

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**  
**B.Sc. DEGREE : BRANCH V. A. - PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**  
**COURSES OF STUDY OFFERED**  
 (Effective from the academic year 2010 - 2011)  
**CHOICE BASED CREDIT SYSTEM**

Subject Code	Title of Course	Credits	Total Hours			Exam Hours	Marks		
			Lecture Hours (L)	Tutorial Hours (T)	Practical Hours (P)		Continuous Assessment	End Semester	Maximum
<b>Semester - 1</b>									
BT/MC/AF14	Algae, Fungi and Lichens	4	4	0	0	3	50	50	100
BT/MC/FB14	Algal and Fungal Biotechnology	4	4	0	0	3	50	50	100
BT/MC/P112	Algae, Fungi and Lichens - Practical	2	0	0	3	2½	50	50	100
BT/GC/ES12	Environmental Studies	2	2	0	0	2	50	50	100
<b>Allied Core Offered to the Department of Zoology</b>									
BT/AC/GB13	General Botany - I	3	3	0	0	2½	50	50	100
BT/AC/P122	General Botany - Practical	-	0	0	2	-	-	-	-
<b>Semester - 2</b>									
BT/MC/BP24	Bryophytes, Pteridophytes and Gymnosperms	4	4	1	0	2½	50	50	100
BT/MC/P222	Bryophytes, Pteridophytes and Gymnosperms - Practical	2	0	0	3	2½	50	50	100
BT/ME/BI24	Bioinstrumentation	4	4	1	0	3	50	50	100
OR									
BT/ME/HC24	Horticulture (Skill Development Course)	4	4	1	0	3	50	50	100
BT/ME/FH24	Food Microbiology, Sanitation and Hygiene (Skill Development Course)	4	3	0	2	3	50	50	100
<b>Allied Core Offered to the Department of Zoology</b>									
BT/AC/GB23	General Botany - II	3	3	0	0	2½	50	50	100
BT/AC/P122	General Botany - Practical	2	0	0	2	3	50	50	100
<b>Semester - 3</b>									
BT/MC/TE34	Taxonomy of Angiosperms and Economic Botany	4	4	1	0	3	50	50	100
BT/MC/PE33	Phytotherapy and Ethnobotany	3	3	0	0	2½	50	50	100
BT/MC/P332	Taxonomy of Angiosperms and Economic Botany - Practical	2	0	0	3	2½	50	50	100
<b>Semester - 4</b>									
BT/MC/AE44	Anatomy and Embryology of Angiosperms	4	4	1	0	3	50	50	100
BT/MC/P442	Anatomy and Embryology of Angiosperms - Practical	2	0	0	3	2½	50	50	100

1 Lecture Hour = 1 credit

2 Practical Hours = 1 credit / 3 Practical Hours = 2 credits

<b>Semester - 5</b>									
BT/MC/CB54	Cell Biology	4	4	1	0	3	50	50	100
BT/MC/MB54	Microbiology	4	4	0	0	3	50	50	100
BT/MC/EE54	Ecology and Environmental Biotechnology	4	4	1	0	3	50	50	100
BT/MC/P553	Cell Biology, Microbiology and Ecology and Environmental Biotechnology - Practicals	3	0	0	6	3	50	50	100
BT/ME/PR54	Project	4	0	0	5	-	50	50	100
OR									
BT/ME/FN54	Fruit Preservation and Nutrition (Skill Development Course)	4	4	1	0	3	50	50	100
<b>Semester - 6</b>									
BT/MC/PP64	Plant Physiology	4	4	1	0	3	50	50	100
BT/MC/ML64	Molecular Biology	4	4	1	0	3	50	50	100
BT/MC/GG64	Genetics and Genetic Engineering	4	4	1	0	3	50	50	100
BT/MC/AB64	Applied Biotechnology	4	4	1	0	3	50	50	100
BT/MC/P662	Plant Physiology, Genetics and Genetic Engineering, and Applied Biotechnology - Practicals	2	0	0	4	2½	50	50	100
<b>General Electives</b>									
BT/GE/WM24	Waste Management	4	4	0	0	2	50	50	100
BT/GE/HT32	Herbal Therapy	2	2	0	0	-	50	-	100
BT/GE/FP32	Fruit Preservation	2	2	0	0	-	50	-	100
BT/GE/AB44	Applied Botany	4	4	0	0	2	50	50	100
BT/GE/PH54	Plants and Human Welfare	4	4	0	0	2	50	50	100
BT/GE/FH54	Fundamentals of Horticulture	4	4	0	0	2	50	50	100

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**  
**Allied Core Offered by the Department of Botany**  
**to student of Advanced Zoology and Biotechnology**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**GENERAL BOTANY – I**

**CODE: BT/AC/GB 13**

**CREDITS: 3**

**L T P: 3 0 0**

**TOTAL TEACHING HOURS: 39**

**OBJECTIVES**

- To understand the structural details of the simplest groups of the plant kingdom.
- To gain knowledge on the salient features of few families and to know their economic importance.

**Unit 1 (12 Hrs)**

**Taxonomy**

- 1.1. A general outline of Bentham and Hooker's classification
- 1.2. A study of the salient features of the following families and their economic importance
  - a. Annonaceae      b. Cucurbitaceae
  - c. Apocynaceae    d. Lamiaceae
  - e. Amaranthaceae   f. Arecaceae

**Unit 2 (7 Hrs)**

**Anatomy**

- 2.1. Secondary growth in typical dicot stem and root
- 2.2. Anomalous structure of *Nyctanthus* and *Boerhaavia*

**Unit 3 (7 Hrs)**

**Algology**

- 3.1. A brief account of the characteristic features of Algae
- 3.2. A detailed study of the life cycle of the following algae (no development)
  - a. *Nostoc*      b. *Chara*      c. *Sargassum*.

**Unit 4 (8 Hrs)**

**Mycology**

- 4.1. A brief account of the characteristic features of Fungi
- 4.2. A detailed study of the life cycle of the following fungi (no development)
  - a. *Rhizopus*,      b. *Aspergillus*      c. *Polyporus*

**Unit 5 (5 Hrs)**

**General Topics**

- 5.1. Oyster Mushroom Cultivation
- 5.2. Bonsai Technique

## **TEXT BOOK**

Rao, K. N., and R.V.Narayanaswamy, (1986), **Ancillary Botany**, S.Vishwanathan Printers and Pub., Madras

## **BOOKS FOR REFERENCE**

Sharma,O.P.,(1986), **Text book of Algae**, Tata McGraw - Hill Publishing Co. Ltd., New Delhi.

Sharma,O.P.,(1987), **Text book of Fungi**, Tata McGraw - Hill Publishing Co.Ltd., New Delhi.

Singh, V., P.C.Pande and D.K.Jain, (1987), **Anatomy of Seed Plants**, Rastogi Publications, Meerut, India.

## **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 2½ Hours

## **QUESTION PAPER PATTERN:**

**Section A** – Objective questions 22 x 1 = 22 marks

Short Paragraph 6 x 3 = 18 marks (6 out of 9)

**Section B** – 4 x 10 = 40 marks (4 out of 6 questions to be answered in 300 words each)

**Section C** – 1 x 20 = 20 marks (1 out of 2 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE**

**SYLLABUS**

(Effective from the Academic Year 2010 – 2011)

**ENVIRONMENTAL STUDIES**

**CODE : BT/GC/ES 12**

**CREDIT : 2**

**L T P : 2 0 0**

**TOTAL TEACHING HOUR : 26**

**OBJECTIVES OF THE COURSE**

- To create an awareness about current environmental issues
- To make the students eco-sensitive and eco-friendly.
- To educate the students about conservation and management of natural resources

**Unit 1**

**Natural Resources (7Hrs)**

- 1.1. Renewable & non renewable resources
- 1.2. Forest resources – use and over exploitation
- 1.3. Water resources – use and over utilization of surface & ground water
- 1.4. Mineral resources – use and exploitation.
- 1.5. Food resources – world food problems – effects of modern agriculture – sustainable agriculture.
- 1.6. Energy resources – renewable and non renewable energy sources – use of alternative sources of energy.
- 1.7. Need for public awareness in conservation of natural resources.

**Unit 2**

**Ecosystems and Biodiversity (6Hrs)**

- 2.1. Characteristic features of terrestrial and aquatic ecosystems – structure, function, food chain, food web & ecological pyramids.
- 2.2. Ecological succession. (a brief study)
- 2.3. Definition and levels of biodiversity
- 2.4. Hot spots of biodiversity
- 2.5. Threats to biodiversity – habitat loss – poaching of wildlife – man & wildlife conflicts.
- 2.6. Conservation of biodiversity – *in-situ* and *ex-situ* conservation methods

**Unit 3**

**Environmental Pollution (7Hrs)**

- 3.1. Air Pollution : sources , effects and control
- 3.2. Water Pollution: sources, effects and control.
- 3.3. Soil Pollution : sources, effects and control
- 3.4. Noise Pollution : sources , effects and control
- 3.5. Nuclear Hazards
- 3.6. Environmental Impact Assessment
- 3.7. Role of individual, society and government in prevention of pollution.

**Unit 4**

**Social Issues and the Environment (6Hrs)**

- 4.1 Multidisciplinary nature of environmental studies

- 4.2 Population explosion and its impact on environment
- 4.3 Water conservation – rain water harvesting – watershed management
- 4.4 Environmental ethics
- 4.5 Climate change and global warming
- 4.6 Role of information technology in environment

### **TEXT BOOK**

Bharucha, E., (2005), **Textbook of Environmental Studies**, (1<sup>st</sup> edition), Universities Press, Hyderabad.

### **BOOKS FOR REFERENCE**

Arul, P. (2004), **A Textbook of Environmental Studies**, (1<sup>st</sup> edition), Environment Agency, Chennai.

Asthara, D.K., M. Asthara, (2006), **A Textbook of Environmental Studies**, (1<sup>st</sup> edition), S. Chand and Co., Ltd, New Delhi.

Kaushik, A., C.P. Kaushick, (2006), **Perspectives in Environmental Studies**, (2<sup>nd</sup> edition), New Age International Pvt., Ltd., Publishers, New Delhi.

Singh, H.R., (2005), **Environmental Biology**, (1<sup>st</sup> edition), S.Chand and Co., Ltd., New Delhi.

### **END SEMESTER EXAMINATION**

Total Marks : 50

Duration : 2 Hours

### **QUESTION PAPER PATTERN:**

#### **Section A**

- Choose the correct answer 5 Marks
- State True or False 5 Marks
- Match the following 4 Marks

**Section B** – 6 x 2 = 12 marks (6 out of 10 questions to be answered in 30 words each)

**Section C** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**  
**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT**  
**BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ALGAE, FUNGI AND LICHENS**

**CODE: BT/MC/AF 14**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES**

- To enable students know the diverse assemblage of lower plants.
- To learn the life cycle patterns of lower plants.

**ALGAE**

**Unit 1 (6 Hrs)**

- 1.1. Classification of Algae (Bold and Wynne, 1978).
- 1.2. Characteristics of Algal Divisions

**Unit 2 (20 Hrs)**

- Detailed study of the thallus organization, reproduction and life cycle pattern of the following forms (no development)
- 2.1. Cyanochloronta - *Nostoc*
  - 2.2. Chlorophycophyta - *Volvox*, *Caulerpa* and *Cladophora*.
  - 2.3. Charophyta - *Chara*
  - 2.4. Phaeophycophyta - *Sargassum*
  - 2.5. Rhodophycophyta - *Polysiphonia*

**FUNGI**

**Unit 3 (6 Hrs)**

- 3.1. Classification of Fungi (Alexopoulos and Mims, 1979).
- 3.2. Characteristics of major fungal classes.

**Unit 4 (17 Hrs)**

- Detailed study of the thallus organization, reproduction and life cycle pattern of the following forms (no development)
- 4.1. Chytridiomycetes - *Synchytrium*
  - 4.2. Plasmodiophoromycetes - *Plasmodiophora*
  - 4.3. Oomycetes - *Albugo*
  - 4.4. Ascomycetes - *Aspergillus* and *Peziza*
  - 4.5. Basidiomycetes - *Polyporus* and *Puccinia*
  - 4.6. Deuteromycetes - *Cercospora*

**LICHENS**

**Unit 5 (3 Hrs)**

- Lichens: Types, Structure, Reproduction and importance.

## **TEXT BOOKS**

Sharma, O.P., (1986), **Text book of Algae**, Tata McGraw - Hill Publishing Co.Ltd., New Delhi.

Sharma, O.P., (1987), **Text book of Fungi**, Tata McGraw - Hill Publishing Co.Ltd., New Delhi.

## **BOOKS FOR REFERENCE**

Alexopoulos, C. J., (1962), **Introductory Mycology**, John Wiley and Sons Inc., New York.

Bold, H. C. and M.J.Wynne, (1979), **Introduction to Algae**, Prentice Hall of India Pvt. Ltd., New Delhi.

Bold, H.C (1973), **Morphology of Plants**, Harper & Row Publishers. New York.

Chapman, V. J. and D. J.Chapman, (1973), **The Algae**, Macmillan & Co., London.

Dube. H.C., (1985), **A Text Book of Fungi, Bacteria and Viruses**, Vikas Publishing House, New Delhi.

Ingold, C. T., (1993), **Biology of Fungi**, Hutchinson Educational Ltd., London.

Misra, A. and A. A. Agarwal, (1978), **Lichens- A Preliminary Text**, Oxford and IBH Publishing Co.

Morris, I.(1967), **An Introduction to Algae**, Hutchinson University Library, London.

