**BHARATHIDASAN UNIVERSITY**  **TIRUCHIRAPPALLI - 620 024.**

## B.Sc. BOTANY

## CHOICE BASED CREDIT SYSTEM –

## LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

**(Applicable to the candidates admitted from the academic year 2022-23 onwards)**

**(NAAN MUDHALVAN SCHEME was implemented from 2nd to 6th Semester)**

| Sem. | Part | Course | Title | Ins. Hrs | Credit | Exam Hours | Marks Int. | Marks Ext. | Total |
|---|---|---|---|---|---|---|---|---|---|
| I | I | Language Course – I (Tamil $ / Other Languages + #) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Course - I | | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – I (CC) | Algae, Fungi, Lichens and Bryophytes | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – I (CP) | Algae, Fungi, lichens, Bryophytes | 4 | 4 | 3 | 40 | 60 | 100 |
| | | First Allied Course – I (AC) | | 4 | 4 | 3 | 25 | 75 | 100 |
| | | First Allied Practical (AP) | | 3 | - | - | - | - | - |
| | IV | Value Education | | 2 | 2 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **21** | **-** | **-** | **-** | **600** |
| II | I | Language Course - II (Tamil $ / Other Languages + #) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Course - II | | 4 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – II (CC) | Microbiology, Plant Pathology and Plant Protection | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – II(CP) | Microbiology, Plant Pathology and Plant Protection | 4 | 4 | 3 | 40 | 60 | 100 |
| | | First Allied Practical (AP) | | 3 | 2 | 3 | 40 | 60 | 100 |
| | | First Allied Course – II (AC) | | 4 | 4 | 3 | 25 | 75 | 100 |
| | | Add on Course – I ## | Professional English – I | 6* | 4 | 3 | 25 | 75 | 100 |
| | IV | Environmental Studies | | 2 | 2 | 3 | 25 | 75 | 100 |
| | VI | Naan Mudhalvan Scheme (NMS) @@ | Language Proficiency for Employability - Effective English | 2 | 2 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **29** | **-** | **-** | **-** | **900** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| III | I | Language Course – III<br>(Tamil $ / Other Languages + #) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Course - III | | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – III (CC) | Pteridophytes, Gymnosperms and Paleo botany | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical - III (CP) | Pteridophytes, Gymnosperms and Paleo botany | 4 | 4 | 3 | 40 | 60 | 100 |
| | | Second Allied Course – I (AC) | | 4 | 4 | 3 | 25 | 75 | 100 |
| | | Second Allied Practical – I (AP) | | 3 | - | - | - | - | - |
| | | Add on Course – II ## | Professional English - II | 6* | 4 | 3 | 25 | 75 | 100 |
| | IV | Non-Major Elective I @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either<br>a) Basic Tamil if Tamil language was not studied in school level<br>**or**<br>b) Special Tamil if Tamil language was studied upto $10^{th}$ & $12^{th}$ st | Biofertilizers and Biopesticides | 2 | 2 | 3 | 25 | 75 | 100 |
| | VI | Naan Mudhalvan Scheme (NMS) @@ | Digital Skills for Employability – Microsoft Digital Skills | - | 2 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **27** | **-** | **-** | **-** | **800** |
| IV | I | Language Course –IV<br>(Tamil $ / Other Languages + #) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Course – IV | | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course - IV (CC) | Plant Anatomy and Embryology | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical - IV (CP) | Plant Anatomy and Embryology | 4 | 4 | 3 | 40 | 60 | 100 |
| | | Second Allied Practical – I (AP) | | 3 | 2 | 3 | 40 | 60 | 100 |
| | | Second Allied Course – II (AC) | | 4 | 4 | 3 | 25 | 75 | 100 |
| | IV | Non-Major Elective II @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either<br>a) Basic Tamil if Tamil language was not studied in school level<br>**or**<br>b) Special Tamil if Tamil language was studied upto $10^{th}$ & $12^{th}$ std. | Horticulture | 2 | 2 | 3 | 25 | 75 | 100 |
| | VI | Naan Mudhalvan Scheme (NM) @@ | Employability Skills - Employability Skills | - | 2 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **25** | **-** | **-** | **-** | **800** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| V | III | Core Course - V (CC) | Cell and Molecular Biology | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – VI (CC) | Genetics, Biostatistics and Evolution | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – VII (CC) | Morphology, Taxonomy and Economic Botany | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical -V (CP) | Cell and Molecular Biology & Genetics Biostatistics and Evolution & Morphology Taxonomy and Economics Botany | 4 | 4 | 3 | 40 | 60 | 100 |
| | | Major Based Elective – I (Any one) | 1. Herbal Botany<br>2. Horticulture and Landscape Gardening | 5 | 4 | 3 | 25 | 75 | 100 |
| | IV | Skill Based Elective I | Techniques in Biology | 4 | 2 | 3 | 25 | 75 | 100 |
| | | Soft Skills Development | | 2 | 2 | 3 | 25 | 75 | 100 |
| | VI | Naan Mudhalvan Scheme (NMS) @@ | Advanced Technology for Employability in Life science – Organic Food Production Techniques | - | 2 | 3 | 25 | 75 | 100 |
| | **TOTAL** | | | **30** | **29** | **-** | **-** | **-** | **800** |
| VI | III | Core Course - VIII (CC) | Plant Physiology, Biochemistry and Biophysics | 6 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course - IX (CC) | Plant Ecology, Phytogeography and Environmental Biotechnology | 6 | 5 | 3 | 25 | 75 | 100 |
| | | Core Practical – VI (CP) | Plant Physiology, Biochemistry and Biophysics and Plant Ecology, Phytogeography and Environmental Biotechnology | 4 | 4 | 3 | 40 | 60 | 100 |
| | | Major Based Elective - II (Any one) | 1. Agribased Entrepreneurship<br>2. Mushroom Cultivation Technology | 5 | 4 | 3 | 25 | 75 | 100 |
| | | Project | | 4 | 3 | - | 40 | 60 | 100 |
| | IV | Skill Based Elective – II | Sea weed Technology | 4 | 2 | 3 | 25 | 75 | 100 |
| | V | Gender Studies | | 1 | 1 | 3 | 25 | 75 | 100 |
| | | Extension Activities ** | | - | 1 | - | - | - | - |
| | VI | Naan Mudhalvan Scheme (NMS) @@ | Botany & Food Sciences | - | 2 | 3 | 25 | 75 | 100 |
| | | **TOTAL** | | **30** | **27** | **-** | **-** | **-** | **800** |
| **GRAND TOTAL** | | | | **180** | **158** | **-** | **-** | **-** | **4700** |

