

1. Sambamurthy, A.V.V.S. and Subrahmanyam, N.S. 1989. A Textbook of Economic Botany Wiley Eastern Ltd., New Delhi, Bangalore, Bombay, Calcutta, Guwahati Hyderabad, Lucknow, Madras, Pune.
2. Pandey, B.P. 2000. Economic Botany, S. Chand & Co., New Delhi.
3. Verma, V. 1974. A Text Book of Economic Botany, Emkay Publications, New Delhi
4. Hill, A.W, 1952. Economic Botany, McGraw Hill Book Co., New York.
5. Gupta, S.K and Kaushik, M.P., 1973. An Introduction to Economic Botany, K. Nath & Co., Meerut, India.

Course Outcomes:-

Students could be able to

1. Describe the useful product from different microorganism SCP, anti-oxidant, Vitamin, Enzyme, Organic acid, antibiotic and alcohol.
2. Explain the useful product from given Gymnosperms (Wooden drugs)
3. Know the plants for the source and application of the product given in the syllabus.
4. Learn the edible plants and their important products, Beverages, Spices and Fruits.
5. Understand traditional and economically used wooden plants in India.

SKILL BASED MUSHROOM TECHNOLOGY

Objectives:

1. To acquire knowledge on various types of mushrooms.
2. To understand cultivable species of mushrooms.
3. To learn the culture techniques of edible mushrooms.
4. To study the economic of mushroom.

Unit I

History of Mushroom cultivation – economic importance of Mushroom as food – selection ‘starter’ – preparation of spawn – preparation of Compost (outdoor and indoor beds – incubation – Harvesting and marketing.

Unit II

Life cycle of Mushrooms – identification – edible and poisonous Mushrooms – external factors for growth.

Unit III

Spawn production – grain, powder and granular spawn – mother spawn – planting spawn – preparation of cultures and spore culture), preservation and storage of culture – various media (PDA, malt extract, Wheat extract, Compost extract)

Unit IV

Cultivation of White Button Mushrooms (*Agaricus bisporus*) and Oyster Mushrooms (*Pleurotus* spp) – materials – sterilization – spawning and fruiting – house design for *Pleurotus* preservation, canning drying.

Unit V

Control of major diseases of microbes (green moulds, dry bubble, wet bubble, bacterial spot, viral brown disease) – pests (Sciarid flies, phorid flies, beetles) – nematodes (Mycophages)

References:

1. Kanaiyan. S and Ramasamy.K, 1980.A Handbook of Edible Mushroom.Today and Tomorrows.Printers and Publishers, New Delhi, 104 p.
2. Pathak V.N, NagendraYadav and Maneesha Gaur, 1998.Mushroom Production and Processing Technology, Agrobios (India) Jodhpur, 179 p.

Course Outcomes:-

Students could be able to

1. Describe the history economic importance and different steps of cultivation of mushroom.
2. Identify the edible and poisonous mushrooms.
3. Explain the life cycle of mushroom and external factor’s need for its growth
4. Understand the different types of spawn and the various steps involve in spawn productions.
5. Learn the various steps involve in the cultivation of white button mushroom and oyster mushroom.

CORE COURSE XI

PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS

Objectives:

To enable the students

1. To understand the metabolic activities of plants
2. To understand the role of enzymes in various metabolic activities of plants
3. To know the application of the laws of physics in biological phenomena

Unit I

Plant - Water relationship: structure and properties and significance of water - osmotic and non-osmotic uptake of water. Ascent of sap-cohesion theory: root pressure, transpiration, physiology of stomatal action, Translocation of solutes and assimilates. Mass flow, Membrane permeability mineral uptake: Passive and active. Role of major and Minor elements, mineral deficiency symptoms.

Unit II

Photosynthesis: Absorption spectrum, Action spectrum, role of pigments, enhancement effect, photosystems I & II, Photophosphorylation, Carbon Assimilation: Calvin cycle, Hatch & Slack pathway, CAM pathway. photorespiration.

Respiration: Aerobic and anaerobic. Glycolysis, Krebs's Cycle and oxidative phosphorylation, energetics of respiration.