Pandey, B.P., (1981), **A Textbook of Botany- The Algae**, S. Chand & Co., New Delhi.

Sharma, P.D., (2005), **Fungi and Allied Organism**, Narosa Publishers, New Delhi.

Smith, G.M.(1955), **Manual of Phycology**, McGraw-Hill Publishing Co., New York

Vashishta, B.R., (1978), **Botany for Degree Students - Part I-Algae**, S. Chand and Co., New Delhi.

## **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

## **QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)



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**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ALGAL AND FUNGAL BIOTECHNOLOGY**

**CODE: BT/MC/FB 14**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL HOURS: 52**

**OBJECTIVES**

- To gain an insight into the applied aspects of Algology and Mycology.
- To give an experiential learning to the students in the technological applications of Algae and Fungi.

**Unit 1 (8 Hrs)**

**Algae - Industrial applications**

- 1.1. Introduction
- 1.2. Single Cell Protein: as food and mass cultivation of *Spirulina*
- 1.3. Agarophytes-Agar Agar, Alginophytes - Algin and Carrageenan
- 1.4. Liquid seaweed fertilizer and Biofertilizer: *Nostoc and Anabaena*.

**Unit 2 (9 Hrs)**

**Fungi as Food**

- 2.1. Mushrooms: Morphology, Types - *Pleurotus sp.*, *Agaricus sp.* and *Volvariella*, Identification of edible and poisonous mushrooms, Nutritive value
- 2.1.1. Cultivation – Isolation, Spawn production, Growth Media, Spawn running, Harvest and uses

**Unit 3 (9 Hrs)**

**Industrial Mycology**

- 3.1. Antibiotics: Penicillin - Strain Selection, Media, Fermentation, Harvest, Recovery and Uses.
- 3.2. Organic acid: Citric acid - Production, Recovery and Industrial applications.

**PRACTICALS (For Internal Assessment only)\***

**Unit 4 (13 Hrs)**

**Algology – Practical**

- 4.1. Preparation of Agar - Agar, Alginate (Alginate beads) and Immobilisation techniques.
- 4.2. Antimicrobial activity of a few Marine and Fresh water algal extracts.
- 4.3. Cultivation of *Nostoc / Anabaena*

**Unit 5** **(13 Hrs)**

**Mycology**

- 5.1. Mushroom cultivation - *Pleurotus sp(or) Agaricus bisporus*.
- 5.2. Extraction of penicillin - Demonstration
- 5.3. Citric acid preparation.

\* Internal Evaluation based on Continuous Assessment of practical and record submission.

**Field visit**

**BOOKS FOR REFERENCE**

Bold, H.C. and M.J.Wynne, (1979), **Introduction to Algae**, Prentice Hall of India Pvt. Ltd., New Delhi.

Dhawan, V., (2004), **Biotechnology for Food and Nutritional Security**, TERI, India.

Ingold, C.T., (1993), **Biology of Fungi**, Hutchinson Educational Ltd., London.

Nair, L.N., (2007), **Topics in Mycology and Pathology**, New Central Book Agency Pvt., Ltd. Kolkata, India.

Patel, A.H., (1999), **Industrial Microbiology**, Macmillan India Limited, New Delhi.

Prescott and Dunn (1987), **Industrial Microbiology**, The AVI Publishing Co., Inc., USA.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE : BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ALGAE, FUNGI AND LICHENS - PRACTICAL**

**CODE: BT/MC/P1 12**

**CREDITS: 2**

**L T P: 0 0 3**

**TOTAL HOURS: 39**

**ALGAE**

Study of the forms mentioned in the theory syllabus.

Visit to places of phycological importance.

Herbarium - Algal specimens (minimum 3 sheets) to be submitted at the time of examination.

**FUNGI**

Study of the forms mentioned in the theory syllabus.

Herbarium - Fungal diseased plants (minimum 2 sheets) to be submitted at the time of examination.

**LICHENS**

A general study of various types of Lichens.

**PATTERN OF EVALUATION**

Duration : 2½hrs

Marks : 50

- |  |            |
|--|------------|
| 1. Sectioning, Drawing, identification with reasons (1 algae, 1 fungi) | 2 x 7 = 14 |
| 2. Spotters (4)  | 4 x 4 = 16 |
| 3. Algal Mixture   | 5          |
| 4. Spot at sight   | 10         |
| 5. Herbarium (Algae – 3, fungi – 2)                                    | 5          |

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**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT**  
**BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**BIOINSTRUMENTATION**

**CODE: BT/ME/BI 24**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL HOURS: 65**

**OBJECTIVES**

- To provide a basic knowledge of the working principles of the instruments used in biological research.
- To become proficient in handling instruments through practical experiments.

**Unit 1 (10 Hrs)**

**Quantitative Analysis**

- 1.1. pH Meter - Construction and Application
- 1.2. Colorimetry: Beer-Lambert's law, Single beam and Double beam photo-colorimeter.
- 1.3. Spectrophotometry - UV-Visible Spectroscopy, Basic Principle, Instrumentation, Single and Double beam Spectrophotometers (Block diagrams only)

**Unit 2 (11 Hrs)**

**Separation Techniques.**

- 2.1. Chromatography - Principles, techniques and application of Paper Chromatography, TLC, GLC and HPLC.
- 2.2. Electrophoresis: Principles, techniques and applications of Agarose, PAGE

**Unit 3 (7 Hrs)**

**Centrifugation.**

- 3.1. Centrifuge: Principle, Unit of measurement and Instrumentation.
- 3.2. Types: Bench, Ultracentrifuge, Analytical and Micro Centrifuge.
- 3.3. Density Gradient and Differential Centrifugation.

**Unit 4 (12 Hrs)**

**Light Microscopy**

- 4.1. Light Microscope and Micrometry
  - 4.1.1. Preparation of specimen for Light Microscope: Fixatives (FAA and Carnoy's fluid) dehydration, infiltration, preparation of paraffin block, Microtomes (Rotary and Wood Microtome), Progressive and Counter staining; single and double staining schedules.
- 4.2. Polarizing and Phase Contrast Microscope

**Unit 5 (10 Hrs)**

**Electron Microscopy**

- 5.1. Transmission Electron Microscopy

- 5.1.1. Preparation of specimen for TEM: Fixatives - Glutaraldehyde and Osmium tetroxide; Embedding - Spurr, Epon, BEEM capsules. Ultramicrotomy; Knives - glass and diamond; specimen support - grid, Staining - Positive and Negative staining.
- 5.2. Scanning Electron Microscopy
  - 5.2.1. Preparation of specimen for SEM: Fixing, Critical Point Drying, Freeze Drying, Freeze fracture replication, Freeze etching, Specimen coating - Sputter Coating, Shadow Casting.

**Unit 6 (15 Hrs)**

**Practical (Demonstration Experiments)  
(For Internal Assessment only)**

- 6.1. Preparation of Maceration, Leaf clearing and Micrometry
- 6.2. Permanent Mounting of Hand Sections and Paraffin Sections (Single Staining and Double Staining)
- 6.3. Estimation of protein / free amino acid (Proline) using Spectrophotometer.
- 6.4. Estimation of amylase activity using Photo-Colorimeter
- 6.5. Separation of proteins by Electrophoresis
- 6.6. Centrifuge - Isolation of Chloroplast

**BOOKS FOR REFERENCE**

Bozzola, John, J. and D. Russel Lonnie, (1992), **Electron Microscopy -Principles and Techniques for Biologist**; Jones and Bartlett Publishers, Boston, USA.

Harborne, J. B., (1973), **Phytochemical Method**, Chapman and Hall, London.

Jayaraman, J., (1985), **Techniques in Biology - A College level study**, Wiley Eastern Ltd., New Delhi.

Jensen, W. A., (1962), **Botanical Histochemistry**, TataGraw-Hill Pub. Co., Bombay-New Delhi.

Plummer, D. T., (1985), **An Introduction to Practical Biochemistry**, Tata McGraw-Hill Publishing Co., New Delhi.

Sass, J. E., (1958), **Botanical Microtechnique**, Ames, Iowa, USA.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**

**Major Elective Offered by the Department of Botany  
to students of Chemistry, Plant Biology and Plant Biotechnology and  
Advanced Zoology and Biotechnology**

**SYLLABUS**

(Effective from the academic year 2010 - 2011)

**FOOD MICROBIOLOGY, SANITATION AND HYGIENE**

(Skill Development Course)

**CODE : BT/ME/FH 24**

**CREDITS : 4**

**L T P : 3 0 2**

**TOTAL TEACHING HOURS : 65**

**OBJECTIVES OF THE COURSE**

- To provide a broad based education about the microbiological aspects of food.
- To impart skill oriented training on Food microbiology and enhancing the practical knowledge through experiential learning
- To impart knowledge about the sources and transmission of food contamination and the effects of spoilage.
- To highlight the importance of hygiene, sanitation and safe food storage.

**Unit 1 (16 Hrs)**

**Introduction**

- 1.1 General characteristics, morphology, types, basic identifying features of micro-organisms in food.
- 1.2 Instruments in microbiology – Lab work
- 1.3 Grams staining – Lab work
- 1.4 Identification of microorganisms (fungi,) from spoilt fruits and vegetables – Lab work

**Unit 2 (7 Hrs)**

**Micro-organisms**

- 2.1 Microbial growth – growth curve of bacteria
- 2.2 Effect of environmental factors on growth of micro-organisms: pH, water activity, oxygen availability, temperature

**Unit 3 (22 Hrs)**

**Food contamination and spoilage**

- 3.1 Cereals and cereal products
- 3.2 Vegetables and fruits
- 3.3 Milk & milk products - Methylene blue reduction test- milk – Lab work
- 3.4 Culture techniques – determination of microbial load in various food using the following techniques- serial dilution, pour plate, streak, slant, stab – Lab work

**Unit 4 (10 Hrs)**

**Hygiene**

- 4.1 Importance of personal hygiene of food handler- habits-clothes, illness
- 4.2 Education of food handler in handling and serving food
- 4.3 Safety in food storage, handling and preparation – safety of left over food
- 4.4 Cleaning methods: Sterilisation and disinfection- use of chemicals and heat
- 4.5 Food borne illness- bacteria Salmonella, Clostridium

**Unit 5 (10 Hrs)**

**Sanitation**

- 5.1 Kitchen design equipment and systems.
- 5.2 Structure and layout of food premises – maintaining clean environment –

Selecting, and installing cleaning equipment.  
5.3 Waste product handling : solid wastes and liquid wastes.

## **TEXT BOOKS**

Frazier, W.C., (1988), **Food Microbiology**, McGraw Hill Publications, New York.

Hobbs, B.C., and Gilbert, R.J. , (1978), **Food Poisoning and Food Hygiene**, The English Language Book Society and Edward Arnold Publishers Limited, New York.

## **REFERENCE BOOKS**

Jacob, M., (1989), **Safe Food Handling**, A training guide for Manager, WHO, Geneva.

James M. Jay, (1996), **Modern Food Microbiology**, CBS Publishers, New Delhi.

Pelczar, H.J. and Robert, D., (1968), **Microbiology**, McGraw Hill, New York.

Norman G. Marriot, (1989), **Principles of Food Sanitation**, AVI Publishing Co., Inc., Connecticut.

## **END SEMESTER EXAMINATION:**

### **QUESTION PAPER PATTERN:**

**Theory : 50 marks + Practicals : 50 marks**

#### **Theory :**

Total Marks: 50

Duration: 1 ½ Hours

### **QUESTION PAPER PATTERN:**

Section A : 10x2=20 marks ( all questions to be answered)

Section B : 4x5=20 marks (4 out of 6 questions to be answered)

Section C: 1x 10 = 10 marks (1 out of 2 questions to be answered)

#### **Lab work :**

Max marks: 50 marks

Duration : 1 ½ hours

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**HORTICULTURE**

**CODE: BT/ME/HC 24**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL HOURS: 65**

**OBJECTIVES**

- To enable the students to be self-reliant and to develop their entrepreneurial skills.
- To enhance their practical skills through experiential learning.

**Unit 1 (8 Hrs)**

- 1.1. Introduction: aim and scope.
- 1.2. Classification of horticultural plants
- 1.3. Garden implements and gardening operations.
- 1.4. Vegetative Propagation: Layering, Grafting and Budding.

**Unit 2 (12 Hrs)**

Cultural Practice - Propagation, Planting and Harvesting of the following -  
Fruits: Mango, Banana, Guava and Papaya.  
Vegetable Crops: Onion, Radish, Potato, Brinjal and Lady's finger.

**Unit 3 (12 Hrs)**

- 3.1. Techniques of growing Plants in Pot: Types of Pots, Potting and Repotting.
- 3.2. Hanging basket
- 3.3. Kitchen garden - Layout
- 3.4. Market garden and Truck garden.
- 3.5. Indoor garden and Public garden.
- 3.6. Rock garden and Terrace garden.
- 3.7. Vegetable forcing

**Unit 4 (12 Hrs)**

- 4.1. Lawn making and its maintenance
- 4.2. Green House: A brief study of the structure, construction, staging, shelving, cultural routine and training plants.
- 4.3. Cut Flowers, Flower arrangement: Fresh and Dry.

**Unit 5 (6 Hrs)**

- 5.1. Bonsai
- 5.2. Terrarium
- 5.3. Hydroponics



### **Practicals - Demonstration**

**(15 Hrs)**

- a. Vegetative Propagating Methods: Cutting/ Layering/ Grafting
- b. Potting / Pot culture (growing annuals)
- c. Terrarium
- d. Bonsai
- e. Flower arrangement (Fresh and Dry)
- f. Kitchen Garden
- g. Rock Garden
- h. Vegetable Carving

### **TEXT BOOK**

Kumar, N., (1990), **Introduction to Horticulture**, Rohini Agencies, Nagercoil.

