

**DEPARTMENT OF BOTANY  
BCM COLLEGE , KOTTAYAM**

**BOARD OF STUDIES:**

**1. DR. DENNIS THOMAS T.**

**( FORMER DEAN AND PRESENT HEAD OF CENTRAL UNIVERSITY, KASARGOD)**

**2. DR. SUNNICHEN V.G.**

**(FORMER PRINCIPAL SCIENTIST , HOME GROWN , VIZHIKATHODU)**

**3. DR. PETER K. MANI**

**(HEAD OF THE DEPARTMENT OF BOTANY, B.C.M COLLEGE)**

| GPO No. | Graduate Programme Outcomes  |
|---------|--|
| GPO 1   | <p><b>Disciplinary knowledge and critical thinking:</b><br/>           Articulate knowledge of one or more disciplines that form a part of UG Programme. critically think , analyse , apply and evaluate various information and follow scientific approach to the development of knowledge.</p> |
| GPO 2   | <p><b>Communication skill:</b><br/>           communicate thoughts and ideas clearly in writing and orally. Develop careful listening , logical thinking and proficiency in interpersonal communication.</p>   |
| GPO 3   | <p><b>Environmental awareness:</b><br/>           sustainable approach to the use of natural resources . Capable of addressing issues , promoting values and give up practices that harm the ecosystem and our planet.</p>   |
| GPO 4   | <p><b>Ethical Awareness:</b><br/>           Uphold ethics or morals in all spheres of life. identify and avoid unethical behaviour in all aspects of work.</p>   |
| GPO 5   | <p><b>Social Commitment:</b><br/>           Be aware of individual roles in society as nation builders , contributib=ng to the betterment of society . Foster social skills to value fellow beings and be aware of ones responsibilities as international citizens.</p>                          |
| GPO 6   | <p><b>Lifelong learners:</b><br/>           Equip students to be life long learners. Be flexible to take u[p the changing demands of work place as well as for personal spheres of activities.</p>   |

| PSO No. | Programme Specific Outcomes(PSO)  | GPO                       |
|---------|---|---------------------------|
| PSO1    | Understand the universal nature of plant science, exemplify different types of classification in living kingdom, and develop basic skills to study Botany. Understand the world of microorganisms and adaptive strategies. Discuss the economic and pathologic importance of microorganisms.  | GPO 1                     |
| PSO2    | Summarize the evolutionary importance of Algae and Bryophytes. Illustrate the external morphology, internal structure and reproduction of different types of Bryophytes and Algae. Apply Phycology in different fields. Extrapolate current development in the field of Biotechnology and Bioinformatics. Instantiate students in micropropagation techniques. Carry out DNA isolation.   | GPO 1                     |
| PSO3    | Interpolate the diversity in habit, habitat and organization of different groups of plants. Remember the modern classification in lower forms of plants. Understand the evolutionary trends in Pteridophytes and Gymnosperms. Understand the significance of Palaeobotany. Understand the anatomy and structural adaptations of Angiosperms. Instantiate the morphology and development of reproductive parts in Angiosperms. Identify the reproductive structures in Angiosperms.  | GPO 1                     |
| PSO4    | Implement students to conduct independent research and prepare research reports. Illustrate different tools and techniques used in research work. Discuss basic computer skills necessary for research. Generalize students to have enough numerical skills for research. Understand plants with immense economic importance. Clarify floral features of different Angiosperms. Identify the common species of plants growing in Kerala and their systematic position. Understand the scope and significance of Ethnobotany and different plants used in daily life by tribals.   | GPO 1,<br>GPO 5           |
| PSO5    | Subsume an insight into the principles of heredity. Illustrate the methods of crop improvement. Discuss the importance of horticulture. Execute the skills in gardening. Analysis of pedigree. Compute allelic frequencies. Calculate recombination frequencies and determination of map distances. Understand the ultra-structure and functioning of cell in sub microscopic and molecular level. Identify different stages of Mitosis and calculate Mitotic index. Identify and study the chromosomal anomalies. Abstract cytological aspects of growth and development. Carry out elementary problems on DNA structure, replication, transcription and Genetic code  | GPO 1,<br>GPO 6           |
| PSO6    | Describe basic skills and techniques related to plant physiology. Illustrate basic knowledge about plant functioning. Interpolate role, structure and importance of biomolecules in plant life. Abstract the significance of environmental science. Exemplify about the extent of the total biodiversity and the importance of their conservation. Discuss various kinds of pollution in the environment and their control measures. Monitor about various environmental laws in India and the role of various movements in the protection of nature. Understand basic human rights. Determine CO <sub>2</sub> , Cl and alkalinity of water samples. Calculation of pH of soil and water samples. Calculate abundance and frequency of plant species by quadrature methods. | GPO 3,<br>GPO 5,<br>GPO 6 |
| PSO7    | Understand the business opportunities in the field of Plant Science. Recognize different types of ornamental gardening, nursery management and mushroom cultivation. Generalize sustainable agriculture and organic farming.  | GPO 6                     |



# **CO- ODD SEMESTERS**



**COURSE CODE: BO1CRT01      COURSE TITLE: METHODOLOGY OF SCIENCE AND AN INTRODUCTION TO BOTANY**

**CREDITS: 2+1**

|               |                                  |
|---------------|----------------------------------|
| Programme     | B.Sc. Botany                     |
| Semester      | I                                |
| Course type   | CORE                             |
| Instructor(s) | VANDANA P NAIR, DR. PETER K MANI |

| CO | Course outcomes  | CL | PSO  |
|----|--|----|------|
| 1. | Understand the universal nature of plant science   | U  | PSO1 |
| 2. | Exemplify different types of classification in living kingdom                              | U  | PSO1 |
| 3. | Interpolate the diversity in habit, habitat and organization of different groups of plants | U  | PSO3 |
| 4. | organize basic skills to study Botany  | A  | PSO1 |

**COURSE CODE: BO3CRT03      COURSE TITLE: PHYCOLOGY AND BRYOLOGY      CREDITS:3+1**

|               |                                    |
|---------------|------------------------------------|
| Programme     | B.Sc. Botany                       |
| Semester      | III                                |
| Course type   | Core                               |
| Instructor(s) | ANTU MARIYA JOOSE, ARCHANA G. NAIR |

| CO | Course outcomes  | CL | PSO   |
|----|--|----|-------|
| 1. | Understand the evolutionary importance of algae as progenitors of land plants.                                   | U  | PSO 2 |
| 2. | Exemplify the unique and general features of algae and Bryophytes and familiarize it.                            | U  | PSO 2 |
| 3. | Analyze the external morphology, internal structure and reproduction of different types of Algae and Bryophytes. | A  | PSO 2 |
| 4. | Implementing Phycology in different fields.  | AP | PSO 2 |
| 5. | Organize a field visit to any one of the ecosystems rich in Algae to experience Algal diversity.                 | A  | PSO 3 |
| 6. | Classify Algae and Bryophytes  | U  | PSO 2 |
| 7. | Recognize the economic importance of Algae and Bryophytes  | R  | PSO 2 |

| Module     | Course description  | Hrs       | CO |
|------------|---|-----------|----|
|            | <b>PHYCOLOGY</b>  |           |    |
| <b>1.0</b> | <b>Introduction to Phycology and classification of Algae</b>  | <b>9</b>  |    |
| <b>1.1</b> | Introduction: general characters, habitat diversity   | <b>1</b>  |    |
| <b>1.2</b> | range of thallus structure and pigments in algae; structure of algal flagella.  | <b>2</b>  |    |
| <b>1.3</b> | Different types of life cycle and alternation of generations in algae.  | <b>3</b>  |    |
| <b>1.4</b> | Classification: by Fritsch (1945)   | <b>2</b>  |    |
| <b>1.0</b> | brief introduction to the modern classification by Lee (2009) [up to divisions].  | <b>1</b>  |    |
| <b>2.0</b> | <b>Type study</b>   | <b>18</b> |    |
| <b>2.1</b> | Salient features, thallus structure and reproduction of algae in the following groups with special reference to the type(s) mentioned: Cyanophyceae – <i>Nostoc</i> | <b>5</b>  |    |
| <b>2.2</b> | Chlorophyceae - <i>Volvox</i> , <i>Oedogonium</i> , <i>Cladophora</i> , <i>Chara</i>  | <b>3</b>  |    |
| <b>2.3</b> | Xanthophyceae – <i>Vaucheria</i>  | <b>2</b>  |    |
| <b>2.4</b> | Bacillariophyceae – <i>Pinnularia</i>   | <b>2</b>  |    |
| <b>2.5</b> | Phaeophyceae – <i>Ectocarpus</i> , <i>Sargassum</i>   | <b>4</b>  |    |
| <b>2.6</b> | Rhodophyceae - <i>Polysiphonia</i>  | <b>2</b>  |    |
| <b>3.0</b> | <b>Artificial culture and economic importance of Algae</b>  | <b>9</b>  |    |
| <b>3.1</b> | Algal culture: isolation, cultivation and preservation of micro- and macro-algae.   | <b>2</b>  |    |
| <b>3.2</b> | Economic importance of algae: algae as food, SCP, fodder, green manure, role in N <sub>2</sub> fixation, medicine and biofuels.                                     | <b>2</b>  |    |
| <b>3.3</b> | Commercial products from Algae - carrageenin, agar-agar, alginates and diatomaceous earth.  | <b>1</b>  |    |
| <b>3.4</b> | Role of algae in pollution studies: as indicators of pollution and as bioremediation agents.  | <b>2</b>  |    |
| <b>3.5</b> | Eutrophication – algal bloom; harmful and toxic algal blooms – neurotoxins and parasitic algae.   | <b>2</b>  |    |



|             |   |           |  |
|-------------|---|-----------|--|
|             | <b>BRYOLOGY</b>   | <b>18</b> |  |
| <b>4.0</b>  | <b>General introduction and classification of bryophytes</b>  | <b>4</b>  |  |
| <b>4.1</b>  | Introduction, general characters and classification of bryophytes by Rothmaler (1951)   | 2         |  |
| <b>4.2</b>  | a very brief account of systems and classifications by Goffinet <i>et al</i> (2008).  | 2         |  |
| <b>5.0</b>  | <b>Type study</b>   | <b>13</b> |  |
| <b>5.1</b>  | Distribution, morphology, anatomy, reproduction and life cycle of the following types (developmental details are not required): Hepaticopsida - <i>Riccia</i> , <i>Marchantia</i> | 5         |  |
| <b>5.2</b>  | Anthocerotopsida - <i>Anthoceros</i>  | 3         |  |
| <b>5.3</b>  | Bryopsida – <i>Funaria</i>  | 3         |  |
| <b>5.41</b> | Evolution of gametophyte and sporophyte among Bryophytes  | 2         |  |
| <b>6.0</b>  | <b>Economic importance</b>  | <b>2</b>  |  |
| <b>6.1</b>  | Economic importance of Bryophytes – biological, ecological, medicinal and as potting material.  | F         |  |