## List of Allied Courses

| First Allied Course | Second Allied Course |
|---|---|
| Zoology | Chemistry |

$ For those who studied Tamil upto 10th +2 (Regular Stream).

+ Syllabus for other Languages should be on par with Tamil at degree level.

# Those who studied Tamil upto 10th +2 but opt for other languages in degree level under Part- I should study special Tamil in Part – IV.

## The Professional English – Four Streams Course is offered in the 2nd and 3rd Semester (only for 2022-2023 Batch) in all UG Courses. It will be taught apart from the Existing hours of teaching / additional hours of teaching (1 hour /day) as a 4 credit paper as an add on course on par with Major Paper and completion of the paper is must to continue his / her studies further. (As per G.O. No. 76, Higher Education (K2) Department dated: 18.07.2020).

* The Extra 6 hrs / cycle as per the G.O. 76/2020 will be utilized for the Add on Professional English Course.

@ NCC Course is one of the Choices in Non-Major Elective Course. Only the NCC cadets are eligible to choose this course. However, NCC Course is not a Compulsory Course for the NCC Cadets.

** Extension Activities shall be outside instruction hours.

@@ Naan Mudhalvan Scheme

## SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

| Sl. No. | Part | Types of the Courses | No. of Courses | No. of Credits | Marks |
|---|---|---|---|---|---|
| 1. | I | Language Courses | 4 | 12 | 400 |
| 2. | II | English Courses | 4 | 12 | 400 |
| 3. | III | Core Courses | 9 | 45 | 900 |
| 4. | | Core Practical | 6 | 24 | 600 |
| 5. | | Allied Courses I & II | 4 | 16 | 400 |
| 6. | | Allied Practical | 2 | 4 | 200 |
| 7. | | Major Based Elective Courses | 2 | 8 | 200 |
| 8. | | Add on Courses | 2 | 8 | 200 |
| 9. | | Project | 1 | 3 | 100 |
| 10. | IV | Non-Major Elective Courses | 2 | 4 | 200 |
| 11. | | Skill Based Elective Courses | 2 | 4 | 200 |
| 12. | | Soft Skills Development | 1 | 2 | 100 |
| 13. | | Value Education | 1 | 2 | 100 |
| 14. | | Environmental Studies | 1 | 2 | 100 |
| 15. | V | Gender Studies | 1 | 1 | 100 |
| 16. | | Extension Activities | 1 | 1 | -- |
| 17. | VI | Naan Mudhalvan Scheme | 5 | 10 | 500 |
| | **Total** | | **48** | **158** | **4700** |

**PROGRAMME OBJECTIVES:**

On complete the course students will be able to:

(i) Demonstrate the range of plant diversity in term of structure function and environmental relationship; (ii) Understand the responsibilities relevant to the biodiversity conservation practices with the help of applying basic knowledge to assess plant diversity and its importance to the society, health, safety and environmental issues; (iii) Understand the role of plants in the functioning of global ecosystem; (iv) Equip the students with subject domain knowledge and technical skills pertaining to plants in a holistic manner; (v) Analyse the plant form by applying fundamental process of plant and knowledge of basic sciences; (vi) They are made aware about social and environmental issues, significance of plants and relevant to the national economy. Understand the issues of environmental contents and sustainable development.

- Understand the importance of biofertilizer and its importance.
- Understand the environmental sustainability goals as a responsible citizen.
- Demonstrate ability and attitude to acquire knowledge and skills in the advancing global scenario to apply them effectively and ethically for professional and social development.
- Utilize scientific knowledge to pursue higher studies in the relevant field.
- Handle ethical issues with social responsibility.
- Communicate effectively and collaborate successfully with peers to become competent professionals.

**PROGRAMME OUTCOME:**

The students will be able to:

- Able to communicate scientific ideas in writing and orally.
- Understand the impact of plant diversity in societal environment contents and need for sustainable development.
- The students able to understand different branches of Botany.
- They become competent enough in various analytical and technical skills related to plant sciences.
- They develop scientific temperament and research attitude.
- They able to analyse different plant forms and their anatomical and physiological characteristics.
- The students become qualified to take up teaching, research work in research institute or industry, entrepreneurship.