### **BOOKS FOR REFERENCE**

Chauhan, D.V.S., (1968), **Vegetable Production in India**, Ram Prasad Sons, Agra.

Edmund, J.B., T.L.Senn, F.S.Andrews and R.G.Halfacre, (1990), **Fundamentals of Horticulture**, (4<sup>th</sup> Ed.), Tata McGraw Hill Pub.Co., London.

Gopalswamy Iyengar, K.S., (1970), **Complete Gardening in India**, Kalyan Press, Bangalore.

Janick, J., (1982), **Horticultural Science**, (3<sup>rd</sup> Ed.), Surgeet Publications, Delhi.

Naik, K.C., (1963), **South Indian Fruits and their Culture**, P.Varadharaj and Co., Madras.

Randhawa, G.S., (1973), **Ornamental Horticulture in India**, Today and Tomorrow Printers and Publishers, New Delhi.

Randhawa, M.S., (1961), **Beautiful Garden Trees**, I.C.A.R., New Delhi.

Yawalkar, K.S., (1961), **Vegetable Crops of India**, Agri - Horticultural Publishing House, Nagpur.

### **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

### **QUESTION PAPER PATTERN**

#### **QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT  
BIOTECHNOLOGY  
SYLLABUS**

(Effective from the academic year 2010 – 2011)

**BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERMS**

**CODE: BT/MC/BP 24**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To learn the classification, structure, organization, reproduction and life cycles of lower vascular plants.
- To analyse the primitive and advanced features of the living and fossil forms.

**BRYOPHYTA**

**Unit 1 (17 Hrs)**

- 1.1. Classification of Bryophyta (Proskauer, 1957)
- 1.2. Characteristic features of each class.
- 1.3. A detailed study of the thallus structure, anatomy and reproduction of the following (no development)
  - 1.3.1. Hepaticopsida - *Porella*
  - 1.3.2. Anthocerotopsida - *Anthoceros*
  - 1.3.3. Bryopsida - *Polytrichum*

**PTERIDOPHYTA**

**Unit 2 (20 Hrs)**

- 2.1. Classification of Pteridophyta (Reimers, 1951)
- 2.2. Characteristic features of each class.
- 2.3. A detailed study of the plant body, anatomy and reproduction of the following: (no development)
  - 2.3.1. Lycopsidea - *Lycopodium*
  - 2.3.2. Sphenopsida - *Equisetum*
  - 2.3.3. Filices - *Marsilea*

**Unit 3 (8 Hrs)**

Fossil forms - Pteridophyta: *Lepidodendron*, *Stigmaria*, *Lepidostrobus* and *Lepidocarpon*  
Gymnosperm: *Williamsonia*

**GYMNOSPERMS**

**Unit 4 (20 Hrs)**

- 3.1. Classification of Gymnosperms (Bierhorst, 1971)
- 3.2. Characteristic features of each class.
- 3.3. A detailed study of the plant body, anatomy and reproduction of the following (no development)
  - 3.3.1. Cycadopsida - *Cycas*
  - 3.3.2. Gnetopsida - *Gnetum*

## **TEXT BOOK**

Pandey, S.N., P.S. Trivedi and Misra, (1999), **A Text Book of Botany** (11<sup>th</sup> Revised Edition, 1998) Vol. II - (Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany), Vikas Publishing House Pvt. Ltd., New Delhi.

## **BRYOPHYTA**

### **BOOKS FOR REFERENCE**

Smith, G.M., (1995), **Cryptogamic Botany**, -Vol. II, McGraw Hill Publishing Co., London

Srivastava, H.N., (2007), **Bryophytes**, Pradeep Publishers, India.

Watson, E.V., (1968), **The structure and Life of Bryophytes**, Hutchinson University Library, London.

## **PTERIDOPHYTA**

### **BOOKS FOR REFERENCE**

Eames, A.J., (1979), **Morphology of Vascular Plants**, Tata McGraw Hill Pub. Co. New Delhi

Smith, G.M., (1979), **Cryptogamic Botany**, -Vol. II, McGraw Hill Publishing Co., London

Sporne, K.R., (1980), **Morphology of Pteridophytes**, B.I. Publications, New Delhi.

## **GYMNOSPERMS**

### **BOOKS FOR REFERENCE**

Chamberlain, C.J., (1986), **Gymnosperms - Structure and Evolution**, CBS, New Delhi.

Coulter, J.M. and C.J. Chamberlain, (1964), **Morphology of Gymnosperms**, Central Book Depot, Allahabad.

Srivastava, H.N., (2004), **Gymnosperms**, Pradeep Publishers, India.

## **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

## **QUESTION PAPER PATTERN**

### **QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERMS - PRACTICAL**

**CODE: BT/MC/P2 22**

**CREDITS: 2**

**L T P: 0 0 3**

**TOTAL HOURS: 39**

**BRYOPHYTA**

Study of the forms mentioned in the theory syllabus.

**PTERIDOPHYTA**

Study of the forms mentioned in the theory syllabus.

**GYMNOSPERMS**

Study of the forms mentioned in the theory syllabus.

**END SEMESTER EXAMINATION:**

Total Marks: 50

Duration: 2½ Hours

**QUESTION PAPER PATTERN:**

- |   |            |
|---|------------|
| 1. Sectioning, Drawing, Identification with reasons | 3 x 8 = 24 |
| 2. Spotters (4)                                     | 4 x 5 = 20 |
| 3. Spot at sight (3)                                | 3 x 2 = 6  |

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**WASTE MANAGEMENT**

**CODE: BT/GE/WM 24**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES**

- To create an awareness of the wastes that can accumulate, its hazards and management of solid and liquid wastes.
- To gain insight as to how waste can be converted into eco-friendly organic manure.

**Unit 1 (5 Hrs)**

**Introduction**

- 1.1. Wastes: Solid and Liquid wastes,
- 1.2. Waste generation and sources - Municipal, Kitchen, Garden, Agricultural and Industrial.

**Unit 2 (12 Hrs)**

**Recycling of wastes**

- 2.1. Composting - Principles, process and factors affecting composting.
- 2.2. Vermiculture Biotechnology: Types of earthworm, Culturing of earthworms, Vermibed maintenance.
- 2.3. Vermicomposting: Principle and process.
- 2.4. Types of Vermicomposting - Heap method and Pit method.

**Unit 3 (10 Hrs)**

**Sewage Disposal**

- 3.1. Primary Treatment.
- 3.2. Secondary Treatment
  - 3.2.1. Aerobic - Septic tanks, Trickling filters and Oxidation pond
  - 3.2.2. Anaerobic - Sludge digestion.
  - 3.2.3. Tertiary treatment - Chemical, Ozone and Reverse Osmosis

**Unit 4 (10 Hrs)**

**Biomonitoring of Water quality and Water purification**

- 4.1. Test for water purity - Coliform Test and Membrane Filter Technique.
- 4.2. Water Treatment - Steps involved in Water Treatment in a typical water purification plant.

**Unit 5****(15 Hrs)****Practicals**

1. Composting - Biodung method.
2. Vermicomposting - Pit method
3. Testing for purity of water - Coliform Test.
4. Physical Analysis of water - pH, Color, Turbidity, TDS  
Chemical Analysis of water - Salinity, Hardness and Nitrate content.
5. Transformation of wastes
6. Visit to Sewage plant and Tamil Nadu Water Supply and Drainage Board (TWAD) / Murugappa Chettiar Research Center (MCRC).

**TEXT BOOK**

Purohit, S.S., (2004), **A Textbook of Environmental Sciences**, Student Edition Publishers.

**BOOKS FOR REFERENCE**

Gupta, P.K., (2003), **Vermicomposting for Sustainable Agriculture**, Agrobios, India.

Kumar, H.D., (1999), **Environmental Pollution**, M.D. Publications, India.

NIIR Board, (2003), **Modern Technology of Waste Management**, Asia Pacific, Delhi.

Rachel, M.A., (1996), **Analysis of Waste Water for use in Agriculture**, (WHO).

Sathe, T.V., (2004), **Vermiculture and Organic Farming**, Daya Publishers, Delhi.

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks  
One Component – 25 Marks

**END SEMESTER (ES) EXAMINATION:** 2 hrs Test – 50 Marks

**QUESTION PAPER PATTERN:**

**Section A** – Objective questions 10 x 1 = 10 marks  
Answer in a sentence or two 5 x 2 = 10 marks

**Section B** – 3 x 5 = 15 marks (3 out of 5 questions to be answered in 100 words each)

**Section C** – 1 x 15 = 15 marks (1 out of 2 questions to be answered in 800 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**Allied Core Offered by the Department of Botany  
to student of Advanced Zoology and Biotechnology**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**GENERAL BOTANY – II**

**CODE: BT/AC/GB 23**

**CREDITS: 3**

**L T P: 3 0 0**

**TOTAL TEACHING HOURS: 39**

**OBJECTIVES**

- To enable the students to understand the physiological activities occurring in plants.
- To expose the students with basic knowledge on the structure, organization, reproduction and life cycle of lower plants.
- To create an awareness on the recent developments.

**Unit 1 (12 Hrs)**

**Physiology**

- 1.1. Photosynthesis - Light and Dark reactions
- 1.2. Respiration - Aerobic and Anaerobic
- 1.3. Growth Hormones - Auxins, Gibberellins, Cytokinins, ABA and Ethylene-  
Practical applications
- 1.4. Physiology of Flowering - Photoperiodism
- 1.5. Seed Dormancy

**Unit 2 (5 Hrs)**

**Bryophyta**

- 2.1. A brief mention of the characteristic features of Bryophytes
- 2.2. A detailed study of the life cycle (no development) of *Funaria*

**Unit 3 (5 Hrs)**

**Pteridophyta**

- 3.1. A brief mention of the characteristic features of Pteridophytes
- 3.2. A detailed study of the life-cycle (no development) of *Adiantum*

**Unit 4 (7 Hrs)**

**Gymnosperms**

- 4.1. A brief account of the characteristic features of Gymnosperms
- 4.2. A detailed study of the life-cycle (no development) of *Cycas*

**Unit 5 (4 Hrs)**

**Plant Pathology**

- 5.1. A study of the causal organism, symptoms and control measures of the following plant diseases:
  - 5.1.1. Citrus Canker
  - 5.1.2. Tikka Disease of Groundnut.

**Unit 6**

**(6 Hrs)**

**General Topics**

6.1. Basic Plant Hybridization Techniques

6.2. Principles of Plant Tissue culture

**TEXT BOOK**

Rao, K. N., and Narayaswamy, R.V., (1986), **Outlines of Botany**, S.Viswanathan Printers and Pub., Madras

**BOOKS FOR REFERENCE**

Sinha,R.K., (2006) **Modern Plant Physiology.**, Narosa Publishing House, New Delhi.

Verma. V., (1989), **Text Book of Plant Physiology**, Emkay Publications, New Delhi.

Vidyarthi, R.D., (1992), **Text Book of Botany**, S.Chand and Co.Ltd., New Delhi.

**END SEMESTER EXAMINATION:**

Total Marks: 100 (converted to 50)

Duration: 2½ Hours

**QUESTION PAPER PATTERN:**

**Section A** – Objective questions 22 x 1 = 22 marks

Short Paragraph 6 x 3 = 18 marks (6 out of 9)

**Section B** – 4 x 10 = 40 marks (4 out of 6 questions to be answered in 300 words each)

**Section C** – 1 x 20 = 20 marks (1 out of 2 questions to be answered in 1000 words each)



**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**Allied Core Offered by the Department of Botany  
to student of Advanced Zoology and Biotechnology**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**GENERAL BOTANY – PRACTICAL**

**CODE: BT/AC/P1 22**

**CREDITS: 2**

**\*L T P: 0 0 4**

**TOTAL HOURS: 52**

**\*Practical – 2 hours per week in semester I and 2 hours per week in semester II**

**End semester examination at the end of the academic year**

**Unit 1**

**Taxonomy**

Description in technical terms of plants belonging to the families mentioned in the syllabus.

Identification of plants to their respective families, dissection of flowers, observation and sketching of floral parts, construction of floral diagram and floral formula

**Unit 2**

**Anatomy**

Preparation of suitable sections of angiosperm material included in the Syllabus and their interpretation

**Unit 3**

**Algology and Mycology**

Identification, observation and sketching of types included in the syllabus

**Unit 4**

**Physiology**

Physiological experiments included in the syllabus – Observation and interpretation.

**Unit 5**

**Bryophyta**

Identification, observation and sketching of types included in the syllabus

**Unit 6**

**Pteridophyta and Gymnosperms**

Preparation of suitable sections of forms included in the syllabus and their Interpretation

**Unit 7**

**General Topics**

Cultivation of Oyster Mushrooms (demonstration only)

Bonsai Technique (demonstration)

## **PATTERN OF EVALUATION**

Duration : 2½hrs

Marks : 50

1. Taxonomy – Description (1)	8
2. Anatomy – Sectioning & Identification (1)	8
3. Physiology – Comment on set up (1)	7
4. Bryo, Pterido & Gymnos – Sectioning & identification	7
5. Spotters (5) – 5 x 4	20

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**FRUIT PRESERVATION**

**CODE: BT/GE/FP 32**

**CREDITS: 2**

**L T P: 2 0 0**

**TOTAL HOURS: 26**

**OBJECTIVES**

- To enable students to develop skills related to preservation.
- To give students practical training in the preparation and preservation of different fruit products.