COURSE CODE: BO5CRT05

**COURSE TITLE: ANATOMY REPRODUCTIVE BOTANY AND  
MICROTECHNIQUE**

CREDITS:3+1

|               |                  |
|---------------|------------------|
| Programme     | B.Sc. Botany     |
| Semester      | V                |
| Course type   | Core             |
| Instructor(s) | DR. PETER K MANI |

| CO | Course outcomes  | CL | PSO   |
|----|--|----|-------|
| 1  | Understand the individual cells, tissues and structural details in plants                    | U  | PSO 3 |
| 2. | Instantiate the knowledge of organization of tissues and anatomy of wood.                    | U  | PSO 3 |
| 3. | Recall fruit and seed development.   | A  | PSO 3 |
| 4. | Understand the morphology and development of reproductive parts                              | U  | PSO 3 |
| 5. | Interpolate the structural details of female and male reproductive parts with fertilization. | U  | PSO 3 |
| 6. | Understand the details of preservation of plant specimens.                                   | U  | PSO 3 |
| 7. | Extend the data of Microtechnique for practical knowledge.                                   | A  | PSO 3 |

| Module     | Course description   | Hrs       | CO |
|------------|--|-----------|----|
|            | <b>ANATOMY</b>   | <b>27</b> |    |
| <b>1.0</b> | <b>Structure and composition of plant cells</b>  | <b>8</b>  |    |
| 1.1        | Cell wall-Structure of cell wall, sub-microscopic structure of cellulose, micelle, microfibril and macro fibril.               | 2         | 1  |
| 1.2        | Structure and function of plasmodesmata  | 1         | 1  |
| 1.3        | Simple and bordered pits; different types of cell wall thickening in treachery elements; extra cell wall thickening materials. | 2         | 1  |
| 1.4        | Growth of cell wall -apposition, intussusception.  | 1         | 1  |

|            |  |           |     |
|------------|--|-----------|-----|
|            | Non-living inclusions in plant cells: food products, secretory products, excretory (waste) products - nitrogenous and non nitrogenous.   | 2         | 1   |
| <b>2.0</b> | <b>Organization of tissues</b>   | <b>9</b>  |     |
| 2.1        | Tissues: meristematic tissue – characteristic features, functions and classification.  | 2         | 1,2 |
| <b>2.2</b> | Theories on apical organization - apical cell theory, histogen theory, tunica-corpus theory.   | 1         | 1,2 |
| <b>2.3</b> | Permanent tissues - structure and function of simple and complex tissues.  | 1         | 1,2 |
| <b>2.4</b> | Secretory tissues: external secretory tissue - glands and nectaries; internal secretory tissues - laticifers.  | 1         | 2   |
| <b>2.5</b> | Tissue systems: epidermal tissue system - epidermis, cuticle, trichome. Stomata – structure, types; bulliform cells.   | 1         | 2   |
| <b>2.6</b> | Ground tissue system - cortex, endodermis, pericycle, pith and pith rays.  | 1         | 1,2 |
| <b>2.7</b> | Vascular tissue system - structure of xylem and phloem, different types of vascular bundles and their arrangement in root and stem.  | 2         | 1,2 |
| <b>3.0</b> | <b>Plant body structure</b>  | <b>6</b>  |     |
| <b>3.1</b> | Primary structure of stem, root and leaf (dicot and monocot).  | 1         | 1,2 |
| <b>3.2</b> | Normal secondary growth in dicot stem and root.  | 2         | 1,2 |
| <b>3.3</b> | Periderm: structure and development - phellum, phellogen, phelloderm, bark, and lenticels.   | 2         | 2   |
| <b>3.4</b> | Anomalous secondary thickening: <i>Bignonia</i> stem, <i>Boerhaavia</i> stem and <i>Dracaena</i> stem.   | 3         | 1,2 |
| <b>4.0</b> | <b>Wood anatomy</b>  | <b>4</b>  |     |
| 4.1        | Basic structure of wood - heart wood, sap wood; hard wood, soft wood; growth rings and dendrochronology; porous and non-porous wood; ring porous and diffuse porous wood, tyloses. | 3         | 1,2 |
| 4.2        | Reaction wood: tension wood and compression wood.  | 1         | 2   |
|            | <b>REPRODUCTIVE BOTANY</b>   | <b>18</b> |     |
| <b>5.0</b> | <b>Introduction</b>  | <b>2</b>  |     |
| 5.1        | Introduction to embryology, floral morphology - parts of flower  | 2         | 4   |
| <b>6.0</b> | <b>Microsporangium and male gametophyte</b>  | <b>4</b>  |     |

|             |  |          |          |
|-------------|--|----------|----------|
| 6.1         | Microsporangium: structure and development of anther, microsporogenesis, dehiscence of anther, structure of pollen.  | 3        | 4        |
| 6.2         | Male gametophyte development.  | 1        | 4        |
| <b>7.0</b>  | <b>Megasporangium and female gametophyte</b>   | <b>6</b> |          |
| 7.1         | Megasporangium: types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous.  | 3        | 4        |
| 7.2         | Megasporogenesis – female gametophyte – structure of a typical embryo sac, types of embryo sacs - monosporic ( <i>Polygonum</i> type), bisporic ( <i>Allium</i> type) and tetrasporic ( <i>Peperomia</i> type).            | 3        | 4        |
| <b>8.0</b>  | <b>Fertilization</b>   | <b>2</b> | <b>5</b> |
| 8.1         | Mechanism of pollination, agents of pollination, germination of pollen grains; double fertilization.   | 2        | 5        |
| <b>9.0</b>  | <b>Endosperm and embryo</b>  | <b>4</b> | <b>5</b> |
| 9.1         | Endosperm: types – cellular, nuclear and helobial.   | 1        | 5        |
| 9.2         | Embryogeny, structure of dicot and monocot embryo, seed formation. Polyembryony.   | 3        | 5        |
|             | <b>MICROTECHNIQUE</b>  |          |          |
| <b>1.10</b> | <b>Preservation of plant specimens, sectioning and mounting</b>  | <b>9</b> | <b>6</b> |
| 1.11        | Introduction to microtechnique: killing and fixing - purpose.  | 2        | 6        |
| 1.12        | Dehydration - purpose, agents used - ethyl alcohol.  | 1        | 6        |
| 1.13        | Sectioning: hand sections, serial section; Microtome - rotary, sledge (application only).  | 2        | 6        |
| 1.14        | Staining technique: principle of staining; stains - hematoxylin, fast green, acetocarmine; vital stains - neutral red, Evans blue; mordants - purpose with examples. Types of staining - single staining, double staining. | 2        | 6        |
| 1.15        | Mounting and mounting media – purpose, mounting media - glycerine, DPX, Canada balsam. Use of permanent whole mounts; permanent sections; maceration, smear and squash preparation.  |          | 6        |
|             |  | 2        | 6        |

COURSE CODE: BO5CRT08      COURSE TITLE: **ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS**  
 CREDITS:3+1

|               |                  |
|---------------|------------------|
| Programme     | B.Sc. Botany     |
| Semester      | V                |
| Course type   | CORE             |
| Instructor(s) | ANTU MARIYA JOSE |

| CO | Course outcomes  | CL | PSO  |
|----|--|----|------|
| 1. | Understand the significance of Environmental Science   | U  | PSO6 |
| 2. | Illustrate the structure and function of ecosystems and instantiate novel mechanisms for sustainable utilization of natural resources.   | U  | PSO6 |
| 3. | Understand about energy flow, biogeochemical cycles and development of ecosystems. Exemplify the extend of total biodiversity and the importance of their conservation.            | U  | PSO6 |
| 4. | Categorize various kinds of pollution, their impacts and control measures.   | U  | PSO6 |
| 5. | Determine CO <sub>2</sub> , Cl and alkalinity of water samples, Calculation of pH of soil and water samples. Calculate abundance and frequency of plant species by quadrat methods | AP | PSO6 |
| 6. | Summarize about various environmental laws in India and the role of various movements in the protection of nature and natural resources  | U  | PSO6 |
| 7. | Understand basic human rights  | U  | PSO6 |

| Module     | Course description   | Hrs       | CO       |
|------------|--|-----------|----------|
|            | <b>ENVIRONMENTAL SCIENCE</b>   |           |          |
| <b>1.0</b> | <b>Introduction to Ecology</b>   | <b>10</b> | <b>1</b> |
| 1.1        | Introduction, definition scope and relevance and sub divisions of ecology  | 1         | 1        |
| 1.2        | Population ecology: population size, density, natality, mortality, age, rate of natural increase, growth forms and carrying capacity.  | 1         | 1        |
| 1.3        | Population interactions between species- competition, parasitism, predation, commensalism, mutualism, neutralism.  | 1         | 1        |
| 1.4        | Community concept, biotic community, species diversity, species richness, dominance: growth forms and structure, trophic structure, ecotone, edge effect, habitat, ecological niche, microclimate, ecological indicators and keystone species. | 2         | 1        |
| 1.5        | Structure and function of ecosystems, ecosystem components- abiotic and biotic, productivity- primary and secondary- gross and net productivity, homeostasis in the ecosystems   | 1         | 2        |
| 1.6        | Energy flow , food chain, food web, trophic levels, trophic structure, and ecological pyramids( pyramid of number, energy and biomass)   | 1         | 3        |
| 1.7        | Biogeochemical cycles( carbon and nitrogen cycle)  | 1         | 3        |
| 1.8        | Ecosystem development- ecological succession, process, climax community, hydrosere and xerosere.   | 2         | 3        |
| <b>2.0</b> | <b>Biodiversity and its conservation</b>   | <b>8</b>  | <b>3</b> |
| 2.1        | Biodiversity: definition, types, examples – endemism - hot spots; hot spots in India - Western Ghats as hot spot. Wetlands and their importance. Biodiversity loss - IUCN threat categories, Red data book.                                    | 2         | 3        |
| 2.2        | Causes and rate of biodiversity loss - extinction, causes of extinction. Conservation: methods - <i>in-situ</i> , <i>ex-situ</i> .   | 2         | 3        |
| 2.3        | Joint Forest management – people’s participation in biodiversity conservation: community reserve, eg. Kadalundi-vallikkunnu.   | 2         | 3        |
| 2.4        | Remote sensing and GIS: introduction, principle, application of remote sensing and GIS in environmental studies and biodiversity conservation, Ecotourism: ecotourism centers in Kerala - Thenmala and Thattekkad WLS.                         | 2         | 3        |
| <b>3.0</b> | <b>Environmental pollution</b>   | <b>10</b> | <b>4</b> |

|            |  |           |          |
|------------|--|-----------|----------|
| 3.1        | Environmental pollution - introduction, definition; Air pollution - air pollutants, types, sources, effect of air pollution on plants and humans, control measures   | 2         | 4        |
| 3.2        | Water pollution – common pollutants, sources, impact, control measures; water quality standards - DO and BOD, eutrophication.  | 2         | 4        |
| 3.3        | Soil Pollution - causes, sources, solid waste, biodegradable, non-biodegradable,   | 2         | 4        |
| 3.4        | Management of solid waste, composting, e – waste.  | 2         | 4        |
| 3.5        | Environmental issues - global warming, greenhouse effect, climate change - causes and impact, ozone layer depletion. Carbon sequestration.   | 2         | 4        |
| <b>4.0</b> | <b>Conservation of nature</b>  | <b>10</b> | <b>6</b> |
| 4.1        | Global conservation efforts - Rio Earth summit - Agenda 21, Kyoto protocol, COP15 (15 <sup>th</sup> Conference of the parties under the UN framework convention on climate change) and Paris protocol, major contributions. Conservation strategies and efforts in India and Kerala. | 4         | 6        |
| 4.2        | Organizations, movements- WWF, Chipko, NEERI   | 1         | 6        |
| 4.3        | Contributors - Salim Ali, Sunder Lal Bahuguna, Madhav Gadgil, Anil Agarwal, Medha Patkar, Vandana Siva   | 2         | 6        |
| 4.4        | Environmental Legislation and Laws: Environment (protection) Act 1986, Air (protection and control of pollution) act, 1981 Water (protection and control of pollution) Act, 1974, Wildlife (protection) Act, 1972, Forest (conservation) Act, 1980, Biological Diversity Act (2002)  | 3         | 6        |
|            | <b>HUMAN RIGHTS</b>  | <b>18</b> | <b>7</b> |
| <b>5.0</b> | <b>Introduction to Human Rights.</b>   | <b>5</b>  | <b>7</b> |
| 5.1        | Introduction, meaning, concept and development- history of Human Rights – different generations of Human Rights.   | 2         | 7        |
| 5.2        | Universality of Human Rights- Basic international Human Rights documents- UDHR, ICCPR, ICESCR, Value and dimensions of Human Rights.   | 3         | 7        |
| <b>6.0</b> | <b>Human Rights and united nations</b>   | <b>7</b>  | <b>7</b> |
| 6.1        | Human Rights co-ordination within UN systems- Role of human secretariat- The economic and social council, The commission of Human Rights.  | 3         | 7        |
| 6.2        | The security council and Human rights, the committee on the elimination of racial discrimination, the committee on economic, social and cultural rights.   | 2         | 7        |

|            |   |          |          |
|------------|---|----------|----------|
| 6.3        | The Human rights committee- critical appraisal of UN Human Rights Regime.   | 2        | 7        |
| <b>7.0</b> | <b>Human Rights National Perspective</b>  | <b>6</b> | <b>7</b> |
| 7.1        | Human Rights in Indian constitution- Fundamental rights, The constitutional context of Human Rights- directive principles of state policy and Human Rights. | 1        | 7        |
| 7.2        | Human rights of Women, Children, Minorities, Prisoners.   | 3        | 7        |
| 7.3        | Science technology and Human Rights, National Human rights commission, State human rights commission, Human rights awareness in education                   | 2        | 7        |