Unit III

Plant Growth regulatory substances; auxins, gibberellins, cytokinins, ethylene and abscisic acid - their chemical nature, physiological effects and function. Role of hormones in flowering, senescence and abscission- Photoperiodism, vernalization and seed dormancy.

Unit IV

Biochemistry: Enzymes - Nature and properties. Mechanism of enzyme action-factors affecting Enzyme action, substrate concentration – inhibitors, cofactors. Structure, classification and functions of carbohydrates, lipids and Proteins. Secondary metabolites – alkaloids, flavonoids, terpenoids and anthocyanins.

Unit V

Biophysics-physical forces and chemical bonds, biological effect of ionising radiations, basic principles of spectroscopy, Laws of Thermodynamics and entropy-electron transfer processes-a) Definition of pH -its determination; b) Buffers and electrolytes and their functions. c) Fractionation of biomolecules by paper chromatography, d)Centrifugation.

BOOKS:

PLANT PHYSIOLOGY

1. Devlin, R.M. (1969). Plant Physiology. Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi.
2. Dulsy Fatima, R.P. et. al., (1994). *Elements of Biochemistry*. Saras Publications, Nagercoil, Tamilnadu.
3. Jain, V.K. (1990). *Fundamentals of Plant Physiology*. S. Chand & Co., New Delhi.
4. Noggle, R. and Fritz (1989). *Introductory Plant Physiology*. Prentice Hall of India.

5. Pandey, S.N. (1991). *Plant Physiology*. Vikas Publishing House (P) Ltd., New Delhi.
6. Periyasamy, K. (1978). *Cell Iyakka Viyal* (Cell Physiology). Tamilnadu text Book Society, Chennai.
7. Salisbury, F.B. and Ross, C.W. (1999). *Plant Physiology*. CBS Publishers and Printers, New Delhi.
8. Saraswathy and Rangamannar (1973). *Thaavara Valarchithai Martram* (Metabolism & Biosynthesis). Tamilnadu Text Book society, Chennai.

BIOCHEMISTRY

1. Day, P.M. and Harborne, J.B. (2000). *Plant Biochemistry*. Harcourt Asia (P) Ltd., India & Academic Press, Singapore.
2. Jain, J.L. (1998). *Fundamentals of Biochemistry*. S. Chand & Co., New Delhi.
3. Jayaraman, J. (1981). *Laboratory Manual of Biochemistry*. Wiley Eastern Ltd., New Delhi.
4. Lehninger, A.L. (1984). *Biochemistry* (2nd Edition). Kalyani Publishers, Ludhiana, New Delhi.
5. Plummer, D.T. (1988). *An Introduction to Practical Biochemistry* (3rd Edn.,). Tata McGraw Hill Publishing Co., Ltd., New Delhi.
6. Srivastava, H.S. (1990). *Elements of Biochemistry*. Rastogi Publications, Meerut, India.
7. Stryer, L. (1989). *Biochemistry*. W.H. Freeman & Co., New York, San Francisco.
8. Wilson, K. and Walker, J. (1994). *Principles and Techniques of Practical Biochemistry* (4th Edition). Cambridge University Press, U.K.

BIOPHYSICS

1. Annie and Arumugam, N. (2000). *Biochemistry & Biophysics*. Saras Publications, Nagercoil, Tamilnadu.
2. Casey, E.J. (1969). *Biophysics-Concepts and Mechanisms*. Van Nostrand Reinhold Co., & Affiliated East West Press (P) Ltd., New Delhi.
3. Narayanan, P. (2000). *Essentials of Biophysics*. New Age International Publishers (P) Ltd., New Delhi, Bangalore, Calcutta, Chennai, Guwahati, Hyderabad, Lucknow, Mumbai.
4. Salil Bose, S. (1982). *Elementary Biophysics*. Vijaya Printers, Madurai.