**Unit 1**

**Introduction**

**(4 Hrs)**

- 1.1. Principles of Food Preservation
- 1.2. Types of spoilage
- 1.3. Factors promoting spoilage

**Unit 2**

**Methods of Fruit Preservation**

**(5 Hrs)**

- 2.1 Refrigeration
- 2.2 Freezing
- 2.3 Canning
- 2.4 Dehydration
- 2.5 Chemical Preservatives

**Unit 3**

**Techniques in Fruit Preservation**

**(5 Hrs)**

- 3.1. Proportion of ingredients
- 3.2. Selection of fruits
- 3.3. Estimation tests
- 3.4. Filling and bottling of products
- 3.5. Precautions

**Practical**

**Unit 4**

**Preparation of products preserved in sugar**

**(8 Hrs)**

- 4.1. Lime syrup
- 4.2. Grape crush
- 4.3. Orange squash

- 4.4. Mixed fruit jam
- 4.5. Guava jelly
- 4.6. Ginger preserve
- 4.7. Tutti fruity

**Unit 5** (4 Hrs)

**Preparation of products preserved in salt**

- 5.1. Tomato chutney
- 5.2. Mixed vegetable pickle

**BOOKS FOR REFERENCE**

Blank, F.C., (2000), **Handbook of Food and Nutrition**, Agrobios Publishers, Jodhpur.

Frazier, W.C. and West Hoff, D.C., (1995), **Food Microbiology (4<sup>th</sup> Ed.)**, Tata McGraw Hill Publishing Co., Ltd., New Delhi.

Home scale - **Processing and Preservation Fruits and Vegetables**, (1996), Central Food Technological Research Institute. Mysore.

Kulshrestha, S. K., (1994), **Food Preservation**, Vikas Publishing House, New Delhi.

Ramakrishnan, S., (1996), **Nutritional Biochemistry**, T.R.Publications, India.

Scenetra, R., (2007), **Food Science and Nutrition**, Oxford Univ. Press.

Swaminathan, M., (1992), **Handbook of Food Science and Experimental Foods**, The Bangalore Printing and Publishing Co., Ltd., Bangalore.

**PATTERN OF EVALUATION (Totally Internal)**

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks

One Component – 25 Marks

**This will be converted to 100 marks by Controller of Examination**

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree  
SYLLABUS

(Effective from the academic year 2010 – 2011)

**HERBAL THERAPY**

**CODE: BT/GE/HT 32**

**CREDITS: 2**

**L T P: 2 0 0**

**TOTAL HOURS: 26**

**OBJECTIVE**

- To enable students to acquire knowledge of common medicinal plants, with special reference to their availability and therapeutic value.

**Unit 1 (9 Hrs)**

**Indian Systems of Medicine**

- 1.1. Introduction: Ayurveda, Siddha and Unani.
- 1.2. Basic Principles of Ayurveda: Panchamahabhutas, Tridhosha concept and Malas.
- 1.3. Preparation of Ayurvedic and Siddha medicine.  
Ayurveda: Svarasa (Juice); Churna (powder); Kalka (paste); Kashaya (Decoction and Infusion) and Bhasma.  
Siddha: Lavanam, Pashanam, Loham, Rasam and Gandhakam.

**Unit 2 (5 Hrs)**

**Herbs and Therapeutics**

- 2.1. Herbal remedies for some common ailments: Diarrhoea, Ulcer, Cold, Asthma, Fever, Hypertension, Jaundice, Chickenpox, Diabetes, Menstrual disorders, Bites and Stings.
- 2.2. General health tonics and Salads.

**Unit 3 (3 Hrs)**

**Skin care**

- 3.1. Herbal care for facial skin: Herbal face pack for dry, oily and normal skin.
- 3.2. Herbal remedy for pimples, acnes, black heads, corns, warts and boils.

**Unit 4 (3 Hrs)**

**Hair care**

- 4.1. Herbal remedy for dandruff, premature greying and loss of hair.
- 4.2. Hair washes and herbal hair tonics.

**Unit 5 (6 Hrs)**

**Practical and Demonstration**

- 5.1. Preparations of Ayurvedic medicines (Churnam, Decoction, Leghyam, Tailam and Skin cream)
- 5.2. Demonstration of facial and hair care.

## **Field Visit**

### **BOOKS FOR REFERENCE**

Hans, R.H., (1994), **Ayurveda the Gentle Health System**, Motilal Banarsidass Publishers, Delhi.

Jaibala,S. and G. Balakrishnan, (1975), **A Hand Book of Common Remedies Based on Siddha System of Indian Medicine**, Ed., St. Louis Institute Press, Madras.

Judith H.Morrison, (1994) **The Book of Ayurveda, A guide to personal wellbeing**, Gaia Books Ltd, London.

Pieronia, A. and Price, L.L., (2006), **Eating and Healing: Traditional food as Medicine**

Prajapati, N. D. and S. S Purohit, (2003), **A Handbook of Medicinal Plants**, Agrobios, Jodhpur

S.S Agrawal, M.Paridhave (2007), **Herbal Drug Technology**, Universities Press (India) Pvt,Ltd., New Delhi.

Saha,N.N.(1981), **Herbal Remedies**, Universal Publication, New Delhi.

Sunil, J.V., (1998), **Ayurveda and Panchakarma. The Science of Healing and Rejuvenation**, Motilal Banarsidass Publishers, Delhi.

Vaidya Bhagwan Dash (1978), **Fundamentals of Ayurvedic Medicine**, Konark

### **PATTERN OF EVALUATION (Totally Internal)**

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks  
One Component – 25 Marks

**This will be converted to 100 marks by Controller of Examination**

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY - PRACTICAL**

**CODE: BT/MC/P3 32**

**CREDITS: 2**

**L T P: 0 0 3**

**TOTAL HOURS: 39**

**TAXONOMY OF ANGIOSPERMS**

Laboratory sessions will consist of working with fresh materials to illustrate descriptive terminology, derivation and salient features of plant families – floral analysis (1 material / family).

A plant collection of 10 plants belonging to at least 10 different families – Herbarium to be submitted for the end semester examination.

Use of dichotomous key in the classification of the given specimens.

**ECONOMIC BOTANY**

Economically important products of families mentioned in Unit 4 and Unit 5 of the theory syllabus.

Submission of 5 economically important products with information on binomial, vernacular name and nature of product.

**END SEMESTER EXAMINATION:**

Total Marks: 50

Duration: 2½ Hours

**QUESTION PAPER PATTERN:**

1. Family Identification	2 x 4 = 8
2. Description, Drawing & Dissection	1 x 12 = 12
3. Key Preparation	5
4. Spot at sight	20
5. Herbarium	5

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**PHYTOTHERAPY AND ETHNOBOTANY**

**CODE: BT/MC/PE 33**

**CREDITS: 3**

**L T P: 3 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES**

- To create awareness on the indigenous medicinal systems and tribal traditional practices.
- To learn the therapeutic property of plants through preparation of herbal medicines.

**Unit 1 (8 Hrs)**

**Origin of herbs in health care**

- 1.1. Basic principles of Ayurveda and Siddha: Panchamahabhutas, Tridhosha Concept, Malas, Agni, Prakruti.
- 1.2. Drug preparation: Ashwam, Arishtam, Taila, Churnam, Leghyam, Bhasmam, Infusion and Decoction, Poultice: Salves, Compresses, Mouthwash.
- 1.3. Adulteration, Detection and Standardization of drugs.

**Unit 2 (18 Hrs)**

**Pharmacognosy**

Vernacular name, Binomial, Family, Active principle, Morphology of the useful part, and Medicinal Uses of the following:

- 2.1. Roots : *Asparagus racemosus*; *Rauwolfia serpentina*.
- 2.2. Underground stem : *Zingiber officinalis*, *Curcuma longa*, *Allium cepa* and *Aloe vera*.
- 2.3. Leaves : *Ocimum sp.*, *Tylophora asthmatica*, and *Catharanthus roseus*
- 2.4. Flowers : *Hibiscus rosa-sinensis* and *Datura stramonium*.
- 2.5. Fruits : *Piper longum*, *Terminalia bellerica*, *Terminalia chebula* and *Emblica officinalis*.
- 2.6. Seeds : *Strychnos nuxvomica* and *Trigonella foenum-graceum*.
- 2.7. Bark : *Cinnamomum zeylanicum*
- 2.8. Whole plant : *Azadirachta indica*, *Eclipta alba*, *Acalypha indica* and *Phyllanthus amarus*.

**Unit 3 (4 Hrs)**

**Ethnobotany**

- 3.1. Ethnobotany : Definition and scope
- 3.2. Methodologies of Ethnobotanical research, Fieldwork, Literature, Herbaria and Musea.



- 3.3. Ethnobotany and health care.
- 3.4. Ethnobotanical studies of Toda, Kurumba and Irula Tribes.
- 3.5. Sacred groves and conservation of endangered indigenous plants.

**Unit 4 (4 Hrs)**

**Ayurveda and beauty**

- 4.1. Role of Dhatu in physical beauty and daily routine to enhance beauty.
- 4.2. Essential oils and Salads.

**Unit 5 (18 Hrs)**

**Practicals (For Internal Assessment only)**

- 5.1. Preparation of the following Ayurveda / Siddha Medicines for common ailments:
  - Infusion and Decoction: Jaundice, Menorrhagia, Ulcer and Flatulence
  - Poultice: Ringworm
  - Salves and Creams: Night cream
  - Mouth wash and Herbal tooth powder
  - Tailam: Dandruff, Premature greying of hair and Hair growth
  - Churnam: Hypertension, Diabetes, Dysentery and Asthma
  - Leghyam: Cold and Asthma
- 5.2. Microscopic and qualitative analysis of herbal drug (Churnam)
- 5.3. Facial and hair care using herbal products.

**BOOKS FOR REFERENCE**

Das, S.N., (2006), **Medicinal Plants for Health and Wealth**, Agrotech. New Delhi.

Dash, V.B., (1978), **Ayurvedic Treatment for Common Diseases**, Konark Publishers Pvt. Ltd., New Delhi.

Dash, V.B., (1989), **Fundamental of Ayurvedic Medicine**, Konark Publishers Pvt. Ltd., New Delhi.

Dastur, J.F., (1988), **Medicinal plants of India and Pakistan**, D.B.Taraporewala Sons and Co. Pvt. Ltd., Bombay.

Duke, J.A., (2002), **Handbook on Medicinal Herbs**, CRC Press, London.

Froog, S., (2005), **Medicinal Plants - Field and Laboratory Manual**, International Book Distributors.

Grewalr, R.C., (2000), **Medicinal Plants**, Harvard Univ. Press, Cambridge.

Hanson, B.A., (2005), **Understanding Medicinal Plants, their chemistry and therapeutic action**, The Haworth Press Inc. New York.

ICMR, (2006), **Quality Standards of Indian Medicinal Plants**, (Vols. I, II, III, & IV), ICMR Publishers, New Delhi.

Jaibala, S. and G.Balakrishnan, (1975), **A Hand Book of Common Remedies based on Siddha System of Indian Medicine**, Ed., St.Louis institute Press, Madras.

Jain, S.K., (1997), **Contribution to Ethnobotany**, Scientific Publishers, India.

Kapoor, L.D., (2001), **Handbook of Ayurvedic Medicinal Plants**, CRC Press, India.

Prajapati, N.D. and S.S.Purohit, (2003), **Agro's Color Atlas of Medicinal Plants**, Agrobios, Jodhpur.

Rastogi, R.P., (1988), **Compendium of Indian Medicinal Plants**, Vols. I, II, III and IV, Central Drug Research Institute Publication and Information Directorate, New Delhi.

Reddy, K.J., B.Bahadur, B.Bhadriah and M.L.N.Rao, (2007), **Advances in Medicinal Plants**, Universities Press, New Delhi.

Saha, N.N., (1981), **Herbal Remedies**, Universal Publication, New Delhi.

Trivedi, P.C., (2006), **Medicinal Plants: Ethanobotanical Approach**, Agrobios, Jodhpur.

#### **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

#### **QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**

**CODE: BT/MC/TE 34**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To learn the vegetative and reproductive features of a few families.
- To be able to construct keys for identification of flowering plants for the families under study
- To identify some of the common flowering plants of Tamil Nadu through the use of floras.

**TAXONOMY OF ANGIOSPERMS**

- Unit 1 (10 Hrs)**
- 1.1 Importance of taxonomy
  - 1.2 Classification - Artificial, Natural and Phylogenetic system of classification.
  - 1.3 Detailed study of Bentham and Hooker's classification - Merits and Demerits.
  - 1.4 Taxonomic keys - use of dichotomous keys.
- Unit 2 (5 Hrs)**
- 2.1. Plant nomenclature: Binomial and Polynomial
  - 2.2. ICBN, Typification, Effective and Valid Publications, Author Citation, Choice of names and Rejection of names.
  - 2.3. Numerical Taxonomy
- Unit 3 (5 Hrs)**
- 3.1. Herbarium Techniques: collection, pressing, drying, poisoning, mounting and preservation of plant specimens.
  - 3.2. Botanical Gardens and some important herbaria.
- Unit 4 (35 Hrs)**
- Detailed study of the diagnostic characteristics and economic importance of the following families.
- Dicotyledones
- 4.1. Polypetalae - Annonaceae, Nymphaeaceae, Rutaceae, Fabaceae (including the subfamilies), Cucurbitaceae and Apiaceae.
  - 4.2. Gamopetalae - Rubiaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae and Lamiaceae.