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**First Year** **CORE COURSE I** **Semester I**

**ALGAE, FUNGI, LICHENS AND BRYOPHYTES**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To relate the skill and methods in thallophytes and non-flowering plant groups.
- To employ knowledge in Understanding the structural and functional diversity of Lower group of plants.
- To organize for collection and examination of lower group of plants from various environment.
- Justify the concept of lichens and bryophytes as indicator for water and air pollution.
- To know about Bryophytes.

**UNIT – I ALGAE:**

Introduction and general account of Algae, Classification (F. E, Fritsch 1945) Criteria used for algal classification, phylogentic classification Range of thallus Reproductive diversity and Life cycle patterns of Algae. Economic importance of Algae.

**UNIT – II ALGAE:**

Ecology of algae, characteristic feature, thallus organization and reproduction of the principal classes of algae with reference to cyanophyceae- Microcystis, Oscillatoria, Lyngbya-Chlorophyceae - chlorella, Hydrodictyon, Zygnema Caulerpa, chara and Nitella*Xanthophyceae - Botrydium, Bacillariophyceae -Navicula,Phacephyceae - Ectocarpus, Laminaria, Phodophyeae - Batrachospermum, polysiphonia.*

**UNIT – III FUNGI:**

General account of fungi, classification of fungi Alexopolous and mims (1979), phylogeny and cell structure, Heterosis, pararsexuality, heterothallism, Reproduction, hormonal mechanism of sexual reproduction, Economic importance of fungi, fossil fungi, characteristics features, systematic position, thallus organization, reproduction, phylogeny and inter relationship of principal classes such as *myxomycotina-Stemonitis, Mastigomycotina - Pythium, zygomycotina-Pilobolus Ascomycotina-Penicillium, Basidiomycotina-Puccinia, Dueteromycotina-Fusarium*

**UNIT – IV LICHENS:**

General characters of lichens and its symbionts, classification and distribution, thallus structure and reproduction Economic importance and ecological role of Lichens invitro culture –A detailed study of *Parmelia* and *Usnea*

**UNIT – V BRYOPHYTES:**

Bryophytes, General characters, distribution and classification of Bryophytes (Rothmalar,1955), Structure, reproduction and life cycle of major group-*Marchantiales, Jungermaniales, Anthocerotales*, and *polytrichales*. Evolution of gametophyte and sporophyte. Ecological and economic importance of Bryophytes.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Algae, Fungi, Lichens and Bryophytes during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Fritsch F.E.1945, structure and reproduction of algae, Cambridge University press.
2. Chapman, V. J and Chapman, D.J.1975.The Algae, Macmillan India Ltd, Delhi
3. Hale, M.E (Jr) 1983, The Biology of Lichens Edward Arnold Mayland.
4. Bold, H.C & wynne, M.J.1985, Introduction to the algae, prentice Hall of India, New Delhi
5. Sharma, O.P 1998 Text book Algae, Tata McGraw Hil, New Delhi
6. Webster, J and weber, R.W.S. 2007, Introduction to fungi Cambridge University press, New York
7. Lee, R.E.2008, phycology Cambridge University press, New York
8. Nash, T.H.2008, Lichen Biology, Cambridge University press
9. Dr.manoj Kumar Sharma ,Algae, Fungi and Bryophytes
10. Dr G M rane ,Dr P S Baviskar , prof C D Patil Microbial Diversity Algea and Fungi kavayitri bahinabai chaudhari north Maharashtra university
11. Round F.E. 1984, The ecology of Algae, Cambridge University press
12. Reborts, P. Evans, s.2014 The book of fungi, A life size guide to six hundred specials from around the world, University of Chicago press.
13. watkinson. S.C., Boddy, L and Money, N 2016. The fungi Elsevier, London
14. https://www.britannica.com/science/algae
15. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/2_18K1B01_2020120403315034.pdf
16. https://www.biologydiscussion.com/algae/cyanophyceae-characteristics-occurrence-and-classification/46739
17. https://www.biologydiscussion.com/fungi/classification-of-fungi-by-various-botanists/46471


**COURSE OUTCOMES:**

- Relate the morphology structure of Algae, Fungi, bryophytes and Lichens.
- Apply the practical knowledge to understanding the diversity of plant forms.
- Examine the importance of structural diversity in the evolution of plant forms.
- State the ecological and economic importance of Algae, Fungi, lichen and bryophytes.
- Compare the structural organization of gametophytes and sporophytes in different classes of bryophytes.

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**First Year** | **CORE PRACTICAL I** | **Semester I**

**ALGAE, FUNGI, LICHENS AND BRYOPHYTES**

**Code:** | **(Practical)** | **Credit: 4**

**COURSE OBJECTIVES:**

- To characterize the life cycle patterns of major groups of plants.
- To learn about the practical knowledge on algae.
- To know about the fungi.
- To study about the Parmelia and usnea.
- To gain a knowledge on Bryophytes.

Type study and Micro slide preparation of the following:

**Algae:**

Cyanophyceae- Microcystis, Oscillatoria, Lyngbya
Chlorophyceae - chlorella, Hydrodictyon, Zygnema Caulerpa, chara and Nitella
Xanthophyceae - Botrydium, Bacillariophyceae -Navicula
Phacephyceae - Ectocarpus, Laminaria.
Phodophyeae - Batrachospermum, polysiphonia.