COURSE CODE: BO5CRT07      COURSE TITLE: **PLANT PHYSIOLOGY AND BIOCHEMISTRY**  
 CREDITS:3+1

|               |                 |
|---------------|-----------------|
| Programme     | B.Sc. Botany    |
| Semester      | V               |
| Course type   | CORE            |
| Instructor(s) | ARCHANA G. NAIR |

| CO | Course outcomes  | CL | PSO   |
|----|--|----|-------|
| 1. | Understand plant water relations.  | U  | PSO 6 |
| 2. | Recognize the role of nutrients in plant life. Remember the concept of photosynthesis.   | R  | PSO 6 |
| 3. | Compare and differentiate photosystems, photosynthetic cycles, photo- and oxidative phosphorylation. Understand electron transport chains in photosynthesis and respiration. | U  | PSO 6 |
| 4. | Understand plant growth and development and stress physiology. Compare stomatal indices of hydrophytes, mesophytes and xerophytes.   | U  | PSO 6 |
| 5. | Carry out separation of plant pigments. Estimate plant pigments by colorimeter.  | AP | PSO 6 |
| 6. | Understand the role , structure and importance of biomolecules.  | U  | PSO 6 |
| 7. | Estimate proteins using colorimeter.   | AP | PSO 6 |

| Module     | Course description   | Hrs       | CO       |
|------------|--|-----------|----------|
|            | <b>PLANT PHYSIOLOGY</b>  |           |          |
| <b>1.0</b> | <b>Water relations</b>   | <b>6</b>  | <b>1</b> |
| 1.1        | Plant water relations-diffusion, imbibition, osmosis, OP, DPD, TP  | 1         | 1        |
| 1.2        | Water potential - concepts and components (pressure potential, gravity potential, osmotic potential and matric potential)  | 1         | 1        |
| 1.3        | Absorption of water - active and passive, pathway of water movement - apoplastic and symplastic pathway.   | 2         | 1        |
| 1.4        | Ascent of sap - cohesion-tension theory. Transpiration - types, mechanism, theories (Starch-sugar, Proton-K <sup>+</sup> ion exchange), significance; antitranspirants. Guttation. | 2         | 1        |
| <b>2.0</b> | <b>Mineral nutrition</b>   | <b>3</b>  | <b>2</b> |
| 2.1        | Role of major and minor elements in plant nutrition, deficiency symptoms of essential nutrients  | 2         | 2        |
| 2.2        | Mineral uptake - passive (ion exchange) and active (carrier concept)   | 1         | 2        |
| <b>3.0</b> | <b>Photosynthesis</b>  | <b>12</b> | <b>3</b> |
| 3.1        | Photosynthetic pigments  | 1         | 3        |
| 3.2        | Photo excitation - fluorescence, phosphorescence; red drop and Emerson enhancement effect  | 2         | 3        |
| 3.3        | Photosystems - components and organization   | 1         | 3        |
| 3.4        | Cyclic and non-cyclic photophosphorylation   | 2         | 3        |
| 3.5        | Carbon assimilation pathways - C <sub>3</sub> , C <sub>4</sub> plants - Kranz anatomy, CAM.  | 2         | 3        |
| 3.6        | Photorespiration. Factors affecting photosynthesis - Blackmann's law of limiting factors.  | 1         | 3        |
| 3.7        | Translocation of solutes: pathway of phloem transport, mechanism - pressure flow, mass flow hypothesis   | 2         | 3        |
| 3.8        | Phloem loading and unloading   | 1         | 3        |
| <b>4.0</b> | <b>Respiration</b>   | <b>8</b>  | <b>3</b> |
| 4.1        | Respiration: anaerobic and aerobic   | 2         | 3        |
| 4.2        | Glycolysis, Krebs's cycle  | 2         | 3        |

|            |   |           |          |
|------------|---|-----------|----------|
| 4.3        | Mitochondrial electron transport system – components  | 1         | 3        |
| 4.4        | Oxidative phosphorylation, ATPase   | 1         | 3        |
| 4.5        | Chemiosmotic hypothesis. RQ - significance.   | 1         | 3        |
| 4.6        | Factors affecting respiration.  | 1         | 3        |
| <b>5.0</b> | <b>Plant growth and development</b>   | <b>5</b>  | <b>4</b> |
| 5.1        | Plant hormones: their physiological effect and practical applications - auxins, gibberellins, cytokinins, ABA, and ethylene | 1         | 4        |
| 5.2        | Plant movements: tropic movements - geotropism and phototropism   | 1         | 4        |
| 5.3        | Nastic movements - seismonastic and nyctinastic movements   | 1         | 4        |
| 5.4        | Physiology of flowering - phytochrome   | 1         | 4        |
| 5.5        | Photoperiodism, vernalization   | 1         | 4        |
| <b>6.0</b> | <b>Stress physiology</b>  | <b>2</b>  | <b>4</b> |
| 6.1        | Concepts of plant responses to abiotic stresses (water, salt, temperature), biotic stress (pathogens).                      |           | 4        |
| 6.2        | Allelopathy   |           | 4        |
|            |   |           |          |
|            |   |           |          |
|            | <b>BIOCHEMISTRY</b>   | <b>18</b> | <b>6</b> |
| <b>7.0</b> | <b>Water</b>  | <b>3</b>  | <b>6</b> |
| 7.1        | Physical and chemical properties of water   | 1         | 6        |
| 7.2        | Acids and bases; pH - definition, significance;   | 1         | 6        |
| 7.3        | Measurement of pH – colorimetric, electrometric . Buffers: buffer action, uses of buffers.                                  | 1         | 6        |
| <b>8.0</b> | <b>Carbohydrates</b>  | <b>3</b>  | <b>6</b> |
| 8.1        | General structure and functions   | 1         | 6        |
| 8.2        | Classification - mono (glucose and fructose), di (maltose and sucrose) and polysaccharides (starch and cellulose).          | 2         | 6        |
| <b>9.0</b> | <b>Proteins</b>   | <b>4</b>  | <b>6</b> |
| 9.1        | General structure and classification of amino acids - peptide bond  | 1         | 6        |

|             |  |          |          |
|-------------|--|----------|----------|
| 9.2         | structural levels of proteins - primary, secondary, tertiary and quaternary  | 2        | 6        |
| 9.3         | Functions of proteins.   | 1        | 6        |
| <b>10.0</b> | <b>Lipids</b>  | <b>2</b> | <b>6</b> |
| 10.1        | General features and roles of lipids   | 1        | 6        |
| 10.2        | Types of lipids; fatty acids - saturated and unsaturated, fatty acid derivatives - fats and oils, compound lipids (brief study only) | 1        | 6        |
| <b>11.0</b> | <b>Enzymes</b>   | <b>6</b> | <b>6</b> |
| 11.1        | Classification and nomenclature  | 1        | 6        |
| 11.2        | Mechanism of action.   | 1        | 6        |
| 11.3        | Enzyme kinetics.   | 1        | 6        |
| 11.4        | Michaelis-Menten constant (brief study only)   | 1        | 6        |
| 11.5        | Regulation of enzyme action  | 1        | 6        |
| 11.6        | Factors affecting enzyme action  | 1        | 6        |
|             |  | 1        | 6        |
|             |  |          |          |
|             |  |          |          |

COURSE CODE: BO5CRT06  
**BIOSTATISTICS**

COURSE TITLE: **RESEARCH METHODOLOGY, BIOPHYSICS AND**

CREDITS:3+1

|               |                |
|---------------|----------------|
| Programme     | B.Sc. Botany   |
| Semester      | V              |
| Course type   | CORE           |
| Instructor(s) | VANDANA P NAIR |

| CO | Course outcomes  | CL | PSO  |
|----|--|----|------|
| 1) | Implement students to conduct independent research and prepare research reports.   | AP | PSO4 |
| 2) | Illustrate different tools and techniques used in research work                    | U  | PSO4 |
| 3) | Discuss basic computer skills necessary for research                               | U  | PSO4 |
| 4) | Generalize students to have enough numerical skills for research                   | U  | PSO4 |
| 5) | Implement students to learn and practice the literature survey aspects of projects | AP | PSO4 |
| 6) | Understand the general principles of statistical inference                         | U  | PSO4 |
| 7) | Produce researchable hypothesis  | C  | PSO4 |

| Module     | Course description  | Hrs       | CO       |
|------------|---|-----------|----------|
|            | <b>Research methodology</b>   | <b>18</b> |          |
| <b>1.0</b> | <b>Introduction</b>   | <b>4</b>  | <b>1</b> |
| 1.1        | Objectives of research. Types of research - pure and applied.   | 1         | 1        |
| 1.2        | Identification of research problem.   | 1         | 1        |
| 1.3        | Review of literature: purpose, literature sources – names of reputed National and International journals in life science (2 international & 3 national) | 1         | 1        |
| 1.4        | Reprint acquisition - INSDOC, INFLIBNET.  | 1         | 1        |
| <b>2.0</b> | <b>Process of research</b>  | <b>7</b>  | <b>5</b> |
| 2.1        | Conducting research: define the problem, identify the objective, design the study, collection of data, analysis and interpretation                      | 2         | 5        |
| 2.2        | Preparation of research report  | 2         | 5        |

|            |  |           |          |
|------------|--|-----------|----------|
| 2.3        | preparation of dissertation - IMRAD system - preliminary pages   | 1         | 7        |
| 2.4        | introduction and review of literature, materials and methods, results  | 1         | 7        |
| 2.5        | Discussion, conclusion and bibliography.   | 1         | 7        |
| <b>3.0</b> | <b>Use of computer in research</b>   | <b>7</b>  | <b>3</b> |
| 3.1        | Introduction to MS - WINDOWS and LINUX, application of MS WORD - word Processing, editing tools (cut, copy, paste), formatting tools.  | 2         | <b>3</b> |
| 3.2        | MS EXCEL - creating worksheet, data entry, sorting data. Statistical tools (SUM, MEAN, MEDIAN and MODE). Preparation of graphs and diagrams (Bar diagram, pie chart, line chart, histogram). MS-POWERPOINT - presentation based on a biological topic; inserting tables, charts, pictures. | 2         | <b>3</b> |
| 3.3        | Open source and free alternatives to MS Office: Libre Office, Open Office  | 1         | <b>3</b> |
| 3.4        | Search engines: Google.com; meta search engine – dogpile.com; academic search - Google scholar.  | 1         | <b>3</b> |
| 3.5        | Educational sites related to biological science - Scitable, DNAi.  | 1         | <b>3</b> |
|            | <b>BIOPHYSICS</b>  |           | <b>2</b> |
| 4.0        | <b>Introduction</b>  | 2         | <b>2</b> |
| 4.1        | Introduction to biophysics; branches of biophysics - molecular, cellular, membrane and biomedical instrumentation  | 2         | <b>2</b> |
| <b>5.0</b> | <b>Biophysical instrumentation</b>   | <b>16</b> | <b>2</b> |
| 5.1        | Microscopy: compound microscope (Principle, working and applications)  | 2         | <b>2</b> |
| 5.2        | Phase-contrast microscope (Principle, working and applications)  | 2         | <b>2</b> |
| 5.3        | Electron microscope – SEM (Principle, working and applications)  | 2         | <b>2</b> |
| 5.4        | Colorimeter, spectrophotometer(Principle, working and applications)  | 2         | <b>2</b> |
| 5.5        | Centrifuge: ultracentrifuge(Principle, working and applications)   | 2         | <b>2</b> |
| 5.6        | Chromatography: paper, thin layer and column. (Principle, working and applications)  | 2         | <b>2</b> |
| 5.7        | Electrophoresis, PAGE. (Principle, working and applications)   | 2         | <b>2</b> |
| 5.8        | pH meter. Haemocytometer (Principle, working and applications)   | 2         | <b>2</b> |
|            | <b>BIOSTATISTICS</b>   | <b>18</b> | <b>4</b> |
| 6.0        | <b>Introduction</b>  | 2         | <b>4</b> |

|     |  |   |   |
|-----|--|---|---|
| 6.1 | Introduction, statistical terms and symbols  | 2 | 4 |
| 6.2 | Sampling: concept of sample, sampling methods - random and non-random sampling.                              | 2 | 4 |
| 6.3 | Collection and representation of data  | 2 | 4 |
| 6.4 | Diagrammatic and graphic representation - line diagram, bar diagram, pie diagram, histogram, frequency curve | 2 | 4 |
| 6.5 | Measures of central tendency: mean, median, mode, (discrete and continuous series                            | 2 | 6 |
| 6.6 | Measures of dispersion: standard deviation.  | 2 | 6 |
| 6.7 | Distribution patterns: normal distribution, binomial distribution  | 2 | 6 |
| 6.8 | Tests of significance: Chi-square test - uses, procedure   | 2 | 6 |