- 4.3. Monochlamydeae - Amaranthaceae, Euphorbiaceae  
4.4. Monocotyledones -Orchidaceae, Arecaceae and Poaceae

**Unit 5**

**(10 Hrs)**

**Economic Botany**

A brief study of the economic products: botanical name, common name, family, uses and morphology of the useful part of any five plants of the following: -

- 5.1. Fibre and Fibre yielding plants.
- 5.2. Tannins and dyes.
- 5.3. Gums and Resins.
- 5.4. Spices and Condiments.
- 5.5. Fumitories and Masticatories.

**TEXT BOOKS**

Singh.V. and D.K. Jain., (1981), **Taxonomy of Angiosperms**, Rastogi Publications, Meerut.

Verma.V., (1985), **A Text Book of Economic Botany**, Cambridge University Press, London.

**BOOKS FOR REFERENCE**

Gamble,J.S., (1956), **Flora of the Presidency of Madras, Vol. II**, Jayyed Press, Ballimaran, New Delhi.

Hill, A.F., (1979), **Economic Botany**, Tata McGraw-Hill Publishing Co., New York.

Jeffrey, C., (1982), **An introduction to Plant Taxonomy**, Cambridge University Press, London.

Lawrence, George.H.M., (1967), **Taxonomy of Vascular Plants**, Oxford IBH Publishing Co., New Delhi.

Mondal, A.K., (2005), **Advanced Plant Taxonomy**, New Central Book Agency Pvt. Ltd., Kolkata, India.

Naik, V.N., (1984), **Taxonomy of Angiosperms**, Tata McGraw-Hill Publishing Co., New York.

Rendle, A.B., (1980), **Classification of Flowering Plants, Vol.I & II**, Cambridge University Press, London.

Sambarmurthy, A.U.S.S., (2000), **Economic Botany of Crop Plants**, Asiatech. Publishers.India.

Subramanyam, N.S., (1995), **Modern Plant Taxonomy (1<sup>st</sup> Ed.)**, Vikas Publishing House Pvt., Ltd., New Delhi.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**APPLIED BOTANY**

**CODE: BT/GE/AB 44**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVE**

- This course aims to provide an insight into the various applications of Botany.

- Unit 1 (10 Hrs)**  
**Novel Foods**  
1.1. Algal Food: *Spirulina* - Morphology, Mass cultivation, Nutritional value and Uses  
1.2. Fungal Food: Mushroom - Types, Cultivation and Nutritional value.
- Unit 2 (10 Hrs)**  
**Microbiology**  
2.1. Fermented Food: Processing of Cheese - Cheddar and Roquefort  
2.2. Biofuel: Production of Ethanol
- Unit 3 (5 Hrs)**  
**Economic Botany**  
Botanical name, Common name, Family, Morphology of the useful part and uses of the following plants:  
3.1. Medicinal Plants - Neem, Pepper, Sacred Basil, Ginger and Aloe  
3.2. Edible Plants -Rice, Red Gram, Sugarcane, Coffee and Gingelly  
3.3. Cash Crops - Cotton, Tobacco, Rubber, Cardamom, and Cashew
- Unit 4 (15 Hrs)**  
**Horticulture**  
4.1. Types of pots, potting and re-potting techniques  
4.2. Cut flowers - Rose and Gladioli  
4.3. Flower arrangements (Fresh)  
4.4. Bonsai  
4.5. Lawn and its maintenance
- Unit 5 (6 Hrs)**  
**General Topics**  
5.1. Principles of Tissue Culture  
5.2. Hybridization Techniques

**Demonstration****(6 Hrs)**

- a. Economic Botany (Unit 3)
- b. Horticulture. (Unit 4)

**BOOKS FOR REFERENCE**

Chaudari, H.K., (1983), **Elements of Plant Breeding** (7<sup>th</sup> Ed), Oxford - IBH Publishing Co. New Delhi.

Dubey, R.C., (2001), **A Textbook of biotechnology**, S.Chand and Company Ltd., New Delhi.

Hill, A.F., (1979), **Economic Botany**, Tata McGraw - Hill publishing Co., New York.

Kumar, N., (1990), **Introduction to Horticulture**, Rohini Agencies, Nagercoil.

Patel, A.H., (1999), **Industrial Microbiology**, Macmillan India Limited, New Delhi.

Prescott and Dunn, (1987), **Industrial Microbiology**, The AVI Publishing Co., Inc., USA.

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks  
One Component – 25 Marks

**END SEMESTER (ES) EXAMINATION:** 2 hrs Test – 50 Marks

**QUESTION PAPER PATTERN:**

**Section A** – Objective questions                      10 x 1 = 10 marks

Answer in a sentence or two    5 x 2 = 10 marks

**Section B** – 3 x 5 = 15 marks (3 out of 5 questions to be answered in 100 words each)

**Section C** – 1 x 15 = 15 marks (1 out of 2 questions to be answered in 800 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086**

**General Elective Course Offered by Department of Sociology, Botany and Zoology for  
B.A. / B.Sc. / B.Com. Degree**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ETHNOBIOLOGY**

**CODE: SC/GE/EB 44**

**CREDITS: 4**

**L T S: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES OF THE COURSE**

- To become familiar with the nature of ethnobiological knowledge
- To gain an understanding of the diversity of approaches to plant resources among different human groups, and of fundamental significance of plants for foods, medicines, and in technology among peoples of different cultures.
- To gain an understanding of the rich cultural knowledge that human societies have about animals
- To gain understanding of the relationship to the environment that characterize different human societies.
- To engage in critical analysis of contemporary issues of conservation of traditional resources, the effects of globalization and issues surrounding intellectual property of traditional and local peoples in the global market place.

**Unit 1 (10 Hrs)**

**Introduction**

- 1.1 Introduction to Ethnology – Culture – Processes of Culture – Diffusion, Acculturation, Assimilation – Components of Culture – Traditions, Norms, Folkways, Mores, Conventions, Values and Beliefs.
- 1.2 Introduction to Ethnobiology
- 1.3 Ethnobiology

**Unit 2 (10 Hrs)**

**Ethnobotany**

- 2.1 Plants as Foods
- 2.2 Plants as Medicines
- 2.3 Plants for Technology

**Unit 3 (12 Hrs)**

**Ethnozoology – Ethnozoological life forms.**

- 3.1 Ethnoentomology – insects in medicine – Entomophagy
- 3.2 Frogs in popular culture – Salamanders in mythology – toad licking.
- 3.3 Ethnoherpetology – Serpent symbolism – herpetofauna used for food and medicine
- 3.4 Ethnoornithology – birds used for food, medicine and personal adornment and in rituals – Ethnoornithology and conservation
- 3.5 Mammals – used for food and medicine.



**Unit 4** (12 Hrs)

**Traditional Cultural Institutions**

- 4.1 Marriage : Forms of marriage: Monogamy, Polygamy, Polygyny and Polyandry.
- 4.2 Kinship: Kinship terms, classificatory and descriptive system of Kinship, Kinship usages.
- 4.3 Family: Types, Functions, Patterns of residence, patterns of descent and authority, patterns of inheritance.
- 4.4 Religion: Definition of religion, Religion beliefs and practices: Magic, sorcery, Difference between magic, religion, totem and taboo.
- 4.5 Theories: Animism, Manism and Naturalism, Functional theory of religion – Totemism, Sacred and Profane.

**Unit 5** (8 Hrs)

**Ecological Knowledge and Contemporary Issues**

- 5.1 Ethno Genetics – cloning, issues of identity and discrimination, Ethnogenetics and Nationalism, Traditional Ecological knowledge and Traditional Environmental Management.
- 5.2 Contemporary Issues: Traditional Cultures, Resource Management and Conservation, and Traditional Knowledge and Intellectual Property.

**BOOKS FOR REFERENCE**

Belas, R. and Hoijer, H., (1960), **Introduction to Anthropology**, Mac Millan, New Delhi.

Berlin, Brent, (1992), **Ethnobiological Classification: Principles of Categorization of Plants and Animals in Traditional Societies**, Princeton University Press.

Carol R. Ember, Melvin Ember, (1992), **Anthropology – A Brief Introduction**, Prentice Hall, New Jersey.

Cotton, C.M., (1996), **Ethnobotany, Principles and Applications**, John Wiley and Sons.

Ellen, R., (ed.) (2006), **Ethnobiology and The Science of Humankind**, Oxford: Blackwell.

Hansen, Stephen and VanFleet, Justin, (2003), **Traditional Knowledge and Intellectual Property : A Handbook on Issues and Options for Traditional Knowledge Holders in Protecting their Intellectual Property and Maintaining Biological Diversity**, American Association for the Advancement of Science (AAAS), Washington.

Indraneil Dass, (1998), **The Serpent's Tongue : A Contribution to the Ethnoherpetology of India and adjacent countries**, Chimaira Publications.

Minnis, P.E., (ed.), (2000), **Ethnobotany: A reader**, Norman: University of Oklahoma Press.

**CONTINUOUS ASSESSMENT (CA) :** 1 Hour Test – 25 Marks  
One Component – 25 Marks

**END SEMESTER EXAMINATION:** 2 Hours Test – 50 Marks

**QUESTION PAPER PATTERN:**

**Section A** – 5 x 2 = 10 marks (Answer all 5 questions in 50 words each)

**Section B** – 5 x 5 = 25 marks (5 out of 8 questions to be answered in 200 words each)

**Section C** – 1 x 15 = 15 marks (1 out of 2 questions to be answered in 750 words)

**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI- 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

**(Effective from the academic year 2010 – 2011)**

**ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**

**CODE: BT/MC/AE 44**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To enable the students to have a basic knowledge of the structure, organisation, differentiation, function and interrelationship of cells and tissues of the plant body
- To focus on the importance of reproductive biology of plants.

**ANATOMY**

- Unit 1 (20 Hrs)**
- 1.1. Meristem: Classification, Organisation of shoot apex and root apex.
  - 1.2. Lateral meristem: Vascular cambium - structure and formation.
  - 1.3. Cork Cambium: Periderm - Phellem, Phellogen and Phelloderm, Development, Location, Morphology of Bark, Commercial Bark, Protective tissues of monocot and Lenticels.
  - 1.4. Secondary xylem: Vessels, Tracheids, Wood parenchyma and rays, Sap wood, Heartwood, Annual rings, Dendrochronology, Compression wood and Tension wood
  - 1.5. Secondary phloem: Sieve tubes, Companion cells, Phloem parenchyma and Fibres.
- Unit 2 (18 Hrs)**
- 2.1. Secondary growth of normal dicot root and dicot stem.
  - 2.2. Anomalous growth: Primary and Secondary structures.
  - 2.3. Primary thickening meristem in monocots.
  - 2.4. Anomalous secondary thickening in monocot stem - *Dracaena*.
- Unit 3 (10 Hrs)**
- 3.1. Nodal Anatomy - Unilacunar, Trilacunar and Multilacunar nodes.
  - 3.2. Leaf - Internal structure of Isobilateral dicot, Isobilateral and centric monocot leaf .
  - 3.3. Leaf abscission.
  - 3.4. Epidermis

## EMBRYOLOGY

**Unit 4** (17 Hrs)

- 4.1. Microsporangium: Microsporogenesis - Male gametophyte
- 4.2. Megasporangium: Megasporesogenesis - Female gametophyte -  
Monosporic (*Polygonum*), Bisporic (*Allium*) and Tetrasporic  
(*Peperomia*)
- 4.3. Double fertilization.
- 4.4. Endosperm - Types and functions.
- 4.5 Embryo - Development of Dicot embryo - *Capsella*  
- Development of Monocot embryo - *Luzula forsteri*
- 4.6 pomixis

### TEXT BOOKS

Bhojwani, S.S and S.P.Bhatnagar, (1986), **Embryology of Angiosperms**, Vikas Publishing House (Rt.) Ltd., New Delhi.

Singh, V., P.C.Pande and D.K.Jain, (1987), **Anatomy of Seed Plants**, Rastogi Publications, Meerut, India.

### BOOKS FOR REFERENCE

Cutler, D.F., (1986), **Applied Plant Anatomy**, Longman, Green and Co. New York.

Cutter, E.G., (1978), **Plant Anatomy**, (2<sup>nd</sup> Ed.), Part I, The English Language Book Society and Edward Arnold (Publishers) Ltd. London.

Esau K., (1972), **Anatomy of Seed Plants**, (2<sup>nd</sup> Ed.), Wiley Eastern Ltd., New York.

Fahn,A., (1986), **Plant Anatomy**, Pergamon Press, Oxford, London.

Vashista, P.C., (2004), **Plant Anatomy for Under Graduate Students**, Pradeep Publications, New Delhi.