**Fungi:**

Myxomycotina – Stemonitis
Mastigomycotina – Pythium
Zygomycotina - Pilobolus
Ascomycotina - Penicillium
Basidiomycotina – Puccinia
Dueteromycotina – Fusarium

**Lichens:**

Parmelia
Usnea

**Bryophytes:**

Marchantiales
Jungermaniales
Anthocerotales
Polytrichales

**REFERENCES:**


1. Biswas C. and Johri B. M. (1997). Gymnosperms. Narosa Publishers, NewDelhi.
2. Parihar, N.S. (1976). Biology and morphology of the Pteidophytes Central Book Depot.

3. Sporne, K.R. (1986). The morphology of Pteridophytes. Hutchinson University Press. London.
4. Smith, G. M. (1995). The fresh water Algae of the United States, Mc-Graw Hill, New york.
5. Waston E. V. (1971). Structure and life of Bryophytes 3rd Hutchinson University Library London.
6. Vashishta B.R. (1988). Algae. S. Chand & Co., New Delhi.
7. https://www.bdu.ac.in/cde/SLM/B.Sc.%20Botany/I%20Year/B.Sc.Botany_Alagi%2CFungi%20%26%20Plant%20Protection%20%28Practical%29_I-Year_SPS.pdf
8. https://gurunanakcollege.edu.in/files/science/algae-bryophytes-gungi-plant-pathology-and-lichens.pdf

**COURSE OUTCOMES:**

- Learn about the structure, methods and reproduction of Algae
- Know about the economic importance of algae, fungi and lichens.
- Microscopic observation and identification of algae, fungi, lichens and bryophytes.
- Know about the structure, life history and Economic importance of Gymnosperms.
- Make use of practical knowledge to comprehend the variety of plant types.

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**First Year** **CORE COURSE II** **Semester II**

**MICROBIOLOGY, PLANT PATHOLOGY AND PLANT PROTECTION**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To evaluate the structure, reproduction, culture and economic importance of bacteria
- To evaluate the structure, reproduction, culture and economic importance of virus
- To know about the factors responsible for the plant diseases
- To collect knowledge on the pathogens causing diseases in plants.
- To relate the plant protection methods.

**UNIT – I BACTERIOLOGY:**

Bacteria – Discovery, general characteristics and cell structure; nutritional types of bacteria –, sexual and asexual Reproduction. Sterilization techniques, bacterial culture and staining (simple and differential). Economic importance.

**UNIT – II VIROLOGY**:

Viruses – Discovery, general structure. Symptoms of virus infection in plants; transmission of plant viruses – purification; structure and multiplication of bacteriophages; genome organization. Structure and multiplication of viroids. Economic importance.

**UNIT – III PLANT PATHOLOGY:**

Plant Pathology: History – importance – organisms and causal factors responsible for plant diseases (Biotic and Abiotic). General symptoms, Pathogenesis, Host – pathogen interaction,

**UNIT – IV COMMON PLANT DISEASES:**

Study of plant diseases – Symptoms, causative organisms, disease cycle and control measures: (a) Cereals: Rice – blast disease; (b) Vegetables: Brinjal – Little leaf; (c) Fruits: Banana – Bacterial leaf blight, Citrus – Bacterial canker; (d) Oil seeds: Ground nut – Tikka disease; (e) Sugar yielding: Sugarcane – red rot.

**UNIT – V PLANT PROTECTION:**

Plant Protection – Scope, importance, equipment used - sprayers – dusters – soil injector – seed dressing drum; seed treatment – soil sterilization. Methods of plant protection

(a) Cultural – Tillage, sowing and planting dates, crop rotation and fertilizer.
(b) Mechanical – Field sanitation.
(c) Physical – Heat and soil Sterilization.
(d) Chemical – Bactericides, Fungicides, Insecticides, Herbicides.
(e) Biological – Biological control of pests.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only)**

Current developments related to the Microbiology, Plant Pathology and Plant protection during the semester concerned to be kept abreast of continuously and cumulatively

through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Carpenter, P.L. (1967). Microbiology. Saunders Co., Philadelphia, USA.
2. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1978). General Microbiology Mac Millan & Co., New Delhi.
3. Pelizar, M.J., Chan, E.C.S. and Krieg, N.R. (1993). Microbiology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Dubey, R.C. and Maheshwari, D.K. (2007). A Textbook of Microbiology. S. Chand and Co. Ltd., New Delhi.
5. Microbiology Third Edition - ***Richard A. Harvey and Cynthia Nau Cornelissen*** .
6. Bap Reddy, D. and Joshi, N.C. (1991). Plant Protection in India. Allied Publishers Ltd., New Delhi.
7. Rangaswami, G. and Mahadevan, A. (1998). Diseases of Crop Plants in India. Prentice Hall of India Ltd., New Delhi.
8. Pandey, B.P. (2001). Plant Pathology. S. Chand & Co. Ltd., New Delhi.
9. Mehrotra, R.S. (2003). Plant Pathology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
10. Text book of Plant Protection First edition - Dr.E. Marimuthu, Dr.K. Muthuchelian, Royal book publishing international.
11. 1.A Clinician's Dictionary of Pathogenic Microorganisms by James H. Jorgensen; Michael A. Pfaller 2004.
12. Abiotic Disorders of Landscape Plants: A Diagnostic Guide. Publication 3420.
13. Diseases of Trees and Shrubs. Comstock Publishing Associates, a division of Cornell University Press. Greenwood, P., Halstead, A., Chase, A. R., and Gilrein, D. 2000.
14. http://whttp://www.apsnet.org/Pages/default.aspx
15. ww.npdn.org/
16. https://www.wpdn.org:
17. http://www.ipmcenters.org/
18. https://www.britannica.com/science/microbiology
19. https://conductscience.com/introduction-and-importance-of-microbiology/
20. https://biologydictionary.net/microbiology/
21. https://www.researchgate.net/publication/356529627_Plant_Pathology_Introducti on
22. https://www.rvskvv.net/images/I-Year-II-Sem_Principles_Plant-
23. Pathology_ANGRAU_20.04.2020.pdf
24. http://www.ca.uky.edu/agc/pubs/ppa/ppa41/ppa41.pdf