COURSE CODE: BO5COPT01

COURSE TITLE: **AGRIBASED MICROENTERPRISES**

CREDITS:3

|               |   |
|---------------|---|
| Programme     | B.Sc. Botany  |
| Semester      | V   |
| Course type   | OPEN COURSE   |
| Instructor(s) | DR. PETER K. MANI, ANTU MARIYA JOSE, ARCHANA G. NAIR, VANDANA P. NAIR |

| CO | Course outcomes   | CL | PSO   |
|----|---|----|-------|
| 1. | Understand the basic opportunities in the field of plant science.                                       | U  | PSO 7 |
| 2. | Instantiate students in micropropagation techniques.  | U  | PSO 2 |
| 3. | Understand food preservation techniques and methods of preparation of wine, vinegar and dairy products. | U  | PSO 7 |
| 4. | Recognize ornamental garden designs, different types of gardens and nurseries.                          | R  | PSO 7 |
| 5. | Carry out mushroom cultivation  | AP | PSO 7 |
| 6. | Generalize sustainable agriculture and organic farming.   | U  | PSO 7 |
| 7. | Express an enthusiasm and awareness about ornamental gardening  | U  | PSO7  |

| Module     | Course description  | Hrs       | CO       |
|------------|---|-----------|----------|
|            | <b>AGRI-BASED MICROENTERPRISES</b>  |           |          |
| <b>1.0</b> | <b>Organic farming and composting techniques</b>  | <b>9</b>  | <b>1</b> |
| 1.1        | Advantages of organic manures and fertilizers. Composition of fertilizers – NPK content of various fertilizers                                    | 2         | 1        |
| 1.2        | Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost.   | 2         | 6        |
| 1.3        | Preparation of compost - aerobic and anaerobic - advantages of both; vermicompost - preparation, vermiwash.                                       | 3         | 6        |
| 1.4        | Biofertilizers: definition, types – <i>Trichoderma</i> , <i>Rhizobium</i> , PGPR. Biopesticides – Tobacco and Neem decoction. Biological control. | 2         | 6        |
| <b>2.0</b> | <b>Horticulture and Nursery management</b>  | <b>18</b> | <b>7</b> |



|            |   |          |          |
|------------|---|----------|----------|
| 2.1        | Soil components. Preparation of potting mixture. Common Garden tools and implements.  | 5        | 7        |
| 2.2        | Methods of plant propagation - by seeds - advantages and disadvantages.   | 3        | 7        |
| 2.3        | Vegetative propagation - advantages and disadvantages. Natural methods of vegetative propagation. Artificial methods - cutting, grafting, budding and layering.                                     | 5        | 7        |
| 2.4        | Use of growth regulators for rooting.   | 1        | 7        |
| 2.5        | Gardening - types of garden - ornamental, indoor garden, kitchen garden, vegetable garden for marketing.  | 4        | 4        |
| <b>3.0</b> | <b>Food spoilage and preservation techniques</b>  | <b>9</b> | <b>3</b> |
| 3.1        | Causes of spoilage.   | 1        | 3        |
| 3.2        | Preservation techniques - asepsis, removal of microorganisms, anaerobic conditions and special methods – by drying, by heat treatment, by low temperature storage and by chemicals (Food Additives) | 4        | 3        |
| 3.3        | Preparation of wine, vinegar and dairy products.  | 4        | 3        |
| <b>4.0</b> | <b>Mushroom cultivation and Spawn production</b>  | <b>9</b> | <b>5</b> |
| 4.1        | Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification.   | 2        | 5        |
| 4.2        | Spawn – isolation and preparation   | 2        | 5        |
| 4.3        | Cultivation milky mushrooms – using paddy straw and saw dust by polybag.  | 3        | 5        |
| 4.4        | Value added products from mushroom – pickles, candies, dried mushrooms.   | 2        | 5        |
| <b>5.0</b> | <b>Plant tissue culture and micropropagation</b>  | <b>9</b> | <b>2</b> |
| 5.1        | Concept of totipotency.   | 1        | 2        |
| 5.2        | Micropropagation: different methods – shoot tip, axillary bud and meristem culture, organogenesis, somatic embryogenesis.   | 2        | 2        |
| 5.3        | Infra structure of a tissue culture laboratory. Solid and liquid media - composition and preparation.   | 1        | 2        |
| 5.4        | Sterilization techniques  | 2        | 2        |
| 5.5        | Explant - inoculation and incubation techniques.  | 1        | 2        |
| 5.6        | Stages of micropropagation – hardening and transplantation. Packaging and transportation of tissue culture regenerated plantlets.   | 2        | 2        |



COURSE CODE: BO1CMT01 COURSE TITLE: **CRYPTOGAMS, GYMNOSPERMS AND PLANT  
PATHOLOGY**CREDITS:2+1

|               |                                   |
|---------------|-----------------------------------|
| Programme     | B.Sc. Botany                      |
| Semester      | I                                 |
| Course type   | COMPLEMENTARY                     |
| Instructor(s) | ANTU MARIYA JOSE, ARCHANA G. NAIR |

| CO | Course outcomes  | CL | PSO   |
|----|--|----|-------|
|    | Understand the diversity of plants.                                      | U  | PSO 3 |
| 1. | Understand the identifying characters of plant types.                    | U  | PSO 3 |
| 1. | Categorize different plant groups based on their identifying characters. | U  | PSO 3 |
| 1. | Understand the economic importance of different forms of plants.         | U  | PSO 3 |
| 1. | Classify plant diseases based on causative organisms and symptoms.       | U  | PSO 3 |

| Module     | Course description   | Hrs       | CO       |
|------------|--|-----------|----------|
| <b>1</b>   | <b>Algae</b>   | <b>13</b> |          |
| 1.1        | General characters of algae and their classification up to classes (F E Fritsch)                                       | 1         | <b>3</b> |
| 1.2        | range of thallus variation in Algae  | 2         | <b>2</b> |
| 1.3        | Reproduction and life history of Cyanophyceae - Nostoc   | 1         | <b>2</b> |
| 1.5        | Reproduction and life history of Chlorophyceae - Oedogonium (Volvox, Spirogyra, Cladophora - vegetative features only) | 3         | <b>2</b> |
| 1.6        | Reproduction and life history of Phaeophyceae – Sargassum  | 2         | <b>2</b> |
| 1.7        | Reproduction and life history of Rhodophyceae – Polysiphonia   | 2         | 2        |
| 1.8        | Economic importance of Algae: food, industry, medicine, biofertilizers; algal bloom.                                   | 2         | 4        |
| <b>2.0</b> | <b>Fungi and lichens</b>   | <b>9</b>  |          |
| 2.1        | General characters and outline on the classification of fungi by Ainsworth.  | 1         | 3        |
| 2.2        | General characters, thallus structure, reproduction and life history of Zygomycotina – Rhizopus                        | 1         | 2        |
| 2.3        | General characters, thallus structure, reproduction and life history of Ascomycetes – Xylaria                          | 1         | 2        |

|            |  |          |   |
|------------|--|----------|---|
| 2.4        | General characters, thallus structure, reproduction and life history of Basidiomycetes – Puccinia                                    | 2        | 2 |
| 2.5        | Economic importance of Fungi: as food, industry, decomposition of organic matter. Fungal toxins and human health.                    | 1        | 4 |
| 2.6        | Lichens: Classification based on thallus morphology.   | 1        | 3 |
| 2.7        | Usnea - morphology and anatomy of vegetative and reproductive structure.   | 1        | 2 |
| 2.8        | Economic importance of lichen: food, industry, medicine.   | 1        | 4 |
| <b>3.0</b> | <b>Bryophytes</b>  | <b>2</b> |   |
| 3.1        | General characters of Bryophytes.  | 1        | 2 |
| 3.2        | Morphology, anatomy, reproduction and life cycle of Riccia.  | 2        | 2 |
| <b>4.0</b> | <b>Pteridophytes</b>   | <b>3</b> |   |
| 4.1        | General characters of Pteridophytes.   | 1        | 2 |
| 4.2        | Morphology, anatomy (stem), reproduction and life cycle of Selaginella.  | 2        | 2 |
| <b>5.0</b> | <b>GYMNOSPERMS</b>   | <b>4</b> |   |
| 5.1        | General characters of Gymnosperms.   | 1        | 2 |
| 5.2        | Morphology, anatomy (leaf let), reproduction and life cycle of Cycas.  | 3        | 2 |
| <b>6.0</b> | <b>PLANT PATHOLOGY</b>   | <b>5</b> |   |
| 6.1        | Plant diseases   | 1        | 5 |
| 6.2        | Classification of plant diseases on the basis causative organism and symptoms.   | 1        | 5 |
| 6.3        | Study the following diseases with special emphasis on causative organism, symptoms and control measures:<br>(i) Nut fall of Arecanut | 1        | 5 |
| 6.4        | (ii) Bacterial blight of Paddy   | 1        | 5 |
| 6.5        | (iii) Leaf mosaic of Tapioca.  | 1        | 5 |
|            |  |          |   |

# **CO-EVEN SEMESTERS**

COURSE CODE: BO6CRT12 COURSE TITLE: **BIOTECHNOLOGY AND BIOINFORMATICS**

CREDITS:3+1

|               |                |
|---------------|----------------|
| Programme     | B.Sc. Botany   |
| Semester      | VI             |
| Course type   | CORE           |
| Instructor(s) | VANDANA P NAIR |

| CO | Course outcomes   | CL | PSO  |
|----|---|----|------|
| 1. | Extrapolate current development in the field of Biotechnology     | U  | PSO2 |
| 2. | Illustrate the growing aspects of Bioinformatics                  | U  | PSO2 |
| 3. | Organize the students to carry out plant tissue culture           | A  | PSO2 |
| 4  | Examine the vast repositories of biological data knowledge.       | R  | PSO2 |
| 5  | Execute to access and analyze the data available in the databases | AP | PSO2 |
| 6  | Instantiate students in micropropagation techniques               | U  | PSO2 |
| 7  | Carry out DNA isolation   | AP | PSO2 |

| Module     | Course description   | Hrs       | CO       |
|------------|--|-----------|----------|
|            | <b>BIOTECHNOLOGY</b>   | <b>36</b> |          |
| <b>1.0</b> | <b>Plant tissue culture</b>  | <b>6</b>  | <b>1</b> |
| 1.1        | Biotechnology - an overview; plant tissue culture - basic concepts, totipotency, differentiation, de-differentiation and re-differentiation. | 2         | 1        |
| 1.2        | Tissue culture media: components, role of plant growth regulators in tissue culture. Preparation of MS medium                                | 2         | 1        |
| 1.3        | Sterilization of equipments, glassware and culture medium, surface sterilization of explants.  | 2         | 1        |
| <b>2.0</b> | <b>Applications of plant tissue culture</b>  | <b>10</b> | 3,6      |
| 2.1        | Micropropagation, methods - axillary bud proliferation, adventitious regeneration – shoot organogenesis and somatic embryogenesis            | 2         | 3        |
| 2.2        | Direct and indirect; meristem culture. Stages of micropropagation, hardening and transplantation.  | 2         | 6        |

|            |  |           |          |
|------------|--|-----------|----------|
| 2.3        | Advantages and disadvantages of micropropagation - somaclonal variations   | 2         | 6        |
| 2.4        | Embryo culture, callus and cell suspension culture, <i>in vitro</i> production of haploids - anther and pollen culture; uses of haploids. Protoplast culture: isolation of protoplast, culture methods, applications; protoplast fusion - cybrids. | 2         | 3        |
| 2.5        | Artificial seeds, advantages and disadvantages. <i>In vitro</i> production of secondary metabolites; cell immobilization, bioreactors  | 2         | 3        |
| <b>3.0</b> | <b>Recombinant DNA technology and its applications</b>   | <b>10</b> | <b>1</b> |
| 3.1        | Steps in rDNA technology, cloning vectors and their desirable properties   | 2         | 1        |
| 3.2        | Plasmids, cosmids, phage vectors, Phasmids, YAC and BAC; structure and applications of pBR322, M13 and Ti plasmid.   | 2         | 1        |
| 3.3        | Cutting and joining of DNA molecules - Restriction endonucleases and ligases - ligation techniques.  | 2         | 1        |
| 3.4        | Transformation and selection of transformants - using antibiotic resistances markers and complementation.  | 2         | 1        |
| 3.5        | Achievements of recombinant DNA technology: in medicine (Human insulin and gene therapy); in agriculture – Bt cotton; in environmental cleaning - super bugs   | 2         | 1        |
| 4.0        | <b>Techniques in rDNA technology</b>   | 10        | 7        |
| 4.1        | DNA isolation  | 2         | 7        |
| 4.2        | Agarose gel electrophoresis  | 2         | 7        |
| 4.3        | southern hybridization, autoradiography  | 2         | 7        |
| 4.4        | DNA finger printing and its applications. PCR and its applications. DNA sequencing by Sanger's dideoxy method  | 2         | 7        |
| 4.5        | Uses of refrigerated centrifuges, UV trans-illuminator, gel documentation system and Laminar Air Flow chamber  | 2         | 7        |
|            | <b>GENOMICS AND BIOINFORMATICS</b>   | <b>18</b> |          |
| 5.0        | <b>Genomics</b>  | 4         | 4        |
| 5.1        | A brief account on genomics and proteomics; major findings of the following genome projects – <i>E. coli</i>   | 2         | 4        |
| 5.2        | Genome projects -Human, <i>Arabidopsis thaliana</i> .  | 2         | 4        |
| 6.0        | <b>Basic bioinformatics</b>  | 7         | 2,4      |