Course Outcomes:-

1. To know the plant-water relationship through root pressure, transpiration and translocation of solutes.
2. To know the Photo synthesis and Respiration reactions by various pathways.
3. To mention the various plant growth regulators, their chemical nature, physiological effects and functions.
4. To know the role of hormones in different functions of plants.
5. To know the nature, properties and mechanism of enzyme actions.
6. To mention about the structure, classification and functions of carbohydrates, lipids, proteins and secondary metabolites.
7. To know the application of the laws of physics in biological phenomena.

CORE COURSE XII
PLANT ECOLOGY AND CONSERVATION

Objectives:

To enable the students

1. To realize the values of plants and animals of the ecosystem
2. To know about the hazards of pollution and the importance of keeping his/her environment clean
3. To know in detail on various types of vegetation
4. To know about his/her environment and mould the students to become managers of various ecological systems

Unit I

General Ecology – Approaches to the study of Ecology, Autecology – Synecology, Plant environment – climatic, edaphic and Biotic factors (interference on Plant habitat by animals – Grazing and browsing, by humans – deforestation, Agriculture), Allelopathy.

Unit II

Ecosystem concept – components abiotic-biotic-autotrophic producers & heterotrophic consumers, biomass-ecological pyramids, Productivity – primary, secondary & gross; food chain – food web & energy flow – pond ecosystem.

Unit III

Vegetation – Units of vegetation – formation, association, consociation, society – Development of vegetation: Migration – colonization, ecesis, Methods of study of vegetation (Quadrat & transect). Plant succession – Hydrosere & xerosere. Ecological classification of Plants; Morphological and anatomical features of plants and their correlation to the habitat.

Unit IV

Pollution and its control: Air pollution, Radiation pollution, Noise pollution, Thermal pollution-Soil pollution: Industrial, agrochemicals (insecticides, pesticides, fungicides, herbicides). Water pollution – Industrial effluents. Marine pollution.

Unit V

Phytogeography-Approaches to Phytogeography – Climate of India & its climatic zones, Botanical regions (provinces) of India– Vegetational types of Tamil Nadu: Evergreen, deciduous, scrub & Mangrove, Continuous and discontinuous distribution. Endemism. *In situ* and *ex situ* conservation. Application of remote sensing in conservation.

BOOKS:

PLANTECOLOGY&PHYTOGEOGRAPHY

1. Agrawal, K.C. (1987). *Environmental Biology*. Agro Botanical Publisher, India.
2. Arumugam, N. (1994). *Concepts of Ecology* (Environmental Biology). Saras Publications, Nagercoil, Tamilnadu.
3. Chandrasekaran, P. (1996). *ChutruchchoozhalMaasupadu* (Environmental Pollution) T.K. Printers, Pudukkottai, Tamilnadu.
4. Kumar, H.D. (1992). *Modern Concepts of Ecology* (7th Edn.). Vikas Publishing Co., New Delhi.
5. Odum, E.P. (1971). *Fundamentals of Ecology* (2nd Edn.). Saunders & Co., Philadelphia & Natraj Publishers, Dehradun.
6. Sharma, P.D. (2000). *Ecology & Environment*. Rastogi Publications, Meerut, India.
7. Sundaram, R. (1972). *ThaavaraChuyachChoozhnilaiyiyal*. Tamilnadu Text Book Society.
8. Vashishta, P.C. (1990). *Plant Ecology*. Vishal Publications, Delhi, Jalandhar.
9. Verma, P.S. and Agarwal, V.K. (1999). *Concept of Ecology* (Environmental Biology). S.Chand & Co., New Delhi.

PHYTOGEOGRAPHY

1. Cain, S.A. (1944). *Foundations of Plant Geography*. Harper & Brothers, N.Y.
2. Good, R. (1997). *The Geography of flowering Plants* (2nd Edn.). Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi.
3. Mani, M.S. (1974). *Ecology & Biogeography of India*. Dr. W. Junk Publishers, The Hague.

Course Outcomes:-

1. To mention about the approaches to the study of different ecology and plant environment.
2. To know the concepts, components and types of ecosystem.
3. To mention about the developments, methods of study of vegetation, plant successions and ecological classification of plants.
4. To know the different types of pollutions and its control.
5. To mention about the approaches to phytogeography, botanical regions of India, vegetation types of Tamil Nadu and conservation of plants.