**COURSE OUTCOMES:**

- Understand the structure, reproduction, culture and economic importance of bacteria
- Understand and the structure, reproduction, culture and economic importance of virus
- Explain the causes of different plant diseases
- Recognize different plant pathogens
- Explain different plant protection methods.

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**First Year** **CORE PRACTICAL II** **Semester II**

**MICROBIOLOGY, PLANT PATHOLOGY AND PLANT PROTECTION**

**Code:** **(Practical)** **Credit: 4**

**COURSE OBJECTIVES:**

- To know about the microorganisms.
- To Discuss the distinct group of microbes which differ in form and other characters.
- To introduce the subject of Plant Pathology, its concepts and principles.
- To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.
- To acquaint with the structure, virus-vector relationship, biology and management of plant viruses.

**MICROBIOLOGY, PLANT PATHOLOGY & PLANT PROTECTION:**

1. Tools and equipment used in microbiology: Spirit lamp, Inoculation loop, Hot air oven, Autoclave, Pressure Cooker, Laminar air flow chamber, Incubator.
2. Media preparation, Serial techniques and plating techniques. Types of Bacteria from temporary / permanent slides / photographs; Binary fission, conjugation. Simple and differential staining.
3. Slide preparation of causative organisms in plant disease.
4. Identification of various plant protection appliances mentioned in the syllabus and their working mechanism.

**REFERENCES:**


1. Alexopoulos CJ, Mims CW & Blackwell M.2000. Introductory Mycology. 5th Ed. John Wiley & Sons, New York.
2. Sarbhoy AK. 2000. Text book of Mycology. ICAR, New Delhi.
3. Agrios GN. 2005. Plant Pathology. 5th Ed. Academic Press, New York.
4. Mehrotra RS & Aggarwal A. 2003. Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
5. Hull R. 2002. Mathew s Plant Virology. 4th Ed. Academic Press, New York.
6. Jayaraman J & Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publ., Ludhiana.
7. https://uou.ac.in/sites/default/files/slm/BSCBO-101.pdf
8. https://www.ubkv.ac.in/wp-content/uploads/2014/03/PG-Syllabus_PLANT-PATHOLOGY.pdf


**COURSE OUTCOMES:**

- Study about the symptoms caused by viruses, transmission, assay of viruses, physical properties and purification.
- Detailed study of symptoms of important diseases of above mentioned crops.
- Collection and dry preservation of diseased specimens of important crops.
- Microscopic study of important pathogens.
- Acquaintance with formulation of different fungicides and plant protection appliances.

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**Second Year** **CORE COURSE III** **Semester III**

**PTERIDOPHYTES, GYMNOSPERMS AND PALEO BOTANY**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To categorize the Pteridophytes by their characteristic features.
- To rate the stellar evolution, heterospory and seed habit
- To state the gymnosperms.
- To assess the significance geological time scale and carbon dating
- To appraise the significance and importance of fossils.

**UNIT – I PTERIDOPHYTES:**

Pteridophytes -general characteristics and classification by Smith (1955). Morphology, structure, reproduction and life-histories of the following genera: - *Lycopodium, Selaginella.*

**UNIT – II PTERIDOPHYTES:**

Morphology, structure, reproduction and life -histories *Equisetum* Marsilea, Stelar evolution in Pteridophytes. Heterospory and seed habit.

**UNIT – III GYMNOSPERMS:**

Gymnosperms- general characteristics and classification of Gymnosperms by Sporne (1965), Morphology, structure and mode of reproduction and life- histories of the following genera- - *Cycas, Pinus* and *Gnetum*

**UNIT – IV PALEO BOTANY:**

Paleo botany- fossils and methods of fossilization- Different types of fossils. Geological time-scale-an elementary knowledge of the computation of the age of fossils-Radio Carbon dating.

**UNIT – V PALEO BOTANY:**

A brief study of the following fossil forms: - *Rhynia, Lepidodendron, Lepidocarpon, Calamites* and *Williamsonia.*

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Pteridophytes, Gymnosperms and Paleobotany during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**

**PTERIDOPHYTES**


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**GYMNOSPERMS**

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**PALEOBOTANY**

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19. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-bryophytes-pteridophytes-gymnosperms-paleobotany/9788188237456/
20. https://www.saraspublication.com/books/pteridophytes-gymnosperms-and-palaeobotany/
21. https://www.goodreads.com/book/show/30858016-a-textbook-of-bryophytes-pteridophytes-gymnosperms-and-paleobotany

**COURSE OUTCOMES:**

Upon successful completion of this course the students would be able to:

- Compare the classification of pteridophytes.
- Measure the evolution of sporophytes, heterospory and seed habit and stelar evolution of pteridophytes.
- Understand about gymnosperms their classification.
- Illustrate the geological time scale and carbon dating.
- Rate the distribution and reconstructed structure of fossils.