|     |   |   |   |
|-----|---|---|---|
| 6.1 | An introduction to bioinformatics, objectives and applications of bioinformatics  | 1 | 2 |
| 6.2 | Biological data bases: types - primary, secondary and composite databases; nucleotide sequence databases  | 2 | 4 |
| 6.3 | NCBI (GenBank), EMBL, DDBJ; Protein Sequence databases - SWISS-PROT   | 2 | 4 |
| 6.4 | PIR; Protein structure database – PDB   | 1 | 4 |
| 6.5 | Bibliographic database – PubMed   | 1 | 4 |
| 7.0 | <b>Sequence analysis and molecular phylogeny</b>  | 7 |   |
| 7.1 | Sequence analysis tools - BLAST and FASTA, Molecular visualisation tool – RASMOL  | 2 | 5 |
| 7.2 | Sequence alignment - Scoring matrices, global and local alignment, Pairwise and multiple sequence alignment; common software used in alignment - CLUSTAL W & CLUSTAL X. | 2 | 5 |
| 7.3 | Molecular phylogeny - homologs, orthologs and paralogs; phylogenetic tree - rooted and unrooted tree  | 2 | 5 |
| 7.4 | advantages of phylogenetic tree, use of PHYLIP software   | 1 | 5 |



COURSE CODE: BO6CRT10 COURSE TITLE: **CELL AND MOLECULAR BIOLOGY**  
CREDITS: 3+1

|               |                  |
|---------------|------------------|
| Programme     | B.Sc. Botany     |
| Semester      | VI               |
| Course type   | CORE             |
| Instructor(s) | ANTU MARIYA JOSE |

| CO | Course outcomes   | CL    | PSO   |
|----|---|-------|-------|
| 1. | Understand the ultra-structure and functioning of cell in the sub microscopic and molecular level                           | U     | PSO   |
| 2. | Interpolate the mechanism of mitosis and meiosis  | U     | PSO 5 |
| 3. | Understand about different types of chromosomal aberrations. Distinguish different types of mutations and mutagenic agents. | U     | PSO 5 |
| 4. | Abstract the concept of genetic material.   | U     | PSO 5 |
| 5. | Discuss the process of replication of DNA. Carry out elementary problems on DNA replication, transcription and genetic code | U, AP | PSO 5 |
| 6. | Understand the method of gene expression and gene regulation  | U     | PSO 5 |
| 7. | Instantiate the genetics of cancer  | AP    | PSO 5 |

| Module     | Course description  | Hrs       | CO       |
|------------|---|-----------|----------|
|            | <b>CELL BIOLOGY</b>   | <b>27</b> |          |
| <b>1.0</b> | <b>Ultra-structure of cell components</b>   | <b>8</b>  | <b>1</b> |
| 1.1        | Cell biology through ages- a brief history of cell biology  | 1         | 1        |
| 1.2        | Cytosol - chemical composition. Composition, structure and function of plasma membrane - fluid mosaic model.  | 2         | 1        |
| 1.3        | The ultra-structure of a plant cell with structure and function of the following organelles: Endoplasmic reticulum, chloroplasts, Mitochondria, Ribosomes, Dictyosomes, Microbodies - peroxisomes and glyoxisomes, lysosomes and vacuole. | 3         | 1        |
| 1.4        | Cytoskeleton - microtubules and microfilaments.   | 1         | 1        |
| 1.5        | Ultra structure of nucleus: nuclear envelope - detailed structure of pore complex, nucleoplasm -composition, nucleolus.   | 1         | 1        |

|            |   |          |          |
|------------|---|----------|----------|
| <b>2.0</b> | <b>Chromosomes</b>  | <b>6</b> | <b>1</b> |
| 2.1        | Introduction, chromosome number, autosomes and allosomes  | 1        | 1        |
| 2.2        | Morphology -metacentric, submetacentric, acrocentric and telocentric. Structure - chromatid, chromonema, chromomere, centromere and kinetochore, telomere, secondary constriction and nucleolar organizer.                        | 1        | 1        |
| 2.3        | Chromatin fibres: heterochromatin and euchromatin. Karyotype and ideogram.  | 1        | 1        |
| 2.4        | Chemical composition of chromatin: histones and non-histones, arrangement of proteins and DNA in chromatin - the 10 nm fibre (nucleosome model), 30 nm fibre (solenoid model) and central axis with radial loops of 300 nm fibre. | 2        | <b>1</b> |
| 2.5        | Special type of chromosomes: giant chromosomes (salivary gland chromosomes, Lamp brush chromosomes), supernumerary chromosomes (B chromosome).  | 1        | <b>1</b> |
| <b>3.0</b> | <b>Cell division</b>  | <b>6</b> | <b>2</b> |
| 3.1        | Cell cycle - definition, different stages – interphase (G1, S and G2) and division phase.   | 1        | 2        |
| 3.2        | Mitosis: karyokinesis and cytokinesis, significance of mitosis.   | 2        | 2        |
| 3.3        | Meiosis: stages - first meiotic division (reduction division) and second meiotic (equational division), structure and function of synaptonemal complex, significance of meiosis; comparison of mitosis and meiosis.               | 3        | 2        |
| <b>4.0</b> | <b>Chromosomal aberrations</b>  | <b>4</b> | <b>3</b> |
| 4.1        | Numerical: heteroploidy; euploidy – haploidy; polyploidy – autopolyploidy, allopolyploidy ( <i>Raphanobrassica</i> ); aneuploidy - monosomy, trisomy (Fruit morphology in <i>Datura</i> ), nullisomy ( <i>Triticum</i> ).         | 2        | 3        |
| 4.2        | Numerical chromosomal abnormalities in man: Down,,s syndrome, Klinefelter,,s syndrome, Turner,,s syndrome.  | 1        | 3        |
| 4.3        | Structural: deletion (Cri-du-chat syndrome), duplication (Bar eye in <i>Drosophila</i> ), inversions (paracentric and pericentric) and Translocations (Robertsonian translocation).   | 1        | 3        |
| <b>5.0</b> | <b>Mutation</b>   | <b>3</b> | <b>3</b> |
| 5.1        | Mutation: definition, importance. Types of mutations: somatic and germinal; spontaneous and induced; chromosomal and gene or point mutations.   | 1        | 3        |

|            |  |           |          |
|------------|--|-----------|----------|
| 5.2        | Molecular basis of mutation: frame shift, transition, transversion and substitution.   | 1         | 3        |
| 5.3        | Mechanism of mutation induction: base replacement, base alteration, base damage, errors in DNA replication. Mutagens: physical - non-ionizing and ionizing radiations; chemical - base analogs, alkylating agents, deaminating agents. | 1         |          |
|            | <b>MOLECULAR BIOLOGY</b>   | <b>27</b> | 4        |
| <b>6.0</b> | <b>The genetic material</b>  | <b>8</b>  | <b>4</b> |
| 6.1        | Molecular biology: a brief historical prelude. Identification of DNA as genetic material   | 1         | 4        |
| 6.2        | Direct evidences – transformation experiment by Avery <i>et al.</i> ; Hershey and Chase Experiment   | 1         | 4        |
| 6.3        | Evidences for RNA as genetic material in some viruses.   | 1         | 4        |
| 6.4        | Nucleic acids: DNA and RNA, important features of Watson and Crick model of DNA; Chargaff's rule.  | 2         | 4        |
| 6.5        | Alternate forms of DNA - comparison of A, B and Z forms.   | 1         | 4        |
| 6.6        | Structure and function of different types of RNA - tRNA, mRNA, rRNA, snRNA, miRNA.   | 2         | 4        |
| <b>7.0</b> | <b>Replication of DNA</b>  | <b>4</b>  | <b>5</b> |
| 7.1        | Semiconservative replication of DNA - Messlson and Stahl's experiment  | 2         | 5        |
| 7.2        | Process of semiconservative replication with reference to the enzymes involved in each step.   | 2         | 5        |
| <b>8.0</b> | <b>Gene expression</b>   | <b>8</b>  | <b>6</b> |
| 8.1        | Gene expression: concept of gene, split genes, one gene one enzyme hypothesis  | 1         | 6        |
| 8.2        | One gene one polypeptide hypothesis, the central dogma, reverse transcription.   | 1         | 6        |
| 8.3        | Details of transcription in prokaryotes and eukaryotes   | 2         | 6        |
| 8.4        | hnRNA, splicing, release of mRNA.  | 1         | 6        |
| 8.5        | Translation - initiation, elongation and termination   | 2         | 6        |
| 8.6        | Genetic code and its features, wobble hypothesis.  | 1         | 6        |
| <b>9.0</b> | <b>Regulation of gene expression</b>   | <b>5</b>  | <b>6</b> |

|             |   |          |          |
|-------------|---|----------|----------|
| 9.1         | Regulation of gene expression in prokaryotes: operon concept, inducible and repressible systems, negative control and positive control. | 3        | 6        |
| 9.2         | Lac operon, catabolic repression. Tryptophan operon, attenuation. Regulation in eukaryotes  | 2        | 6        |
| <b>10.0</b> | <b>Genetics of cancer</b>   | <b>2</b> | <b>7</b> |
| 10.1        | Genetic basis of cancer – brief description of proto-oncogenes and oncogenes, tumour suppressor genes                                   | 1        | 7        |
| 10.2        | Characteristics of cancer cells.  | 1        | <b>7</b> |

**COURSE CODE: BO6CRT09      COURSE TITLE:GENETICS, PLANT BREEDING AND HORTICULTURE**  
**CREDITS:3+1**

|               |                 |
|---------------|-----------------|
| Programme     | B.Sc. Botany    |
| Semester      | VI              |
| Course type   | CORE            |
| Instructor(s) | ARCHANA G. NAIR |

| CO | Course outcomes  | CL | PSO   |
|----|--|----|-------|
| 1. | Imparting an insight into the principles of heredity                   | U  | PSO 5 |
| 2. | Understand the patterns of inheritance in different organisms.         | U  | PSO 5 |
| 3. | Understand the inheritance pattern of nuclear and extra nuclear genes. | U  | PSO 5 |
| 4. | Understand the methods of crop improvement.                            | U  | PSO 5 |
| 5. | Understand the importance of horticulture in human welfare             | U  | PSO 5 |
| 6. | Develop skill in gardening technique among students.                   | U  | PSO 5 |
|    |  |    |       |

| Module     | Course description                        | Hrs       | CO       |
|------------|---|-----------|----------|
|            | <b>GENETICS</b>                           | <b>27</b> | <b>1</b> |
| <b>1.0</b> | <b>Origin and development of Genetics</b> | <b>3</b>  | <b>1</b> |

|     |  |    |   |
|-----|--|----|---|
| 1.1 | Genetics as a science: origin - experiments of Mendel with <i>Pisum sativum</i> , general terminology used in genetics.                    | 1  | 1 |
| 1.2 | Principles of inheritance, Mendelian laws - monohybrid and dihybrid cross, test cross and backcross.                                       | 2  | 1 |
| 2.0 | <b>Exceptions to Mendelism</b>   | 10 | 1 |
| 2.1 | Modification of Mendelian ratios: incomplete dominance - <i>Mirabilis</i> ; Co-dominance - MN blood group in man                           | 3  | 1 |
| 2.2 | Lethal genes – pigmentation in Snapdragon.   | 1  | 1 |
| 2.3 | Geneic interaction: epistasis, (a) Dominant - fruit colour in summer squashes (b) Recessive - coat colour in mice                          | 3  | 1 |
| 2.4 | Complementary genes - flower colour in sweet pea. Non-epistasis - comb pattern in Fowls.   | 2  | 1 |
| 2.5 | Multiple alleles – ABO blood groups in man; self sterility in <i>Nicotiana</i> .   | 1  | 2 |
| 3.0 | <b>Linkage of genes</b>  | 3  | 2 |
| 3.1 | Linkage and crossing over: chromosome theory of linkage  | 1  | 2 |
| 3.2 | crossing over - types of crossing over, mechanism of crossing over.  | 1  | 2 |
| 3.3 | Linkage map - 2 point cross, interference and coincidence.   | 1  | 2 |
| 4.0 | <b>Determination of sex</b>  | 6  | 2 |
| 4.1 | Sex determination: sex chromosomes and autosomes   | 1  | 2 |
| 4.2 | chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants ( <i>Melandrium album</i> ). Sex linked | 1  | 2 |
| 4.3 | Sex linked inheritance: X-linked - Morgan's experment e.g. eye colour in <i>Dorsophila</i> , Haemophilia in man                            | 1  | 2 |