### END SEMESTER EXAMINATION:

Total Marks: 100

Duration: 3 Hours

### QUESTION PAPER PATTERN

#### QUESTION PAPER PATTERN:

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS - PRACTICAL**

**CODE: BT/MC/P4 42**

**CREDITS: 2**

**L T P: 0 0 3**

**TOTAL HOURS: 39**

**PLANT ANATOMY**

A study of the anatomy of the following:

Secondary structure: Dicot Stem - *Helianthus*

Dicot Root - *Moringa*

Leaf: Isobilateral - Dicot - *Nerium*

Monocot - *Grass*

Centric - Monocot - *Allium*

Stomatal types: Dicot

Anomalous Structure:

Primary:

*Nyctanthus*

***Boerhaavia***

Secondary:

*Bignonia*

*Bougainvillea*

*Leptadenia*

*Dracaena*

Nodal Anatomy: Unilacunar, Trilacunar and Multilacunar nodes (diagrammatic sketch only)

**EMBRYOLOGY**

A study of the following:

1. T.S of young anther and mature anther
2. Binucleate and Tetranucleate embryo sacs
3. Stages of Dicot embryo development
4. L.S. of mature monocot embryo
5. Endosperm - nuclear, cellular and ruminant
6. Embryo dissection - *Tridax* / *Achyranthes*

**END SEMESTER EXAMINATION:**

Total Marks: 50

Duration: 2½ Hours

**QUESTION PAPER PATTERN:**

Sectioning, Drawing, Identification with reasons	3 x 8 = 24
Embryo Dissection	6
Spotters (2 Anatomy, 2 Embryology)	4 x 5 = 20

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**FUNDAMENTALS OF HORTICULTURE**

**CODE: BT/GE/FH 54**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES**

- To enable the students to be self-reliant and to develop their entrepreneurial skills.
- To enhance their practical skills through experiential learning.

**Unit 1 (6 Hrs)**

- 1.1. Introduction: Divisions of horticulture
- 1.2. History of Gardening - some famous gardens in India
- 1.3. Types of Gardens: Indoor, Public and Kitchen garden

**Unit 2 (8 Hrs)**

- 2.1. Pot cultures: Selection of pots, potting, repotting and potting mixtures (any two)
- 2.2. Vegetative propagation: Layering, Cutting, Grafting.

**Unit 3 (5 Hrs)**

- 3.1. Gardening operations: Planting, Transplanting, Pinching, Disbudding, Defoliation, Staking, Pruning, Watering, Mulching, and Topiary.
- 3.2. Ornamental garden and its parts.

**Unit 4 (10 Hrs)**

- 4.1. Lawn and Lawn making
- 4.2. Rockery
- 4.3. Terrarium
- 4.4. Bonsai

**Unit 5 (8 Hrs)**

- 5.1. Commercial Floriculture: Economic flowers - Jasmine and Rose.
- 5.2. Cut flowers, importance and methods to prolong vase life.
- 5.3. Flower arrangement - Fresh and Dry

**Demonstration Practical (15 Hrs)**

- i. Cutting
- j. Layering
- k. Grafting

- l. Potting
- m. Terrarium
- n. Bonsai
- o. Flower arrangement - Fresh and Dry

### **TEXT BOOKS**

Kumar, N., (1990), **Introduction to Horticulture**, Rohini Agencies, Nagercoil.

### **BOOKS FOR REFERENCE**

Bose, T.K., (1999), **Tropical Horticulture**, Vol. II and I. Naya Prokesh, Calcutta, India.

Chauhan, D.V.S., (1968), **Vegetable Production in India**, Ram Prasad Sons, Agra.

Edmund, J.B., T.L.Senn, F.S.Andrews and R.G.Halfacre, (1990), **Fundamentals of Horticulture**, (4<sup>th</sup> Ed.), Tata McGraw Hill Pub. Co., London.

Gopalswamy Iyengar, K.S., (1970), **Complete Gardening in India**, Kalyan Press, Bangalore.

Janick, J., (1982), **Horticultural Science**, (3<sup>rd</sup> Edition), Surgeet Publications, Delhi.

Naik, K.C., (1963), **South Indian Fruits and their Culture**, P.Varadharaj and Co., Madras.

Prasad, S., (2000), **Principles of Horticulture**, Agrobotanical Publishers, India.

Randhawa, G.S., (1973), **Ornamental Horticulture in India**, Today and Tomorrow Printers and Publishers, New Delhi.

Randhawa, M.S., (1961), **Beautiful Garden Trees**, I.C.A.R., New Delhi.

Saini, R.S., (2001), **Laboratory Manual of Analytical techniques in Horticulture**, Agrobios, Jaipur.

Yawalkar, K.S., (1961), **Vegetable Crops of India**, Agri - Horticultural Publishing House, Nagpur.

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks  
One Component – 25 Marks

**END SEMESTER (ES) EXAMINATION:** 2 hrs Test – 50 Marks

### **QUESTION PAPER PATTERN:**

**Section A** – Objective questions 10 x 1 = 10 marks  
Answer in a sentence or two 5 x 2 = 10 marks

**Section B** – 3 x 5 = 15 marks (3 out of 5 questions to be answered in 100 words each)

**Section C** – 1 x 15 = 15 marks (1 out of 2 questions to be answered in 800 words each)



STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

General Elective Course Offered by Department of Botany for  
B A. / B.Sc. / B.Com. / Degree

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**PLANTS AND HUMAN WELFARE**

**CODE: BT/GE/PH 54**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVES**

- To create an awareness of the importance of plants to the human need.
- To gain basic knowledge on biodiversity and its usefulness to man.

- Unit 1 (10 Hrs)**  
**Fibre and Fibre yielding plants: (Common Name, Morphology of the useful part and Uses of the following)**  
1.1. Textile Fibres - Cotton and Jute.  
1.2. Hard Fibres - Coir.  
1.3. Filling Fibres - Kapok
- Unit 2 (10 Hrs)**  
**Tannins and Dyes: (Common Name, Morphology of the useful part and Uses of the following)**  
2.1. Tannins: Bark - Hemlock, Oak, and Wattle.  
2.2. Dyes: Wood - Log Wood, Leaves - Indigo and Henna, Flowers - Safflower, Saffron, Seeds - Annatto.
- Unit 3 (10 Hrs)**  
**Gums and Resins: (Common Name, Morphology of the useful part and Uses of the following)**  
3.1. Gums : Gum Arabic, Gum Tragacanth and Asafoetida.  
3.2. Resins: Amber, Lacquer, Shellac, Turpentine and Myrrh.
- Unit 4 (10 Hrs)**  
**Essential oils**  
4.1. Perfume oils - Roses, *Geranium*, *Calamus*, Grass oils (Oil of *Citronella*, Lemon Grass Oil, Oil of Vetiver), Lavender and Jasmine.  
4.2. Camphor

**Unit 5**

**(12 Hrs)**

**Medicinal plants**

Drugs obtained from:

- 5.1. Root - Ginseng, *Colchicum*.
- 5.2. Bark - Quinine
- 5.3. Stem - Ephedrine
- 5.4. Leaves - *Aloe, Belladonna, Senna* and *Eucalyptus*

**BOOKS FOR REFERENCE**

Das, S.N., (2006), **Medicinal Plants for Health and Wealth**, Agrotech, Delhi.

Hill, A.F., (1952), **Economic Botany**, Tata McGraw - Hill Publishing Co., New Delhi

Kumar, N., (1993), **Introduction to Spices, Plantation Crops and medicinal Plants**, Rajalakshmi Publishers, Nagercoil.

Pandey, B.P. and Anitha, (1988), **Economic Botany**, S. Chand and Co., New Delhi.

Sambarmurthy, A.U.S.S., (2000), **Economic Botany of Crop Plants**, Asiatech Publishers, India.

Sundararajan, S., (1999), **Morphology and Economic Botany of Angiosperms**, Anmol, New Delhi.

Verma, V., (1998), **Textbook of Economic Botany**, Emkay Publications, New Delhi.

**CONTINUOUS ASSESSMENT (CA):** 1 hr Test – 25 Marks  
One Component – 25 Marks

**END SEMESTER (ES) EXAMINATION:** 2 hrs Test – 50 Marks

**QUESTION PAPER PATTERN:**

**Section A** – Objective questions 10 x 1 = 10 marks  
Answer in a sentence or two 5 x 2 = 10 marks

**Section B** – 3 x 5 = 15 marks (3 out of 5 questions to be answered in 100 words each)

**Section C** – 1 x 15 = 15 marks (1 out of 2 questions to be answered in 800 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**CELL BIOLOGY**

**CODE: BT/MC/CB 54**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To gain an insight into the cellular and molecular aspects of the plant cell.
- To provide a better understanding about the structure and function of the cell.

**Unit 1 (12 Hrs)**

**Introduction**

- 1.1. Cell Theory: A brief study of the relationship of cytology with other biological sciences.
- 1.2. Cell Membrane: Chemical composition, Molecular organization of the cell membrane and molecular models, Biogenesis and Cell membrane surface.
- 1.3. Cell Wall - Primary and Secondary

**Unit 2 (20 Hrs)**

**Cell Organelles**

- 2.1. Endoplasmic Reticulum: Morphology, SER and RER, Chemistry of ER membrane - Origin and functions
- 2.2. Golgi Apparatus: Ultrastructure, Origin and functions
- 2.3. Mitochondria and Chloroplast: Ultrastructure, DNA and Biogenesis
- 2.4. Microtubules: Occurrence, structure, chemical composition, function and organization of microtubules in cilia, flagella and centrioles.

**Unit 3 (15 Hrs)**

**Nucleus**

- 3.1. Nuclear organization, Nuclear membrane, Nucleolus.  
Chromosomes- structure and chemistry, Nucleosomes, Chromatin - Heterochromatin and Euchromatin, Giant Chromosomes - Lamp brush, Polytene; Chromosome identification-banding technique.
- 3.2. DNA structure - DNA supercoiling – Histones – Nonhistones.

**Unit 4 (8 Hrs)**

**Cell Signaling**

- 4.1. Signaling Molecules and their receptors, Functions of cell surface receptors
- 4.2. Pathways - MAP Kinase

**Unit 5****(10 Hrs)**

5.1 Cell cycle - Mitosis and Meiosis

5.2 Developmental Biology of Plants - *Arabidopsis thaliana***TEXT BOOKS**

Ajoy Paul, (2007), **Textbook of Cell and Molecular Biology**, Books and Allied Pvt. Ltd., Kolkata, India.

Verma P.S and K.Agarwal , (1988) **Cytology**, Chand and Co, Ltd., New Delhi.

**BOOKS FOR REFERENCE**

Benjamin, L., (2008), **Genes IX**, Oxford University Press and Cell Press, New York, U.S.A.

David P.Clark (2005), **Molecular Biology**, Elsevier Academic Press, USA.

De Robertis, E.D.P, and E.M.F.De Robertis, (2001), **Cell and Molecular Biology**, (6<sup>th</sup> Ed.) W.B.Saunders College, Philadelphia

Geoffrey, M.Cooper and Robert, E.Hausman, (2007), **The Cell**, (4<sup>th</sup> Ed.), ASM Press, Washington D.C, USA

Karp.G., (2002), **Cell and Molecular Biology**, John Wiley & Sons, Inc. New york.

Polard.F.D., W.C.Earnshaw and J.L.Schwartz, (2008), **Cell Biology**, Saunders, Elsevier, Philadelphia.

Wolfe, S.L., (1993), **Molecular and Cellular Biology**, Wadsworth Publishing, USA.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN****QUESTION PAPER PATTERN:****Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**ECOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY**

**CODE: BT/MC/EE 54**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To give a basic idea and to create awareness on ecological concepts.
- To emphasise the importance of an environmentally sound and sustainable development.
- To highlight the significance of health hazards caused by toxic chemicals released in the environment.
- To focus on the use of biological organisms as agents of monitoring toxicity and remedy.

**Unit 1 (10 Hrs)**

**Ecosystem**

- 1.1. Concepts, components, kinds and structure.
- 1.2. Ecological pyramids, Energy flow, Food chain, Food web and Homeostasis.

**Unit 2 (16 Hrs)**

**Plant Communities**

- 2.1. Qualitative analysis - Floristic composition, Stratification, Periodicity, Life forms - Raunkaier's Biological Spectrum.
- 2.2. Quantitative analysis: Density, Cover, Abundance, Frequency, Dominance, Index of dominance, Index of similarity between 2 samples, Indices of species diversity, Shanon's index of general diversity.
- 2.3. Sampling of population - Quadrat, Transect, Loop and Point method.

**Unit 3 (15 Hrs)**

**Environmental Toxicology**

- 3.1. Biomagnification and Bioaccumulation.
- 3.2. Biotransformation - DDT.
- 3.3. Testing methods of Toxicity: Acute, Subacute, Chronic and Special tests.

**Unit 4 (12 Hrs)**

**Biomonitoring**

- 4.1. Biodegradation of Xenobiotics using microbes
- 4.2. Types of Bioremediation: *Insitu* and *Exsitu*, Phytoremediation

- 4.3. Biosensors and Bioindicators.
- 4.4. Bioleaching

**Unit 5 (12 Hrs)**

**Environmental Impact Assessment**

- 5.1. Environmental Quality assessment and monitoring
- 5.2. Hazard identification and assessment
- 5.3. Exposure assessment
- 5.4. Environmental risk assessment
- 5.5. Risk Characterisation

**TEXT BOOKS**

Sharma P. D. (2003), **Environmental Biology and Toxicology**, Rastogi Publications, India.

Sharma P. D. (1997), **Ecology and Environment**, Rastogi Publications, India.

**BOOKS FOR REFERENCE**

Alan Scragg, (2007), **Environmental Biotechnology**, 2<sup>nd</sup> edition, Oxford University Press, New York.

Deepender, B., (1996), **Environment and Ecology**, Printwell Publishers, Jaipur.

Levinton, J.S., (2001), **Marine Biology, Function, Biodiversity and Ecology**, Oxford University Press, New York.

Ludwig, J.A., (1989), **Statistical Ecology**, John Wiley and Sons, New York.

Puri, G.S., (1996), **Forest Ecology**, Oxford and IBH. New Delhi.