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**Second Year** **CORE PRACTICAL III** **Semester III**

**PTERIDOPHYTES, GYMNOSPERMS AND PALEO BOTANY**

**Code:** **(Practical)** **Credit: 4**

**COURSE OBJECTVES:**

- Describe habit and habitat of pteridophytes, their characteristics and classification.
- To Describe stelar variation and evolution of stele in pteridophytes.
- Distinguish and identify the Pteridophytes in your surroundings.
- To know about the distribution and economic importance of Pteridophytes.
- Briefly studied on Gymnosperms.

A study of the Morphology and anatomy of both vegetative and reproductive parts of the living genera and fossil forms of the following Genera.

**PTERIDOPHYTES**

- *Lycopodium* – Stem and cone
- *Selaginella* – Stem and Cone
- *Equisetum* – Stem and cone
- *Marsilea* – Rhizome and sporocarp

**GYMNOSPERMS**

Cycas Rachis, Leaflet – T.S; Coralloid root, male cone. Megasporophyll and Microsporophyll. Needle –T.S. Young stem – T.S; Male and Female cone. Stem – Gnetum – T.S, Male and Female Strobilus – Demonstration only.
**Slides** - *Rhynia, Lepidodendron, Lepidocarpon*, *Calamites* and *Williamsonia*
**Fossils:** Impression, Compression and petrification.

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3. Arnold, C.A. (1948), ―Classification of gymnosperms‖, Botanical Gazette, Vol. 110, pp. 212.
4. Bhatnagar, S.P. andMoitra, A. (1997),Gymnosperms.New Age International (P) Limited, New Delhi.
5. Devevoryas, T. (1963), Morphology and evoloution of fossil plants,Hott, Rinehart & Winston, New York.
6. Sporne, Library K. R. 1965. The Morphology of Gymnosperms. Htchinson University Press, London
7. Bhatnagar, S. P. and Moitra A. 1996 Gymnosperms. New Age International Limited.
8. Rashid, A. [1989] : An Introduction to Pteridop Ltd., New Delhi).

9. Stewart, W. N. and G. W. Rothwell 1993: Paleobotany and the Evolution of Plants, 2nd Edn. Cambridge University press.

**COURSE OUTCOMES:**

- Learn about the general characters and classification, stelar evolution in Pteridophytes, heterospory and origin of seed habit.
- Know about the structure, life history and Economic importance of Gymnosperms.
- Training students to prepare micropreparation and showing permanent slides/photographs of *Rhynia, Lepidodendron* etc.
- It provides a thorough knowledge about the diversity, structural organization and reproduction of Pteridophytes and Gymnosperms.
- Gain the knowledge on fossils.

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**Second Year** **NON MAJOR ELECTIVE I** **Semester III**

**BIOFERTILIZERS AND BIOPESTICIDES**

**Code:** **(Theory)** **Credit: 2**

**COURSE OBJECTIVES:**

- To describe the importance of biofertilizers and their cultivation.
- To learn mass cultivation of different bio fertilizers.
- To identify the types of mycorrhiza and its advantages.
- To assess the knowledge about the types of biopesticides and its advantages.
- To understand the mechanism and action of biopesticides.

**UNIT – I BIOFERTILIZERS:**

Definition, Classification of fertilizers (Synthetic and Natural fertilizer), organic fertilizers, Biofertilizers – General account and importance, Fertilizers application method (Foliar, seed dressing, soil drenching), Dry and wet formulation.

**UNIT – II MASS CULTIVATION:**

Mass cultivation: Bacterial biofertilizers *Azospirillum, Azotobacter* and Rhizobium and Cyanobacterial biofertilizers – *Anabaena and nostoc.*

**UNIT – III FUNGAL BIOFERTILIZERS:**

Fungal biofertilizers, Mycorrhizal Classification, isolation and its importance, VAM- Inoculum production and its field applications.

**UNIT – IV BIOPESTICIDES:**

Biopesticides – Definition, types and mass production of biopesticides, methods and application of biopesticides. Methods of quality control and Techniques of biopesticides. Advantages of biopesticides and commercialization.

**UNIT – V BIOPESTICIDES:**

Mechanism of action and application of biopesticides – viral origin (*NPV*) – fungal origin (*Trichoderma*) – bacterial origin (*Pseudomonas* and *Bacillus*).

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Biofertilizer and Biopesticides during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Joshi, S.R. (2018). Biopesticides: A Biotechnological Approach. New Age International (P) Ltd., Publishers.
2. Koul, O. and Dhaliwal, G.S. 2012. Biopesticides and Pest Management. Cumpus Books International.
3. Subba Rao, N.S. (2000). Soil Microbiology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
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8. The complete technology book on Biofertilizer and organic farming ( 2nd revised edition ) NIIR Board.
9. Biofertilizers and biopesticides by Technoscience Publications, 1998 A.M Deshmukh.
10. Biofertilizers Technology by Kannaiyan, S., Kumar, K., Govindarajan, K. – 2010.
11. https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-66
12. https://www.toppr.com/guides/biology/microbes-in-human-welfare/biofertilizers/
13. https://www.vedantu.com/biology/biofertilizers
14. https://www.peptechbio.com/blog-biofertilizers/
15. https://www.onlinebiologynotes.com/biofertilizer-advantages-types-methods-of-application-and-disadvantages/
16. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8230470/
17. https://www.researchgate.net/publication/347427936_Benefits_and_limitations_in_using_biopesticides
18. https://gacbe.ac.in/pdf/ematerial/18BBO35S-U4.pdf
19. https://www.researchgate.net/publication/342049610_Low_Cost_Production_Technology_of_Azolla_Bio-fertilizer_for_Sustainable_Agriculture
20. http://www.zor.zut.edu.pl/Glomeromycota/Classification.html


**COURSE OUTCOMES:**

Upon successful completion of this course the students would be able to:

- Understand the importance of biofertilizers.
- To organize the bio fertilizers for mass cultivation parameters.
- To categorize the type of bio fertilizers to be used.
- To employ the biofertilizers for commercialization.
- Aware the mechanism and action of biopesticides.