|            |   |    |   |
|------------|---|----|---|
| 4.4        | Y-linked inheritance;   | 1  | 2 |
| 4.5        | sex limited and sex influenced inheritance.   | 1  | 2 |
| 4.6        | Pedigree analysis.  | 1  | 2 |
| 5.0        | <b>Quantitative inheritance</b>   | 2  | 2 |
| 5.1        | Quantitative characters: polygenic inheritance  | 1  | 2 |
| 5.2        | continuous variation - kernel color in wheat, ear size in maize.  | 1  | 2 |
| 6.0        | <b>Extra-chromosomal inheritance</b>  | 2  | 3 |
| 6.1        | Extra chromosomal inheritance: chloroplast mutation - variegation in 4O"clock plant; mitochondrial mutations in yeast.                  | 1  | 3 |
| 6.2        | Maternal effects - shell coiling in snail; infective heredity - kappa particles in Paramecium.  | 1  | 3 |
| <b>7.0</b> | <b>Population genetics</b>  | 1  | 3 |
| 7.1S       | Concept of population, gene pool, Hardy-Weinberg principle (brief).   | 1  | 3 |
|            | <b>PLANT BREEDING</b>   | 13 | 4 |
| <b>1.0</b> | <b>Introduction to plant breeding</b>   | 1  | 4 |
| 1.1        | Introduction and objectives of plant breeding. Plant breeding centers in Kerala, their achievements – CPCRI, CTCRI, RRII.               | 1  | 4 |
| <b>2.0</b> | <b>Plant introduction</b>   | 2  | 4 |
| 2.1        | Plant introduction: domestication - centers of origin   | 1  | 4 |
| 2.2        | procedure of plant introduction - quarantine regulations, acclimatization, agencies of plant introduction in India, major achievements. | 1  | 4 |
| <b>3.0</b> | <b>Selection</b>  | 2  | 4 |
| 3.1        | Plant Selection: mass, pure-line, clonal.   | 2  | 4 |

|            |   |          |          |
|------------|---|----------|----------|
| <b>4.0</b> | <b>Hybridization</b>  | <b>4</b> | <b>4</b> |
| 4.1        | Hybridization: types, procedure, important achievements   | 1        | 4        |
| 4.2        | Heterosis in plant breeding, inbreeding depression, genetics of heterosis and inbreeding depression.                          | 1        | 4        |
| 4.3        | Handling segregating generation - pedigree method, bulk method, back cross method.  | 1        | 4        |
| 4.4        | Disease resistance breeding.  | <b>1</b> | 4        |
| <b>5.0</b> | <b>Mutation breeding and polyploidy breeding</b>  | <b>2</b> | <b>4</b> |
| 5.1        | Mutation breeding: methods, applications and important achievements.  | 1        | 4        |
| 5.2        | Polyploidy breeding: methods and applications.  | <b>1</b> | 4        |
| <b>6.0</b> | <b>Tissue culture as method in plant breeding</b>   | <b>2</b> | <b>4</b> |
| 6.1        | Application of meristem culture, embryo culture and pollen culture in plant breeding.   | 1        | 4        |
| 6.2        | Role of tissue culture in the creation of transgenic plants.  | 1        | 4        |
|            | <b>HORTICULTURE</b>   | <b>3</b> | <b>5</b> |
| <b>1.0</b> | <b>Introduction</b>   | <b>3</b> | <b>5</b> |
| 1.1        | Introduction to horticulture - definition, history.   | 1        | 5        |
| 1.3        | Classification of horticultural plants. Disciplines of horticulture - pomiculture, olericulture, floriculture, arboriculture. | <b>1</b> | 5        |
| 1.4        | Garden implements - budding knife, secateurs, hedge shear, hand cultivator, sprayers, lawn mower, garden rake, spade.         | 1        | 5        |
| 1.5        | Irrigation methods: surface, sub, drip and spray irrigations; mist chambers - advantages and disadvantages.                   | 1        | 5        |
| <b>2.0</b> | <b>Plant propagation</b>  | <b>5</b> | <b>5</b> |



|            |   |          |          |
|------------|---|----------|----------|
| 2.1        | Seed propagation: seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling   | 1        | 5        |
| 2.2        | Advantages and disadvantages of seed propagation.   | 1        | 5        |
| 2.3        | Vegetative propagation: natural and artificial; artificial methods - cutting, layering, grafting and budding, micro-propagation;                                | 2        | 5        |
| 2.4        | Advantages and disadvantages of vegetative propagation.   | 1        | 5        |
| <b>3.0</b> | <b>Gardening</b>  | <b>6</b> | <b>5</b> |
| 3.1        | Types of garden: brief study on ornamental garden, indoor garden, kitchen garden, aquatic garden, vertical garden, medicinal garden, terrace garden, terrarium. | 2        | 5        |
| 3.2        | Garden designing: garden components - lawns, shrubs and trees, borders, topiary, hedges, edges, walks, drives.  | 1        | 5        |
| 3.3        | Physical control of plant growth: training and pruning. Bonsai - selection of plant - bonsai containers and method of bonsai formation.                         | 2        | 5        |
| 3.4        | Plant growing structures: green house, orchidarium, conservatory; Potting mixture – components.   | 1        | 5        |

**COURSE CODE: BO6CRT11**

**COURSE TITLE: ANGIOSPERM MORPHOLOGY, TAXONOMY AND**

**ECONOMIC BOTANY**

**CREDITS: 3+1**

|               |                                  |
|---------------|----------------------------------|
| Programme     | B.Sc. Botany                     |
| Semester      | VI                               |
| Course type   | CORE                             |
| Instructor(s) | VANDANA P NAIR, DR. PETER K MANI |

| CO | Course outcomes   | CL | PSO |
|----|---|----|-----|
| 1  | Understand the plant morphology terminologies as a foundation for plant recognition and identification.   | U  | 3   |
| 2  | Interpolate the vegetative characters of the plants   | U  | 3   |
| 3  | Analyze the methods and principles of plant systematics emphasizing the classification and nomenclature.  | An | 4   |
| 4  | Instantiate the interdisciplinary approaches to the advancement of plant taxonomy.  | An | 4   |
| 5  | Plan desk, lab and field based studies of angiosperm diversity, identifying morphological specialties and writing short species descriptions and illustrations. | C  | 4   |
| 6  | Identify members of the major angiosperm families by observing their diagnostic features and economic importance.   | An | 4   |
| 7  | Evaluate the contributions, scope and significance of ethnobotany   | E  | 4   |

| Module     | Course description  | Hrs       | CO |
|------------|---|-----------|----|
|            | <b>ANGIOSPERM MORPHOLOGY</b>  | <b>13</b> |    |
| <b>1.0</b> | <b>Leaf, Inflorescence and Fruit morphology</b>   | <b>13</b> |    |
| 1.1        | Leaf Morphology: types, venation, phyllotaxy.   | 2         | 1  |
| 1.2        | Morphology of flower: flower as modified shoot; detailed structure of flowers   | 1         | 1  |
| 1.3        | Floral parts - their arrangement, relative position - symmetry, aestivation and placentation types - cohesion and adhesion  | 3         | 1  |
| 1.4        | Floral diagram and floral formula   | 1         | 1  |
| 1.5        | Inflorescence: racemose types - simple raceme, corymb, umbel, spike, spadix, head and catkin  | 2         | 2  |
| 1.6        | Cymose types - simple cyme; monochasial - scorpid and helicoid, dichasial and polychasial; special type - cyathium, hypanthodium, verticillaster, thyrus and panicle. | 2         | 2  |
| 1.7        | Fruits: simple - fleshy, dry - dehiscent, schizocarpic, indehiscent, aggregate, multiple (sorus and syconus).   | 2         | 2  |
|            | <b>TAXONOMY</b>   | <b>12</b> |    |

|            |   |           |          |
|------------|---|-----------|----------|
| <b>2.0</b> | <b>Principles of Plant systematics</b>  | <b>12</b> | <b>3</b> |
| 2.1        | Aim, scope, significance and components of taxonomy.  | 2         | 3        |
| 2.2        | Types of classification - artificial (brief account), natural – Bentham and Hooker (Detailed account) and Phylogenetic (Brief account).   | 3         | 3        |
| 2.3        | Angiosperm phylogeny group system (introduction only).  | 1         | 3        |
| 2.4        | Plant nomenclature - binomial, ICBN/ICN principles - rule of priority and author citation.  | 2         | 4        |
| 2.5        | Interdisciplinary approach in taxonomy -Cytotaxonomy and Chemotaxonomy.   | 2         | 4        |
| 2.6        | Herbarium technique – importance of herbarium; preparation of herbarium and their preservation. Important herbaria in India, BSI.   | 2         | 3        |
| <b>3.0</b> | <b>Detailed study of families</b>   | <b>30</b> |          |
|            | Study the following families of Bentham and Hooker,,s System with special reference to their vegetative and floral characters; special attention should be given to common and economically important plants within the families: |           |          |
| 3.1        | Annonaceae, Nymphaeaceae  | 2         | 5        |
| 3.2        | Malvaceae, Rutaceae, Anacardiaceae  | 3         | 5        |
| 3.3        | Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae)  | 2         | 5        |
| 3.4        | Combretaceae, Myrtaceae, Cucurbitaceae,   | 3         | 5        |
| 3.5        | Umbelliferae (Apiaceae)   | 2         | 5        |
| 3.6        | Rubiaceae, Compositae (Asteraceae), Sapotaceae  | 3         | 5        |
| 3.7        | Apocynaceae, Asclepiadaceae   | 3         | 5        |
| 3.8        | Solanaceae, Convolvulaceae  | 2         | 5        |
| 3.9        | Acanthaceae, Verbenaceae,   | 3         | 5        |
| 3.10       | Labiatae (Lamiaceae)  | 2         | 5        |
| 3.11       | Amaranthaceae, Euphorbiaceae  | 2         | 5        |
| 3.12       | Orchidaceae, Palmae (Arecaceae), Graminae (Poaceae)   | 3         | 5        |
|            | <b>ECONOMIC BOTANY AND ETHNOBOTANY</b>  | <b>17</b> |          |
| <b>4.0</b> | <b>Economic botany</b>  | <b>12</b> |          |

|            |   |          |   |
|------------|---|----------|---|
|            | Study the following groups of plants with special reference to the botanical name, family and morphology of the useful part and uses:                               |          | 6 |
| 4.1        | Cereals - Rice, Wheat<br>Millets Ragi; Pulses - Green gram, Bengal gram, Black gram   | 2        | 6 |
| 4.2        | Sugar yielding plants – Sugarcane<br>Fruits - Apple, Pineapple, Orange, Mango and Banana  | 2        | 6 |
| 4.3        | Vegetables - Bittergourd, Ladies finger, Carrot and Cabbage<br>Tuber crops -Tapioca; Beverages - Tea, Coffee<br>Oil yielding plants - Ground nut, Coconut, Gingelly | 2        | 6 |
| 4.5        | Spices –Cardamom, Pepper, Cloves, Ginger<br>Timber yielding plants - Teak wood and Rose wood  | 2        | 6 |
| 4.6        | Fibre yielding plants - Coir, Jute, Cotton<br>Rubber yielding plants - Para rubber<br>Gums and Resins – Whitedamer, Gum Arabic, Asafoetida                          | 2        | 6 |
| 4.7        | Insecticide yielding Plants - Tobacco and Neem  | 1        | 6 |
| <b>5.0</b> | <b>Ethnobotany</b>  | <b>5</b> |   |
| 5.1        | Introduction  | 1        | 7 |
| 5.2        | Scope and significance of ethnobotany   | 1        | 7 |
| 5.3        | Study of the following plants used in daily life by tribals and village folks for: Food – <i>Artocarpus heterophylla</i> , <i>Corypha</i>                           | 1        | 7 |
| 5.4        | Shelter - <i>Bambusa</i> , <i>Ochlandra</i> and <i>Calamus</i>  | 1        | 7 |
| 5.5        | Medicine – <i>Curcuma longa</i> , <i>Trichopus zeylanicus</i> and <i>Alpinia galanga</i> .  | 1        | 7 |
|            |   |          |   |