CORE PRACTICAL XIII

PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS & PLANT ECOLOGY AND CONSERVATION

Objective:

1. To study about the plant physiology and train for experiments and know about the physiological apparatus
2. To study the plant ecology and types of plants like hydrophytes, xerophytes and mesophytes
3. To learn about the vegetation and conservation of plants and study about aquatic ecosystem.

PLANT PHYSIOLOGY, BIOCHEMISTRY & BIOPHYSICS

For demonstration only

1. Enzyme activity using amylase.
2. Colorimeter – Operation and working principle
3. pH meter–Operation and working principle
4. Centrifuge – Operation and working principle

To be performed by each student

1. Colorimetric estimation of sugars
2. Gravimetric estimation of Starch
3. Determination of osmotic pressure of onion/Rheo leaf.
4. Effect of light intensity on transpiration using Ganong's potometer.
5. Determination of stomatal frequency and estimation of transpiration rate.
6. Determination of absorption and transpiration ratio in plants.
7. Measurement of respiration rate using germinating seeds and flower buds with simple respiroscope.
8. Separation of plant pigments by paper chromatography.
9. Determination of photosynthetic rate in water plants under different CO₂ concentrations.
10. Measurement of oxygen evolution under different colours using Wilmott's bubbler.

PLANT ECOLOGY AND CONSERVATION

1. Study of morphological and anatomical features of hydrophytes and xerophytes.
2. Study of morphological features of epiphytes, parasites and halophytes.
3. Study of vegetation by the quadrat and line transect method.
4. Estimation of frequency, density & Dominance.
5. Determination of soil & water pH.
6. The light and dark bottle experiment for primary productivity study in the aquatic ecosystem

Course Outcomes:-

1. To know the enzyme activity using amylase, operation and working principle of calorimeter, PH meter and centrifuge.
2. To know how to estimate sugar and starch, determination of osmotic pressure, transpiration, stomatal frequency and absorption in plants.
3. To give the measurement of respiration rate and oxygen evolution by using certain techniques.
4. To know the separation of plant pigments by paper chromatography and determination of photo synthetic rate.
5. To know the morphological and anatomical features of ecologically important plants.
6. To know the methods of vegetation, estimation of frequency, density and dominance, determination of soil and water 'PH'.

MAJOR-BASED ELECTIVE II

PLANT BREEDING, HORTICULTURE AND LANDSCAPING

Objectives:

This course introduces

1. The various methods of plant breeding and plant propagation
2. teaches students the art of growing plants for a pre-defined purpose and pleasure and facilitates students to become an entrepreneur

PLANT BREEDING

Unit I

Methods of crop improvement – Introduction, acclimatization, selection methods (Mass, pure line and clonal). Hybridization techniques – interspecific and Intergeneric hybridization, Heterosis.

Unit II

Back crossing, Mutation breeding, Polyploidy and its application in plant breeding, Role of auto- and allopolyploid, breeding for crop improvement with reference to Paddy, Wheat, Sugarcane and Groundnut.

HORTICULTURE

Unit III

Horticulture - scope and importance. Horticultural crops - climate, soil, water and nutritional needs. Plant propagation methods– cutting, layering, grafting and budding. Plant growth regulators in horticulture.

Unit IV

Classification of horticultural crops- Pomology, Olericulture, Floriculture, Spices and Plantation crops. Green house, Indoor gardening, Bonsai. Flower arrangements – Nursery management and Maintenance.

Unit V

Landscaping: Principles, elements and design and layout - formal garden, Informal garden, Special types of gardens (bog garden, sunken garden, terrace, rock garden), and specific areas.