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**Second Year** **CORE COURSE IV** **Semester IV**

**PLANT ANATOMY AND EMBRYOLOGY**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- Assess classification, Identification, Structure, Function and role of apical to Lateral meristem in plant growth.
- To employ the function and organization of woody stem.
- Categorize anatomy of stem, root and leaf to their secondary growth.
- To assess the process of seed setting.
- To illustrate the structure of Micro, Megasporangium and Gametophyte.

**UNIT – I ANATOMY - I:**

Introduction, Scope and importance, History of plant Anatomy, type of cells and tissues, Classification of plant tissues, Meristematic tissues, types, structure and function. Epidermal tissue system, secretary tissues, Development of plant body.

**UNIT – II ANATOMY - II:**

Simple permanent tissues – Parenchyma, Collenchyma and Sclerenchyma, Structure, Composition and function. Complex permanent tissue – xylem, phloem structure, composition and function. Primary structure of Monocot stem, leaf and root.

**UNIT – III ANATOMY:**

Stem thickening in Monocot and Dicots. Root thickening of Dicot. Anomalous Secondary growth in stem of *Boerhavia, Bignonia, Nyctanthes* and *Dracaena* Structure, function and Seasonal Activity of Cambium, Structure and development of Periderm.

**UNIT – IV EMBRYOLOGY:**

Structure and development of Microsporangium and male gametophyte. Structure and development of megasporangium. Structure of ovules and its types, development of ovule – megasporagenesis. Development of embryo sac – Monosporic – *Polygonum* type bisporic – *Allium* type and tetrasporic – *Pepromia* type.

**UNIT – V EMBRYOLOGY:**

Double fertilization and Triple fusion. Apomixis, Development of Endosperm, Dicot embryo (*Capsella* type) and Monocot embryo (*Lyzula* type), Polyembryony structure of fruit and seed.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Plant Anatomy and Embryology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**

1. Tayal, M.S. Plant Anatomy, 3rd edition (2012). Rastogi publications, Meerut.

2. Pandey, B.P. (1978). Plant Anatomy, S. Chand & Co., New Delhi.
3. Vasishta, F.C. A text book of pant Anatomy. Pradeep Publications, Jullendar.
4. Katherine Esau, (1975). Plant Anatomy, Wiley Eastern Private Ltd., New Delhi.
5. Johi, B.M. (1984). Embryology of Angiosperm, Springler verlag, Berlin.
6. Dwinedi, J.N., (1988). Embryology of Angiosperms. Rastogi and Co., Merrut.
7. Plant Anatomy (2001) S. Chand by Dr.B.P.Pandey.
8. Fahn, A. (1974). Anatomy Pergamon Press, Oxford.
9. Maheswari, (1982). Introduction to the embryology of Angiosperms.
10. Bhojwani, S.S and Bhatnagar, S.P., (1974). The embryology Angiosperms, Vihas publishing house, New Delhi.
11. Plant Anatomy A concept- Based approach to the structure of seed plants by Richard Crang Shelia Lyons- Sobaski Robert Wise.
12. https://academic.oup.com/aob/article-pdf/78/3/325/7982600/780325.pdf
13. http://www.cas.miamioh.edu/~meicenrd/anatomy/ch0_history/history.html
14. https://organismalbio.biosci.gatech.edu/growth-and-reproduction/plant-development-i-
15. tissue-differentiation-and-function/
16. https://www.toppr.com/guides/biology/anatomy-of-flowering-plants/plant-tissues/
17. https://courses.lumenlearning.com/wm-biology2/chapter/plant-tissues-and-organs/
18. https://agriculturistmusa.com/plant-embryology/
19. http://www.vpscience.org/materials/US04CBOT22%20UNIT%20II.pdf
20. https://www.biologydiscussion.com/microsporogenesis/microsporogenesis-and-
21. microspore-with-diagram/13535
22. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2806162/

**COURSE OUTCOMES:**

- Inspect process of compatibility involved in plant reproduction.
- Comply importance and tissues involved in secondary growth of Dicot and Monocot.
- State the types of plant growth and compare their structure, function and its process of luxuriant pant growth.
- Demonstrate anomalous Secondary growth in dicot and Monocot.
- Examine fertilization, types of Endosperm, dicot embryo, Polyembryony, Parthenocarpy and Apomixis.

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**Second Year** **CORE PRACTICAL IV** **Semester IV**

**PLANT ANATOMY AND EMBRYOLOGY**

**Code:** **(Practical)** **Credit: 4**

**COURSE OBJECTIVES:**

- To provide basic knowledge of plant internal architecture and cellular composition and reproduction.
- To familiar with the history of microscopy and different parts of compound microscopes.
- To learn about different techniques of anatomy like sectioning and staining.
- To know mounting media and mounting techniques.
- To explain the common stains for plant cells

**Anatomy**

1. Identifying Stomatal types using leaf peel method
2. Stem – Primary Structure – *Tridax*, *Zea maize*
3. Root – Primary structure Bean, Canna
4. Leaf anatomy – *Nerium*
5. Anamalous Secondary growth – *Boerhavia*, *Nyctanthes* and *Achyranthes*.