**COURSE CODE: BO6PET01****COURSE TITLE: AGRIBUSINESS****CREDITS: 2+1**

|               |   |
|---------------|---|
| Programme     | B.Sc. Botany  |
| Semester      | VI  |
| Course type   | CORE  |
| Instructor(s) | DR. PETER K MANI,VANDANA P NAIR,ANTU MARIYA JOSE,ARCHANA G NAIR |

| CO | Course outcomes   | CL | PSO   |
|----|---|----|-------|
| 1  | Identify the business opportunities and details of entrepreneurship in the field of plant sciences.   | C  | PSO 7 |
| 2  | Familiarize the various value added products and their processing techniques.   | Ap | PSO 7 |
| 3  | Harness the opportunities and potentials in the field of Nursery management, processing technology and food sciences.   | Ap | PSO 7 |
| 4  | <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> Instantiate the idea about the need of sustainable development and organic farming | An | PSO 7 |
| 5  | Understand the cultivation techniques of vegetables, fruits and medicinal plants in our daily life.   | U  | PSO 7 |
| 6  | Understand the scope, significance, problems and prospects of floriculture and apiculture.  | An | PSO 7 |
| 7  | Interpolate the ideas of floriculture with flower arrangement techniques and ornamental garden designing.   | C  | PSO 7 |
| 8  | Develop skills in mushroom cultivation techniques   | C  | PSO 7 |

| Module     | Course description  | Hrs      | CO |
|------------|---|----------|----|
| <b>1.0</b> | <b>Entrepreneurship</b>   | <b>2</b> |    |
| 1.1        | Basic qualities of an Entrepreneur. Financial assistance from Banks.  | 1        | 1  |
| 1.2        | Role of Institutions like MSME Training Institute, Khadi and village industries board, self help groups, Co-operative sector,Kudumbasree projects and microenterprises. | 1        | 1  |
| <b>2.0</b> | <b>Value added food products</b>  | <b>8</b> |    |
| 2.1        | Preparation and preservation techniques.  | 1        | 2  |
| 2.2        | Major causes of spoilage of food.   | 1        | 2  |

|            |  |          |   |
|------------|--|----------|---|
| 2.3        | Principles of preservation - asepsis, removal of microorganisms, anaerobic situation and special methods - drying, thermal processing - pasteurization, sterilization and canning - low temperature, use of chemical preservatives and food additives. | 2        | 2 |
| 2.4        | Preparation of wine, vinegar.  | 1        | 2 |
| 2.5        | Preparation of pickles, jam, jelly   | 1        | 2 |
| 2.6        | Preparation of syrups, sauce, dry fruits,  | 1        | 2 |
| 2.7        | Preparation of dairy products - cheese, butter, yoghurt, paneer  | 1        | 2 |
| <b>3.0</b> | <b>Processing techniques</b>   | <b>8</b> |   |
| 3.1        | Processing of latex: centrifuged latex products and galvanized rubber products.  | 1        | 2 |
| 3.2        | Processing, storage and marketing of Cocoa   | 1        | 2 |
| 3.3        | <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> Processing, storage and marketing of Coconut (Copra, Coir and Tender coconut)   | 1        | 2 |
| 3.4        | Processing, storage and marketing of Rice (par boiled, raw rice and rice flour)  | 1        | 2 |
| 3.5        | Processing, storage and marketing of Pepper, Cardamom, Ginger  | 1        | 2 |
| 3.6        | Processing, storage and marketing of Arrowroot, Tapioca  | 1        | 2 |
| 3.7        | Processing, storage and marketing of Cashew, Mango, Jack fruit, Guava, Grapes  | 1        | 2 |
| 3.8        | Processing, storage and marketing of Lemon, Papaya, Musa, Garcinia.  | 1        | 2 |
| <b>4.0</b> | <b>Nursery management</b>  | <b>6</b> |   |
| 4.1        | Preparation of potting mixtures, polybags.   | 1        | 3 |
| 4.2        | Plant growing structures - green houses, shaded houses, polyshed, mist chamber   | 1        | 3 |
| 4.3        | Irrigation methods- sprinkling system, drip irrigation   | 1        | 3 |
| 4.4        | Modern strategies in propagation by root initiation of cutting, layering technique, budding and grafting technique.  | 1        | 3 |
| 4.5        | Micropropagation, Planting, transplanting and hardening of seedlings   | 1        | 3 |

|            |  |   |   |
|------------|--|---|---|
| 4.6        | After care of seedlings. Packing and transport of seedlings.   | 1 | 3 |
| <b>5.0</b> | <b>Organic farming and composting techniques</b>   | 6 |   |
| 5.1        | Organic manures and fertilizers, composition of fertilizers. NPK content of various fertilizers and preparation of fertilizer mixtures.  | 1 | 4 |
| 5.2        | Common organic manures - bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost.  | 1 | 4 |
| 5.3        | Preparation of compost - aerobic and anaerobic - advantages and limitations. Vermicompost - preparation; Vermiwash - preparation.  | 2 | 4 |
| 5.4        | Biofertilizers - definition and preparation of different types - Trichoderma, Rhizobium, PGPR, PSB, mycorrhiza. Application of biofertilizers.   | 1 | 4 |
| 5.5        | Biopesticides, Tobacco and Neem decoction. Biological control of disease and pests.  | 1 | 4 |
| <b>6.0</b> | <b>Cultivation of vegetables, fruits and medicinal plants</b>  | 6 |   |
| 6.1        | Types - home gardening, market gardening and truck gardening.  | 1 | 5 |
| 6.2        | Packing and transporting of vegetables.  | 1 | 5 |
| 6.3        | Organic farming of fruit crops - packing and transporting of fruits.   | 1 | 5 |
| 6.4        | Induction of flowering and weed control.   | 1 | 5 |
| 6.5        | Cultivation of medicinal and aromatic plants of common use and great demand.   | 2 | 5 |
| <b>7.0</b> | <b>Floriculture and Apiculture</b>   | 6 | 6 |
| 7.1        | Floriculture: problems and prospects of floriculture in Kerala.  | 1 | 6 |
| 7.2        | Scope of growing Anthurium, Orchids and Jasmine in Kerala.   | 1 | 6 |
| <b>7.3</b> | Common cut flowers - Rose, Gerbera, Gladiolus, Aster, <i>Chrysanthemum</i> , Anthurium and Orchids. Common leaves used in flower arrangement - <i>Cyprus</i> , <i>Podocarpus</i> , <i>Asparagus</i> , Palms, Cycads and Ferns. | 2 | 6 |
| <b>7.4</b> | Apiculture: scope and significance. Structure, installation and maintenance of an Apiarium.  | 1 | 6 |
| <b>7.5</b> | Extraction, processing, preservation and marketing of honey.   | 1 | 6 |
|            |  |   |   |

|             |  |          |          |
|-------------|--|----------|----------|
| <b>8.0</b>  | <b>Flower arrangement</b>  | <b>4</b> |          |
| 8.1         | Types - Western, Eastern (Japanese/ Ikebana) and modern.   | 1        | 7        |
| 8.2         | Wases, flower holders and floral foam. Wase life of flowers and leaves.  | 1        | 7        |
| 8.3         | After care of flower arrangements – Bouquets.  | 1        | 7        |
| 8.4         | Packing and maintenance of flowers and leaves.   | 1        | 7        |
| <b>9.0</b>  | <b>Ornamental garden designing</b>   | <b>4</b> | <b>7</b> |
| 9.1         | Garden components.   | 1        | 7        |
| 9.2         | Lawn preparation by seeds, seedling and turfing.   | 1        | 7        |
| 9.3         | Maintenance of garden by Irrigation, Pruning, Repotting.   | 1        | 7        |
| 9.4         | Disease and Pest control.  | 1        | 7        |
| <b>1.10</b> | <b>Mushroom cultivation and farming</b>  | <b>4</b> |          |
| 1.11        | Mushrooms: significance, nutritive value. Types of Mushrooms – Button – <i>Pleurotus</i> , <i>Volvorella</i> . | 1        | 8        |
| 1.12        | Spawn production, storage and marketing. Growth of Mushrooms on paddy straw and saw dust by poly bag.          | 1        | 8        |
| 1.13        | Mushroom growing structures and maintenance of humidity. Pests and defects of mushrooms.                       | 1        | 8        |
| 1.14        | Storage, transporting and marketing of mushrooms.  | 1        | 8        |
|             |  |          |          |
|             |  |          |          |



## SEMESTER IV

**COURSE CODE:BO4CRT04    COURSE TITLE:PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY  
CREDITS: 3+1**

|                    |                                     |
|--------------------|-------------------------------------|
| Programme          | B.Sc. Botany                        |
| Semester           | IV                                  |
| Course type        | CORE                                |
| Instructor(s)<br>) | ANTU MARIYA JOSE,ARCHANA G.<br>NAIR |

| <b>C<br/>O</b> | <b>Course outcomes</b>   | <b>CL</b> | <b>PSO</b> |
|----------------|--|-----------|------------|
| 1.             | Understand the diversity in habits, habitats and organization of various groups of plants. | U         | PSO 3      |
| 2.             | impart an insight into the modern classifications in lower forms of plants.                | U         | PSO 3      |
| 3.             | Understand the evolutionary trends in Pteridophytes and Gymnosperms                        | U         | PSO 3      |
| 4.             | Analyze the anatomical variations in vascular plants.                                      | A<br>n    | PSO 3      |
| 5.             | Recognize the economic importance of Pteridophytes, and Gymnosperms..                      | R         | PSO 3      |
| 6.             | Understand the significance of Paleobotany and its applications.                           | U         | PSO 3      |

| <b>Module</b> | <b>Course description</b>                                       | <b>Hrs</b> | <b>CO</b> |
|---------------|---|------------|-----------|
|               | <b>PTERIDOLOGY</b>  | 27         | 1         |
| <b>1.0</b>    | <b>General introduction and classification of Pteridophytes</b> | <b>5</b>   | <b>1</b>  |
| <b>1.1</b>    | Introduction  | <b>1</b>   | <b>1</b>  |

|     |  |           |     |
|-----|--|-----------|-----|
| 1.2 | Classification of Pteridophytes up to classes by Smith (1955)  | 2         | 2   |
| 1.3 | A very brief account of the classification by Christenhusz et al., 2011.   | 2         | 2   |
| 2.0 | <b>Type study</b>  | <b>18</b> | 1   |
| 2.1 | Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required):<br>Psilophyta - Psilotum | 2         | 1,4 |
| 2.2 | Lycophyta - Lycopodium, Selaginella  | 2         | 1,4 |
| 2.3 | Sphenophyta - Equisetum  | 2         | 1,4 |
| 2.4 | Pterophyta - Pteris, Marsilea.   | 2         | 1,4 |
| 2.4 | Stelar evolution in Pteridophytes;   | 3         | 1,4 |
| 2.6 | Heterospory and seed habit.  | 2         | 1,4 |
| 3.0 | Economic importance  | 3         | 5   |
| 3.1 | Importance of Pteridophytes: medicinal, ornamental, as biofertilizer.  | 2         | 5   |
| 3.2 | <b>GYMNOSPERMS</b>   | <b>18</b> | 1   |
| 4.0 | General introduction and classification of Gymnosperms   | 5         | 2   |
| 4.1 | Introduction, General characters   | 1         | 1,4 |
| 4.2 | Classification of Gymnosperms by Sporne (1965)   | 3         | 1,4 |
| 4.2 | A very brief account of the classification by Christenhusz et al (2011).   | 1         | 1   |
| 5.0 | <b>Type study</b>  | <b>11</b> | 1   |
| 5.1 | Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required): Cycadopsida – Cycas                | 3         | 1   |
| 5.2 | Coniferopsida – Pinus  | 3         | 1   |
| 5.3 | Gnetopsidae – Gnetum.  | 3         | 1   |
| 5.4 | Affinities of Gymnosperms with Pteridophytes and Angiosperms.  | 2         | 1   |
| 6.0 | <b>Economic importance of Gymnosperms</b>  | <b>2</b>  | 5   |
| 6.1 | Uses of Gymnosperms: as food, medicine, in industry and as ornamental plants.  | 2         | 5   |
|     | <b>PALEOBOTANY</b>   | <b>9</b>  |     |
| 7.0 | <b>Fossils</b>   | <b>6</b>  | 6   |

|            |   |          |   |
|------------|---|----------|---|
| <b>7.1</b> | Introduction to paleobotany and its significance.                                       | 1        | 6 |
| <b>7.2</b> | Fossil formation, types of fossils  | 1        | 6 |
| <b>7.3</b> | Study of fossil Bryophyte - Naiadita lanceolata   | 1        | 6 |
| <b>7.4</b> | Fossil Pteridophytes – Rhynia, Calamites  | 1        | 6 |
| <b>7.5</b> | Fossil Gymnosperm – Williamsonia.   | 1        | 6 |
| <b>7.6</b> | Applied aspects of Paleobotany - exploration of fossil fuels.                           | 1        | 6 |
| <b>8.0</b> | <b>Paleobotany in India</b>   | <b>3</b> | 6 |
| <b>8.1</b> | Brief study of the fossil deposits in India. Important Indian Paleobotanical Institutes | 2        | 6 |
| <b>8.2</b> | Contributions of Indian Paleobotanists - Birbal Sahni.                                  | 1        | 6 |