Santra, S.C., (2005), **Environmental Science**, New Central Book Agency Pvt. Ltd., Kolkata, India.

Verma, P.S., (2000), **Environmental Biology and Principles of Ecology**, S.Chand Publishers, India

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN**

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 10 questions to be answered)

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**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**MICROBIOLOGY**

**CODE: BT/MC/MB 54**

**CREDITS: 4**

**L T P: 4 0 0**

**TOTAL TEACHING HOURS: 52**

**OBJECTIVE**

- To provide an understanding of microorganisms and their contributions to everyday processes like nutrient cycling, water purification and waste disposal.

**Unit 1 (3 Hrs)**

**History of Microbiology**

- 1.1. Germ Theory of disease, Vaccination, Koch's Postulates, Whittaker's Five Kingdom Theory.

**Unit 2 (12 Hrs)**

**Bacteria**

- 2.1. Classification (Bergey's Manual), Outlines of major groups only.
- 2.2. Morphology, Growth, Control and Endospore formation.
- 2.3. Genetic Recombination: Conjugation, Transformation and Transduction.

**Unit 3 (15 Hrs)**

**Viruses**

- 3.1. General properties of Viruses.
- 3.2. Cultivation, Purification and Assay (Plaque formation).
- 3.3. Structure: Virion size, Helical Capsid, Icosahedral Capsid and Viral Envelope.
- 3.4. Replication: Bacteriophages (Lytic and Lysogenic Cycles), Plant Virus (Tobacco Mosaic Virus) and Animal Virus (Herpes Simplex Virus and Retro Virus).
- 3.5. Prions, Virions and Virusoids.

**Unit 4 (10 Hrs)**

**Soil Biology**

- 4.1. Rhizosphere
- 4.2. Distribution, Taxonomy, and Functions of Bacteria, Actinomycetes, Fungi, Algae, Protozoa, Nematodes, Mites, Collembolans and Annelids.
- 4.3. Biogeochemical Cycle: Nitrogen, Sulphur, Phosphorous and Carbon.
- 4.4. Mycorrhiza.

## Unit 5

(12 Hrs)

### Microbiology of Water and Air

- 5.1. Microbiology of domestic water and sewage.
- 5.2. Purification of drinking water.
- 5.3. Sewage treatment and disposal.
- 5.4. Distribution and sources of air borne organisms.
- 5.5. Enumeration of microorganisms in air - sampling techniques.

### TEXT BOOK

Powar, C.B., and H.F.Daginawala, (1991), **General Microbiology - Vol. II**, Himalaya Publishing House, Mumbai.

### BOOKS FOR REFERENCE

Atlas, R.M., (1998), **Microbial Ecology**, Kalaikathir Achagam, India.

Hogg, S., (2005), **Essentials Microbiology**, John Wiley and Sons Limited, England.

Maier, R.M., I.L. Pepper and C.P. Gerba, (2006), **Environmental Microbiology**, Academic Press, U.S.A.

Parry, J.Thelma, Pawsey and K.Rosa, (1984), **Principles of Microbiology**, Hutchinson and Co. Pvt. Ltd., London.

Pelczar, J.Michael, (Jr.), D.Reid, Roger, E.C.S.Chan and Kreig, (1993), **Microbiology**, (5<sup>th</sup> Edition), Tata McGraw - Hill Publishing Co. Ltd., New Delhi.

Presscot, L.M., P.H. John and D.A. Klein, (2005), **Microbiology**, W.M. Brown Publishers, U.S.A.

Tortora, G.J., (2004), **Microbiology. An Introduction**, Benjamin Cummings Publishing Co., Inc., California.

Volk, A.Wesley, and M.F.Wheeler (1980), **Basic Microbiology**, J.B.Lippincott & Co., Philadelphia, USA.

### END SEMESTER EXAMINATION:

Total Marks: 100

Duration: 3 Hours

### QUESTION PAPER PATTERN

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**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)



**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**CELL BIOLOGY, MICROBIOLOGY, ECOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY - PRACTICAL**

**CODE: BT/MC/P5 53**

**CREDITS: 3**

**L T P: 0 0 6**

**TOTAL HOURS: 78**

**CELL BIOLOGY (26 Hrs)**

1. Identification of various cell organelles through photomicrographs
2. Isolation of Chloroplast
3. Smear and Squash techniques
4. Histochemistry: Methods to identify cellulose, lignin, protein, sugar, starch, lipids, nucleic acids
5. Ergastic substances: Druses, raphides and Cystolith

**MICROBIOLOGY (26 Hrs)**

1. Demonstration of the working and use of Autoclave, Hot Air Oven, Water bath and Laminar air flow.
2. Inoculation techniques: Slant, Pour plate, Streak plate, Stab.
3. Preparation of Nutrient media and Broth.
4. Isolation of Bacteria or Fungi from soil on various media: Enrichment, Selective and Differential media.
5. Gram staining
6. Antimicrobial property of heavy metal / Turmeric

**Demonstration Experiments:**

1. Effect of temperature and pH on bacterial growth.
2. Wine production.
3. Motility test.
4. Tests for Coliform.
5. Estimation of BOD.
6. Vermitechnology
7. Methylene Blue Reductase test
8. Wine production and Estimation of lactic acid.

**ECOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY (26 Hrs)**

1. Construction of Quadrat, Belt and Line Transect - Calculation of Frequency, Percentage, Density and Abundance.
2. Effect of toxic substances (chemicals) on mitogenic property of onion root.
3. Morphological and structural adaptations of Hydrophytes, Xerophytes and Halophytes (any one in each category)

**END SEMESTER EXAMINATION:**

Total Marks: 50

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

1. Cell Biology (Squash)	7
2. Microbiology – Inoculation	7
Gram's staining	7
3. Ecology – Quadrat / transect	7
Sectioning	7
4. Spotters (3 x 5)	15

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V. A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**FRUIT PRESERVATION AND NUTRITION**

**CODE: BT/ME/FN 54**

**CREDITS: 4**

**L T P: 3 0 2**

**TOTAL HOURS: 65**

**OBJECTIVES**

- To enable students to understand the nutritional value and principles involved in the spoilage and preservation of fruits and vegetables.
- To give students practical training in the preservation of fruits and vegetables.

**Unit 1 (12 Hrs)**

**Principles and Methods of Preservation**

- 1.1. High Temperature
- 1.2. Low Temperature
- 1.3. Drying
- 1.4. Canning and Bottling
- 1.5. Radiation
- 1.6. Chemical Preservatives

**Unit 2 (8 Hrs)**

**Nutritive value of Fruits and Vegetables**

- 2.1. Pigments in fruits and vegetables: Physical, Chemical properties of Flavonoids and Carotenoids.

**Unit 3 (10 Hrs)**

**Canning**

- 3.1. Canning of Fruits: Apple, Banana, Mango and Pineapple.
- 3.2. Canning of Vegetables: Bean, Carrot, Peas and Tomato.

**Unit 4 (8 Hrs)**

**Fermented Beverages**

- 4.1. Principles of Fermentation and Factors controlling Fermentation
- 4.2. Preparation of Grapewine, Cider and Vinegar

**Unit 5 (5 Hrs)**

**Principle, Chemistry and Preparation of Pectin**

- 5.1. Factors affecting Jelly preparation
- 5.2. Preparation of Guava, Apple and Orange Jelly

**Practical****(22 Hrs)**

1. Preparation of Preserves and Candies: Jam, Jelly, Marmalade, Tutti-fruity and Ginger preserve and candied peel
2. Preparation of Lime syrup, Grape crush, Mango squash, Pineapple syrup and Sherbets
3. Preparation Lime pickle and Mixed vegetable pickle
4. Preparation of “Vathal” and “Vadams”
5. Preparation of Fermented products - Wine and Vinegar

**BOOKS FOR REFERENCE**

Blank, F.C., (2000), **Handbook of Food and Nutrition**, Agrobios Publishers, India.

Frazier, W.C. and D.C. West Hoff, (1995), **Food Microbiology**, (4<sup>th</sup> Ed.), Tata McGraw Hill Publishing Co., Ltd., New Delhi.

Home scale- **Processing and Preservation Fruits and Vegetables**, (1996), Central Food Technological Research Institute, Mysore, India

Kulshrestha, S. K. (1994), **Food Preservation**, Vikas Publishing House, New Delhi.

Muller, H.G., (1998), **Nutrition and Food Processing**, Avi. Pub. India.

Ramakrishnan, S., (1996), **Nutritional Biochemistry**, T.R. Publications, India.

Scenetra, R., (2007), **Food Science and Nutrition**, Oxford Univ. Press, New Delhi.

Swaminathan, M., (1992), **Handbook of Food Science and Experimental Foods**, The Bangalore Printing and Publishing Co., Ltd., Bangalore

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN****QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

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**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**PROJECT**

**CODE: BT/ME/PR 54**

**CREDITS: 4**

**L T P: 0 0 5**

**TOTAL HOURS: 65**

**Dissertation : 50 marks**

**CA : 50 marks**

**Guide lines :**

- **Page limit:** The dissertation shall be within a space of about 40 - 50 pages typed in font size 12, with 1<sup>1</sup>/<sub>2</sub> line spacing in A4 Size paper.
- **Each dissertation will contain the following certificate:**  
'Dissertation submitted to Stella Maris College (Autonomous) Chennai, in requirement for the Degree of Bachelor of Science in Plant Biology and Plant Biotechnology' by name of the candidate, Department of Botany, Place, Month, Year.
- **Submission:** Each student will prepare two copies of the dissertation and submit 15 days before the commencement of the End Semester Examination. One copy (hard and soft) to be submitted to the Head of the Department.

**Guidelines for Evaluation**

• Internal	-	<b>50 marks</b>
• Dissertation	-	<b>50 marks</b>
Style, format and neatness in presentation	-	05
Review of Literature,	-	05
Materials and Methods	-	05
Results,	-	10
Discussion and Summary	-	20
Conclusion	-	05
Grand Total	-	<b>100 marks</b>

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**APPLIED BIOTECHNOLOGY**

**CODE: BT/MC/AB 64**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVE**

- To provide basic information on the importance of biotechnology in the field of tissue culture and its importance in health care, energy and environment.

**Unit 1 (20 Hrs)**

**Tissue culture**

- 1.1. Totipotency, Culture techniques: Equipment, Media, Explant, Callus formation, Organogenesis.
- 1.2. Root culture, Shoot culture, Anther and Pollen culture.
- 1.3. Cell culture, Protoplast culture: Isolation, Culture and Regeneration.
- 1.4. Somaclonal Variation.
- 1.5. Somatic hybridization and Cybrid: Spontaneous and Induced fusion, Identification and Selection of hybrid cells.
- 1.6. Applications: Horticulture, Pharmaceutical industry.

**Unit 2 (10 Hrs)**

**Conventional and Modern Plant Breeding Methods**

- 2.1. Selection - Pureline and Clonal
- 2.2. Hybridization
- 2.3. Mutation Breeding
- 2.4. Marker Assisted Selection (MAS), Marker Assisted Breeding (MAB)

**Unit 3 (10 Hrs)**

**Biotechnology in Agriculture**

- 3.1. Transgenic plants for crop improvement: Herbicide resistance, Insect resistance, resistance against viral, bacterial and fungal pathogens.
- 3.2. Transgenic plants - Edible vaccines. Transgenic plants as recombinant protein production systems, Choice of plant species for recombinant vaccine production, Model plant systems - Potato, Tomato and Banana.
- 3.3. Biofertilizers

**Unit 4** (5 Hrs)  
**Biofuels**  
4.1.Liquid fuel: Ethanol.  
4.2.Gaseous fuel: Hydrogen and Biogas.  
4.3.Bio diesel: Petroplants and Algal hydrocarbons.

**Unit 5** (20 Hrs)  
**Fermentation Technology**  
5.1.Fermentation - Media, Equipment, Inoculum.  
5.2.Scale up and down stream processing.  
5.3.Dairy - Cheese (Cheddar, Camembert and Roquefort)  
Bakery - Bread  
Beverages - Wine and Beer  
Enzyme - Amylase  
Vitamin - B<sub>12</sub>

### **TEXT BOOK**

Gupta, P.K. (1992), **Elements of Biotechnology**, Rastogi Publications, Meerut, India.

### **BOOKS FOR REFERENCE**

Glick, B.R., and J.J.Pasternak, (1994), **Molecular Biotechnology - Principles and Applications of Recombinant DNA**, Panima Publishing Corporation, New Delhi.

Narayanaswamy, S., (1994), **Plant Cell and Tissue Culture**, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Patel, A.H., (1999), **Industrial Microbiology**, Macmillan India Limited, New Delhi.

Prescott and Dunn, (1987), **Industrial Microbiology**, The AVI Publishing Co., Inc., USA.

Purohit, S, S. and S. K.Mathur, (2000), **Biotechnology - Fundamentals and Applications**, (3<sup>rd</sup> Ed.), Agrobios, India.

Purohit, S.S., (2000), **Agricultural Biotechnology**, Agro Botanica, India.

Waston, J.D., M.Gilman, J.Witkowski and M.Zoller, (1992), **Recombinant DNA**, (2<sup>nd</sup> Ed.), Scientific American Books, New York, U.S.A.

### **END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

### **QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

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**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**GENETICS AND GENETIC ENGINEERING**

**CODE: BT/MC/GG 64**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To re-enforce the importance and value of Mendelian Genetics.
- To create analytical thinking for solving problems.
- To give the students knowledge of the techniques and applications of gene manipulation.