BOOKS:

1. Allard, R.W. (1960). *Principles of Plant Breeding*. John Wiley & Sons, NewYork.
2. Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. (1999). *Floriculture and Landscaping*. NayaPrakash, Calcutta.
3. Chopra, V.L. (1989). *Plant Breeding*. Oxford IBH, NewDelhi.
4. Jenson, N.F. (1988). *Plant Breeding Methodology*. Wiley InerciencePublication, NewYork.
5. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publication, India.
6. Manibhushan Rao, K. (1991). *Text Book of Horticulture*. Macmillan Publications, NewDelhi.
7. Mukherjee, D. (1972). *Gardening in India*. Oxford & IBH Publishing Co., Kolkatta, Mumbai, NewDelhi.
8. Roy Choudhry, N. and Mishra, H.P. (2001). *Text book on Floriculture and Landscaping*. Raja Infotech Enterprise, India.
9. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., NewDelhi.
10. Sharma, J.R. (1994). *Principles and Practice of Plant Breeding*. Tata McGraw Hill, NewDelhi.

Course Outcomes:-

1. To know the various methods of crop improvements of certain plants.
2. To know the importance of Horticulture and propagation methods.
3. To mention about the classification of Horticultural crops flower arrangements, management and maintenance of Nursery.
4. To mention about the principles and layout of special types of garden.

MAJOR-BASED ELECTIVE III

PLANT BIOTECHNOLOGY AND BIOINFORMATICS

Objectives:

1. To comprehend the advances made in the field of plant biotechnology; and bioinformatics
2. To understand how mere jumbling of genes results in the creation of new organisms

Unit I

Biotechnology: definition and scope. Tissue culture: sterilization methods, media preparation (MS basal medium); use of different explants types; materials and callus growth; differentiation; subculturing and hardening.

Unit II

Plasmids: general features and types; plasmids as vectors - pBR 322, Ti- plasmid; cosmids, phagemids, Lambda-phage; transposons; site directed mutagenesis.

Unit III

Steps involved in genetic engineering: generation of desired foreign genes by restriction enzymes and cDNA synthesis; joining DNA molecules; transfer of rDNA molecules into bacteria and plants. Southern and Western blotting. PCR technique. Role of *Agrobacterium* in plant genetic engineering.

Unit IV

Importance and application areas: biomass production - food (single cell proteins); bio-fertilizers. Environmental Biotechnology: Waste treatment - solid (compost), Liquid (industrial effluents), sewage treatment (domestic sewage).

Unit V

Bioinformatics: History, scope and applications. Types of biological databases. Nucleic acid databases - Genbank, NCBI, EMBL, DDBJ; Primary protein databases - SWISSPROT, TrEMBL; Secondary protein databases - PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases - SCOP, CATH; Literature databases - PubMed, Medline.

BOOKS:

1. Arthur, M.L. (2005). *Introduction to Bioinformatics* (Ed:2). Oxford University Press, NewYork.
2. Attwood, T.K. and Parrysmith, D.J. (2001). *Introduction to Bioinformatics*. Pearson Education, NewDelhi.
3. Chatterji, A.K. (2011). *Introduction to Environmental Biotechnology*. Prentice Hall India Pvt., Ltd., NewDelhi.
4. Dubey, R.C. (2013). *A Textbook of Biotechnology*. S. Chand &Company Ltd., NewDelhi.
5. Gupta, P.K. (1994). *Elements of Biotechnology*. Restogi Publications, Meerut.
6. Ignacimuthu, S. (1997). *Plant Biotechnology*. Oxford & IBM PublishingCo., NewDelhi.
7. Kalyan Kumar De. (1997). *Plant Tissue culture*. New central Book Agency, Calcutta.
8. Kumar, H.D. (1991). *A Textbook on Biotechnology*. East west press, New Delhi.
9. Parihar, P. (2014). *A Textbook of Biotechnology*. Argobios Publications, Jodhpur
10. Purohit, S.S. (2003). *Agricultural Biotechnology*. Argobios Publications, Joshpur.
11. Trevan, M.D., Boffey, S., Goulding, K.H. and Stanbury, P.(1988). *Biotechnology – The Biological Principles*. Tata McGraw Hill Publishing Co., NewDelhi.

Course Outcomes:-

1. To know the various techniques of Biotechnology – Tissue culture, Plasmids and Genetic Engineering.
2. To know the importance and application areas – Biomass production, Bio-Fertilizers, Waste treatment and sewage treatments.
3. To mention about the scope, applications of Bioinformatics and types of biological nucleic acid and secondary protein databases.