**SEMESTER : II COURSE CODE: BO2CRT02 COURSE TITLE: MICROBIOLOGY,  
MYCOLOGY AND PLANT PATHOLOGY**

**CREDITS: 2+1**

|               |                                  |
|---------------|----------------------------------|
| Programme     | B.Sc. Botany                     |
| Semester      | II                               |
| Course type   | CORE                             |
| Instructor(s) | VANDANA P NAIR, DR. PETER K MANI |

| CO | Course outcomes   | CL | PSO   |
|----|---|----|-------|
| 1  | Understand the world of microbes, fungi and lichens                       | U  | PSO 1 |
| 2  | Appreciate the adaptive strategies of the microbes, fungi and lichens     | An | PSO 1 |
| 3  | To study the economic and pathological importance of microorganisms       | U  | PSO 1 |
| 4  | Instantiate the economic importance of fungi.                             | U  | PSO 3 |
| 5  | Understand the general characters of different types of fungi and lichen. | U  | PSO 1 |
| 6  | Describe the economic and ecological significance of lichens.             | U  | PSO 3 |
| 7  | Interpolate the details of plant disease development.                     | An | PSO 3 |
| 8  | Identify common plant diseases and devise the control measures.           | U  | PSO 3 |

| Module     | Course description  | Hrs      | CO       |
|------------|---|----------|----------|
|            | <b>MICROBIOLOGY</b>   | <b>9</b> |          |
| <b>1.0</b> | <b>Introduction</b>   | <b>1</b> |          |
| <b>1.1</b> | Introduction to microbiology, scope of microbiology   | <b>1</b> | <b>1</b> |
| <b>2.0</b> | <b>Bacteria</b>   | <b>4</b> |          |
| 2.1        | Bacteria: general characters and classification based on staining, morphology and flagellation.                 | 1        | 2        |
| 2.2        | Ultra structure of bacteria.  | 1        | 2        |
| 2.3        | Reproduction - binary fission. Genetic recombination in bacteria -conjugation, transformation and transduction. | 1        | 2        |
| 2.4        | Economic importance of bacteria.  | 1        | 3        |
| <b>3.0</b> | <b>Viruses</b>  | <b>2</b> |          |
| 3.1        | General characters of viruses, virioids and prions. Structure of TMV and Bacteriophage ( $\lambda$ ).           | 1        | 3        |

|            |  |           |          |
|------------|--|-----------|----------|
| 3.2        | Multiplication of $\lambda$ phage – lytic and lysogenic cycle.   | 1         | 3        |
| <b>4.0</b> | <b>Applied microbiology</b>  | <b>2</b>  |          |
| 4.1        | Isolation and culture of bacteria; media used – general purpose and selective media, applications of bacterial culture (brief study only).                           | 1         | 3        |
| 4.2        | Role of microbes: in producing antibiotics, wine, vinegar, curd – role in N <sub>2</sub> fixation, as biofertilizers – role in food spoilage (Brief study only).     | 1         | 3        |
|            |  |           |          |
|            | <b>MYCOLOGY</b>  | <b>18</b> |          |
| <b>5.0</b> | <b>Introduction, classification and types of fungi</b>   | <b>13</b> |          |
| 5.1        | General characters of fungi.   | 1         | 1        |
| 5.2        | Classification of fungi - Ainsworth (1973)   | 2         | 2        |
| 5.3        | Distinguishing characters of the different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group |           |          |
| 5.4        | Myxomycotina – <i>Physarum</i> ; Mastigomycotina – <i>Albugo</i>   | <b>2</b>  | 5        |
| 5.5        | Zygomycotina - <i>Rhizopus</i> ; Ascomycotina – Hemiascomycetes<br><i>Saccharomyces</i>  | 2         | 5        |
| 5.6        | Plectomycetes - <i>Penicillium</i> ; Pyrenomycetes – <i>Xylaria</i> ;  | 2         | 5        |
| 5.7        | Discomycetes - <i>Peziza</i> ; Basidiomycotina – Teliomycetes – <i>Puccinia</i> ;  | 2         | 5        |
| 5.8        | Hymenomycetes – <i>Agaricus</i> ; Deuteromycotina – <i>Fusarium</i> .  | 2         | 5        |
| <b>6.0</b> | <b>Economic importance of fungi</b>  | <b>3</b>  | <b>4</b> |
| 6.1        | Useful and harmful effects of fungi - medicinal, industrial, agricultural, food, genetic studies, spoilage, fungal toxins and diseases.                              | 2         | 4        |
| 6.2        | Mycorrhiza: ecto- and endomycorrhiza, significance.  | 1         | 4        |
| <b>7.0</b> | <b>Lichens</b>   | <b>2</b>  |          |
| 7.1        | General characters, types, general internal structure. Economic and ecological significance of lichens.  | 2         | 6        |
| 7.2        | Structure, reproduction and life cycle of <i>Parmelia</i> .  | 2         | 5        |
|            | <b>PLANT PATHOLOGY</b>   | <b>9</b>  |          |
| <b>8.0</b> | <b>Plant disease development</b>   | <b>3</b>  |          |

|             |   |   |   |
|-------------|---|---|---|
| 8.1         | History of plant pathology. Classification of plant diseases on the basis of causative organism and symptoms.               | 1 | 7 |
| 8.2         | Host parasite interaction - defence mechanisms in host, mechanism of infection, transmission and dissemination of diseases. | 2 | 7 |
| <b>9.0</b>  | <b>Common plant diseases</b>  | 4 |   |
|             | Study of following diseases with emphasis on symptoms, cause, disease cycle and control:                                    |   |   |
| 9.1         | Bunchy top of Banana, Bacterial blight of Paddy   | 1 | 8 |
| 9.2         | Root wilt of Coconut, Abnormal leaf fall of Rubber  | 1 | 8 |
| 9.3         | Root knot disease of Pepper, Leaf mosaic disease of Tapioca, Citrus canker.   | 2 | 8 |
| <b>1.10</b> | <b>Control of diseases</b>  | 2 |   |
| 1.11        | Prophylaxis - quarantine measures, seed certification, Therapeutic - physical therapy, chemotherapy                         | 1 | 8 |
| 1.12        | Biological control and its significance. Fungicides - Bordeaux mixture. Tobacco and Neem decoction(Brief study only).       | 1 | 8 |

**COURSE CODE: BO4CMT04****COURSE TITLE: ANATOMY AND APPLIED BOTANY****CREDITS: 3+1**

|               |                                 |
|---------------|---------------------------------|
| Programme     | B.Sc. Botany                    |
| Semester      | VI                              |
| Course type   | <b>Complementary</b>            |
| Instructor(s) | DR. PETER K MANI,VANDANA P NAIR |

| CO | Course outcomes  | CL | PSO          |
|----|--|----|--------------|
| 1  | Understand different types of plant tissues and various morphological peculiarities.           | U  | PSO 3        |
| 2  | Subsume the anatomy of different plant organs with reference to their functions.               | An | PSO 3        |
| 3  | Understand the process of normal and anomalous secondary thickening in plants.                 | An | PSO 3        |
| 4  | Identify the morphological and anatomical adaptations of plants growing in different habitats. | An | PSO 3        |
| 5  | Interpret the objectives and basic knowledge of plant breeding.                                | U  | PSO 5        |
| 6  | Describe the various artificial propagation methods used in plant breeding.                    | Ap | PSO 5        |
| 7  | Instantiate the principles, methods and applications of plant tissue culture.                  | Ap | <b>PSO 5</b> |

| Module     | Course description   | Hrs       | CO       |
|------------|--|-----------|----------|
|            | <b>PLANT ANATOMY</b>   | <b>27</b> |          |
| <b>1.0</b> | <b>Cells and tissues</b>   | <b>9</b>  |          |
| 1.1        | Gross structure of primary and secondary cell walls  | <b>1</b>  | <b>1</b> |
| 1.2        | Structure and function of plasmodesmata  | <b>1</b>  | <b>1</b> |
| 1.3        | Nonliving inclusions - cystolith, raphides   | <b>1</b>  | <b>1</b> |
| 1.4        | Tissues – meristematic and permanent.  | <b>2</b>  | <b>1</b> |
| 1.5        | Types of meristems; simple and complex tissues,  | <b>2</b>  | <b>1</b> |
| 1.6        | Types of secretory tissues (nectaries, hydathodes, mucilage ducts and lactiferous tissue). | <b>2</b>  | <b>1</b> |
| <b>2.0</b> | <b>Anatomy of plant organs</b>   | <b>12</b> |          |
| 2.1        | Primary structure of stem in dicots and monocots.  | <b>2</b>  | <b>2</b> |
| 2.2        | Primary structure of root in dicots and monocots.  | <b>2</b>  | <b>2</b> |

|            |   |           |   |
|------------|---|-----------|---|
| 2.3        | Anatomy of monocot and dicot leaf.  | 2         | 2 |
| 2.4        | Secondary thickening in dicot stem and dicot root   | 2         | 2 |
| 2.5        | Heart wood and sap wood; tyloses; hard wood and soft wood; growth rings, dendrochronology | 2         | 2 |
| 2.2        | Anomalous secondary thickening in <i>Bignonia</i> .                                       | 2         | 3 |
| <b>3.0</b> | <b>Ecological anatomy</b>   | <b>6</b>  |   |
|            | Study of the morphological and anatomical adaptations of the following groups:            |           |   |
| 3.1        | Hydrophytes – <i>Nymphaea</i> , Hydrilla  | 2         | 4 |
| 3.2        | Xerophytes – <i>Nerium</i>  | 2         | 4 |
| 3.3        | Epiphytes - <i>Vanda</i>  | 2         | 4 |
|            | <b>APPLIED BOTANY: Plant breeding, Horticulture and Micropropagation</b>                  | 27        |   |
| <b>4.0</b> | <b>Plant breeding</b>   | <b>12</b> | 5 |
| 4.1        | Objectives of plant breeding,   | 2         | 5 |
| 4.2        | Methods of plant improvement - plant introduction, acclimatization.                       | 2         | 5 |
| 4.3        | Plant quarantine  | 2         | 5 |
| 4.4        | Selection - mass selection, pureline selection and clonal selection;                      | 2         | 5 |
| 4.5        | Hybridization - intervarietal, interspecific and intergeneric;                            | 2         | 5 |
| 4.6        | Procedure of hybridization.   | 2         | 5 |
| <b>5.0</b> | <b>Artificial vegetative propagation methods</b>  | <b>5</b>  | 6 |
| 5.1        | Propagation of plants through cutting, layering - air layering.                           | 2         | 6 |
| 5.2        | Budding- T and patch budding  | 1         | 6 |
| <b>5.3</b> | Grafting - tongue and splice grafting   | 1         | 6 |
| 5.4        | Role of cambium in budding and grafting.  | 1         | 6 |
| <b>6.0</b> | <b>Plant tissue culture</b>   | <b>10</b> |   |
| 6.1        | Principles of tissue culture  | 1         | 7 |
| 6.2        | Micropropagation - different steps - selection of explants                                | 2         | 7 |



|            |   |   |   |
|------------|---|---|---|
| 6.3        | Culture media – general composition and preparation; sterilization of media and explants; callus. | 2 | 7 |
| 6.4        | Regeneration of plants: organogenesis, somatic embryogenesis;                                     | 2 | 7 |
| <b>6.5</b> | Artificial seeds.   | 1 | 7 |
| 6.6        | Applications of plant tissue culture.   | 2 | 7 |
| 5.5        | Medicine –Curcuma longa, Trichopus zeylanicus and Alpinia galanga.                                | 1 | 7 |
|            |   |   |   |