**Unit 1 (15 Hrs)**

**Brief history and basic concepts of genetics**

- 1.1. Mendelian Genetics
- 1.2. Gene interactions: Incomplete dominance and Co-dominance, Dominant and Recessive Epistasis, Inhibitory, Complementary, Additive and Duplicate genes.
- 1.3. Multiple Gene Inheritance - Skin colour in man and Ear length in *Maize*
- 1.4. Multiple allele - Human blood groups and Rh factor.

**Unit 2 (15 Hrs)**

**Sex linkage / sex influenced inheritance**

- 2.1. Linkage, Crossing over and Mapping in Eukaryotes and Bacteria
- 2.2. Extrachromosomal Inheritance: Cytoplasmic inheritance - Plastid inheritance
- 2.3. Sex chromosomes in Humans and *Drosophila*, Dosage compensation and Sex linked inheritance.

**Unit 3 (16 Hrs)**

**Genetic Engineering**

- 3.1. Introduction to Genetic Engineering.
- 3.2. Techniques: Restriction Endonucleases, Ligation, Adapters and Linkers.
- 3.3. Cloning Vectors: YAC, BAC and PAC.
- 3.4. Genomic Libraries, cDNA Libraries
- 3.5. Screening: Hybridization - Southern, Northern and Western Blotting.

**Unit 4 (14 Hrs)**

**Genetic Engineering in plants**

- 4.1. Target cells for Transformation
- 4.2. Gene transfer technique using *Agrobacterium*
- 4.3. Physical delivery methods: PEG stimulated, Microinjection and Macroinjection, Microprojectile (Particle gun), Electroporation, Silicon carbide.



**Unit 5****(5 Hrs)****Ethical issues relating to:**

5.1. GM plants.

**TEXT BOOKS**

Gupta, P.K. (1992), **Genetics**, (2<sup>nd</sup> ed.), Rastogi Publications, Meerut, India.

Gupta, P.K. (1992), **Elements of Biotechnology**, Rastogi Publications, Meerut, India.

**BOOKS FOR REFERENCE**

Benjamin, L., (2008), **Genes IX**, Oxford University Press and Cell Press, New York, USA.

Burns, G.W. and P.J.Botline, (1989), **The Science of Genetics - An Introduction to Heredity**, Macmillan Publishing Co. Inc. New York, USA.

Dale, Jeremy W., and Malcolm Von Schantz, (2002), **From Genes to Genomes, - Concepts, and Applications of DNA Technology**, John Wiley and Sons Ltd. UK.

Freifelder, D., (1987), **Molecular Biology**, (2<sup>nd</sup> Ed.), Jones and Barlett Publishers Inc., Boston, USA.

Glick, B.R., and J.J.Pasternak,(1994), **Molecular Biology - Principles and Applications of Recombinant DNA**, Panima Publishing Company Ltd., New Delhi and Bangalore.

Hartwell, H.Leland, Leroy Hood, Michael Goldberg, et al. (2000), **Genetics: From Genes to Genomes**, McGraw Hill Higher Education, USA.

Purohit, S.S and S.K.Mathur, (2000), **Biotechnology - Fundamentals and Applications**, Agrobios, Jaipur, India.

Snustad, D.P. and M.J.Simmons, (2006), **Principles of Genetics**, (4<sup>th</sup> Ed.), John Willey and Sons, USA.

Trevan,M.D., S.Boffey, K.H.Goulding, P.Stanbury, (1997), **Biotechnology - The Biological Principle**, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Watson, J.D., M.Gilman, J.Witkowski and M.Zoller, (1992), **Recombinant DNA**, (2<sup>nd</sup> Ed.), Scientific American Books, New York, USA.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

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**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086**

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**MOLECULAR BIOLOGY**

**CODE: BT/MC/ML 64**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVE**

- To gain an insight into the molecular structure, regulation and functioning of the nucleic acids.

**Unit 1 (15 Hrs)**

**Nucleic acids - structure and function in a cell**

- 1.1 DNA and RNA as genetic material.
- 1.2 Mutations - Point mutations, deletions and insertions
- 1.3 DNA - chemistry of the double helix - types of DNA, Chargaff's rule, DNA size, fragility, Denaturation, Renaturation. Forms of DNA in a cell - Circular, Super helical and Linear DNA.
- 1.4 Molecular structure of three classes of RNA (mRNA, rRNA, tRNA)

**Unit 2 (10Hrs)**

**DNA Replication and Repair**

- 2.1 Modes of Replication - Conservative and Semiconservative.
- 2.2 DNA Replication - initiation, replication forks, leading strand and Lagging strand synthesis; proteins involved in replication.
- 2.3 DNA Repair: Direct repair - photoreactivation

**Unit 3 (10 Hrs)**

**Transcription**

- 3.1 Central dogma - Transcription, translation
- 3.2 Concept of Gene as a unit of expression - Eukaryotic and Prokaryotic
- 3.3 Transcription of Prokaryotic genes: Initiation, Elongation and Termination
- 3.4 Processing of eukaryotic mRNA - Capping, Splicing and Poly Adenylation

**Unit 4 (15 Hrs)**

**Translation**

- 4.1. Genetic Code - triplet codon for Protein Synthesis
- 4.2. Mechanism of Translation - initiation, elongation and termination

**Unit 5** (7 Hrs)  
**Gene Regulation**

- 5.1. Prokaryotic regulation: Operon concept - lac, trp and ara operon.
- 5.2. Eukaryotic regulation: Genetic imprinting.

**Unit 6** (8 Hrs)  
**Transposons**

- 6.1. Introduction and Discovery
- 6.2. Types - Insertion sequence Tn elements, Transfer of antibiotic resistance
- 6.3. Mechanism of Transposition.

**TEXT BOOK**

Ajoy Paul, (2007), **Textbook of Cell and Molecular Biology**, Books and Allied Pvt. Ltd., Kolkata, India.

Rastogi S., (1997), **Cell and Molecular Biology**, New Age International Pvt Ltd. India.

**BOOKS FOR REFERENCE**

Benjamin, L., (2008), **Genes IX**, Oxford University Press and Cell Press, New York, U.S.A.

Bruce Alberts, (2007), **Molecular Biology of the cell** (5<sup>th</sup> Ed.), Garland Publishing, USA.

David P. Clark (2005), **Molecular Biology**, Elsevier Academic Press, USA.

De Robertis, E.D.P, and E.M.F. De Robertis, (2001), **Cell and Molecular Biology**, (6<sup>th</sup> Ed) W.B. Saunders College, Philadelphia

Freifelder, D., (1987), **Molecular Biology** (2<sup>nd</sup> Ed.), Jones and Barlett Publishers Inc., Boston, USA.

Geoffrey, M. Cooper and E.H. Robert, (2007), **The Cell**, (4<sup>th</sup> Ed.), ASM Press, Washington D.C, USA

Glick, B.R. and J.J. Pasternak, (1994), **Molecular Biotechnology - Principles and Applications of Recombinant DNA**, Panima Publishing Corporation, New Delhi and Bangalore

Wolfe, S.L., (1993), **Molecular and Cellular Biology**, Wadsworth Publishing, USA.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

6 x 3 = 18 marks (6 out of 9 questions to be answered)

**Section B** – 4 x 6 = 24 marks (4 out of 6 questions to be answered in 200 words each)

**Section C** – 2 x 20 = 40 marks (2 out of 4 questions to be answered in 1000 words each)

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI – 600 086

**B.Sc. DEGREE: BRANCH V.A. PLANT BIOLOGY AND  
PLANT BIOTECHNOLOGY**

**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**PLANT PHYSIOLOGY, GENETICS AND GENETIC ENGINEERING, AND  
APPLIED BIOTECHNOLOGY - PRACTICAL**

**CODE: BT/MC/P6 62**

**CREDITS: 2**

**L T P: 0 0 4**

**TOTAL HOURS: 52**

**PLANT PHYSIOLOGY**

**(26**

**Hrs)**

1. Determination of osmotic pressure
2. Determination of the rate of respiration using Ganong's Respiroscope
3. Effect of quality of light and CO<sub>2</sub> concentration on the rate of photosynthesis
4. Separation of chlorophyll pigments by paper chromatography
5. Demonstration of Peroxidase activity.
6. Effect of environmental factors on transpiration - light and wind.

**DEMONSTRATION EXPERIMENTS**

1. Colorimetric estimation of Nitrate reductase.
2. Effect of Auxin on root formation.
3. Demonstration of Hill reaction.
4. Estimation of oil content of *Brassica* seed by Soxhlet method.

**GENETICS AND GENETIC ENGINEERING, AND APPLIED  
BIOTECHNOLOGY**

**(26 Hrs)**

1. Problems based on interaction of genes.
2. Mapping of genes.
3. Life cycle of *Drosophila* (cultural studies)
4. Extraction of DNA from Onion cells.
5. Demonstration: Plasmid DNA - Electrophoresis, Restriction enzyme
6. Tissue culture techniques - Apical meristem, Anther and Embryo culture.

**END SEMESTER EXAMINATION:**

Total Marks: 50

Duration: 2½ Hours

**QUESTION PAPER PATTERN:**

- |   |             |
|---|-------------|
| 1. Physiology – Expt. Set up (individual)                         | 10          |
| 2. Genetics – Problems  | 10          |
| 3. Tissue culture – inoculation                                   | 10          |
| 4. Spotters – Physiology (1)<br>Gen, Eng. (2)<br>App. Biotech (1) | 4 x 5<br>20 |

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**SYLLABUS**

(Effective from the academic year 2010 – 2011)

**PLANT PHYSIOLOGY**

**CODE: BT/MC/PP 64**

**CREDITS: 4**

**L T P: 4 1 0**

**TOTAL TEACHING HOURS: 65**

**OBJECTIVES**

- To gain a comprehensive knowledge of the physiological and biochemical pathways involved in the functioning of the plant.
- To enable the students to understand the practical application in relation to agriculture and horticulture.

**Unit 1 (15 Hrs)**

**Water Relations in Plants**

- 1.1. Water potential: Definition and components, Measurement and relation of water potential in an idealized, flaccid and turgid cell.
- 1.2. Transpiration: Definition, Significance and Mechanism of stomatal transpiration, Starch - Sugar interconversion, synthesis of organic acid in guard cells, ATP driven  $H^+$  and  $K^+$  exchange pump, Role of ABA in stomatal opening and closure.
- 1.3. Water movement across the root and xylem - active and passive absorption.

**Unit 2 (12 Hrs)**

**Mineral nutrition.**

- 2.1. Macronutrients and Micronutrients (Manganese, Zinc, Copper, Molybdenum and Boron)
- 2.2. Mechanism of mineral salt absorption: Theories; Donnan equilibrium; Carrier concept and Cytochrome pump theory.
- 2.3. Transport of organic solutes: Phloem loading and unloading.
- 2.4. Sources of Nitrogen, Biochemistry of nitrogen fixation, Nitrate and Nitrite reduction, Assimilation of Nitrite and Ammonium ions.

**Unit 3 (13 Hrs)**

**Photosynthesis**

- 3.1. Principles of light absorption by plants, Photosystem I and II: composition, function, location in thylakoids and Photophosphorylation reactions.
- 3.2.  $CO_2$  assimilation pathway:  $C_3$ ,  $C_4$  cycles and CAM, Photorespiration, Factors influencing photosynthesis.

**Unit 4** (13 Hrs)

**Respiration**

- 4.1. Respiratory quotient, Fermentation and Anaerobic processes.
- 4.2. Glycolysis, Substrate level Phosphorylation, Entner - Doudroff pathway, Glyoxylate cycle.
- 4.3. Krebs cycle, Electron flow components, Electron transport pathway, Oxidative phosphorylation and Cyanide resistant pathway.

**Unit 5** (12 Hrs)

**Growth and phytohormones.**

- 5.1. Growth: kinetics and growth curve
- 5.2. Chemical nature, Bioassay (one only), Physiological effect and practical applications of the following Phytohormones: Auxin, ABA, Cytokinin, Gibberellic acid and Ethylene.
- 5.3. Photoperiodism, Florigen concept and Vernalization

**TEXT BOOKS**

Mukherji, S. and A.K.Ghosh., (2005), **Plant Physiology**, New Central Book Agency (P) Ltd. Kolkatta.

Sinha, R.K., (2006), **Modern Plant Physiology**., Narosa Publishing House, New Delhi.

Verma. V., (1989), **Text Book of Plant Physiology**, Emkay Publications, New Delhi.

**BOOKS FOR REFERENCE**

Bidwell, R.G.S., (1983), **Plant Physiology**, (2<sup>nd</sup> Ed.), Macmillan Publications Co., New York.

Devlin. R.M., (1998), **Plant Physiology**, (3<sup>rd</sup> Ed.), Affiliated East West press, New Delhi.

Malcom Wilkins.B, (1969), **Advanced Plant Physiology** - ELBS/Longman Ed. England.

Noggle, G. Ray and G.J.Fritz, (1998), **Introductory Plant Physiology**, CBS Publishers and Distributors. New Delhi.

Salisbury, F.B., and C.Ross, (2004), **Plant Physiology**, Prentice Hall, New Delhi.

Taiz, L and E. Zeiger, (2003), **Plant Physiology**, Panima Publishing Corporation, New Delhi.

Weston, G.D., (1997), **Crop Physiology - Biotechnology**, Butterworth - Heinemann Ltd., Oxford, London.

**END SEMESTER EXAMINATION:**

Total Marks: 100

Duration: 3 Hours

**QUESTION PAPER PATTERN:**

**Section A** – 18 x 1 = 18 marks (All 18 questions to be answered)

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