**Embryology**

1. T.S. of anther
2. Various stages of embryo Sac, Endosperms, Male and Female gametophytes Polyembryony to be studied by permanent Slide.
3. Dissection of Embryo – *Tridax*.

**REFERENCES:**


1. Bhojwani, S.S., Bhatnagar, S.P., Dantu P. K. (2015). Embryology of Angiosperms, 6th edition. New Delhi, Delhi: Vikas Publication House Pvt. Ltd.
2. Fahn, A. (1982). Plant anatomy. Oxford, U.K.: Pergamon Press.
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5. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
6. Fahn, A.1992. Plant Anatomy, Pergamon Press, USA.
7. Mauseth, J.D. (1988). Plant Anatomy, the Benjammin/Cummings Publisher, USA.


**COURSE OUTCOMES**

- Understand the scope and importance of Anatomy and Embryology.
- Understand the normal and anomalous secondary growth in plants and their causes.
- Perform the techniques in anatomy.
- Know fertilization, endosperm and embryogeny.
- Understand the structure and development in microsporangium and megasporangium.

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**Second Year** **NON MAJOR ELECTIVE II** **Semester IV**

**HORTICULTURE**

**Code:** **(Theory)** **Credit: 2**

**COURSE OBJECTIVES:**

- To understand the different aspects of horticulture
- To learn different methods of propagation
- To value the basic principles of landscape gardening.
- To learn the culture practice and management of horticulture crops
- To get employed with common ornamental and flowering plants.

**UNIT – I FUNDAMENTALS OF HORTICULTURE:**

Introduction and values of horticulture - classification – kinds of soil and soil fertility - organic, inorganic and bio-fertilizers - methods of application – irrigation systems - common garden pests and diseases - methods for controlling pest and diseases.

**UNIT – II PROPAGATION METHODS:**

Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Plant propagation methods - cutting, layering, grafting, budding, stock and scion relationship, micropropagation - uses of plant growth regulators in horticulture -cultivation practice s of coconut, banana and mango.

**UNIT – III PRINCIPLES OF LANDSCAPE GARDENING:**

Gardening - planning, designing and establishment of a garden – garden types - Components – lawn making - kitchen garden - indoor garden – cultivation of commercial flowers - rose, jasmines, Gerbera – Ikebana - Bonsai.

**UNIT – IV HORTICULTURAL CROPS:**

Conservation and management: Documentation and conservation of germplasm; Role of micro propagation and tissue culture techniques; Varieties and cultivarsof various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

**UNIT – V ORNAMENTAL PLANTS:**

Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (*Opuntia*, *Agave* and *Spurges*)

**UNIT – VI CURRENT CONTOURS: (For Continuous Internal Assessment Only):**

Current developments related to the Horticulture during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Edmond JB et al., 1977. Fundamentals of horticulture. Tata McGraw Hill Ltd., New Delhi.
2. Rao KM. 2000. Text Book of Horticulture, MacMillan India Ltd., New Delhi.
3. Gopalswamy Iyyangar, 1970. Complete gardening in India, Kalyan Printers, Bangalore.
4. Horticulture – Principles and practices Fourth edition by George Acquaah.
5. Textbook of Horticulture second edition by K. Manibhushan Rao - Laxmi Publications
6. Handbook of horticulture in 2 volumes @ 2019 by Kusum Lata Chadha.
7. Principles of Horticulture by Charles Adams, Mike early, Jane brook,& Katherine Bamford.
8. https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp/horticulture.pdf
9. https://www.agrimoon.com/wp-content/uploads/Fundamentals-of-Horticulture.pdf
10. https://www.eolss.net/sample-chapters/c09/e6-156-07-00.pdf
11. https://hort.purdue.edu/newcrop/originhorttech.pdf
12. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/2_18KP3B10_2020101608323615.pdf
13. https://www.hort.purdue.edu/newcrop/pdfs/hort-human-cult.pdf
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15. https://www.phytomorphology.com/articles/micropropagation-techniques-in-horticultural-crops-and-various-factors-affecting-it-a-review.pdf
16. https://agriinfo.in/irrigation-methods-for-horticultural-crops-1038/
17. https://edis.ifas.ufl.edu/pdf/MG/MG08600.pdf
18. https://agrimoon.com/wp-content/uploads/Principles-of-Landscape-Gardening.pdf


**COURSE OUTCOMES:**

- Acquire knowledge on horticulture.
- Demonstration of horticulture technique is well achieved.
- Understand the landscape gardening
- Knowledge on culture practice and management
- To get opportunity on various ornamental plants cultivation.

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**Third Year** **CORE COURSE V** **Semester V**

**CELL AND MOLECULAR BIOLOGY**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To make them understand the plant cell.
- To explain the cell structure and organelles.
- To discuss the cell division mechanism.
- To state the gene expression and regulation.
- To learn the regulation of gene expression.

**UNIT – I THE CELL:**

History and introduction of cell, Ultra structure of prokaryotic and eukaryotic cell. Plant cell structure and function, Cell wall- structure, chemistry and functions. Plasma membrane - structure, chemistry and function-Cell theory.

**UNIT – II CELL ORGANELLES:**

Structure and functions of mitochondria and chloroplast, Structure and functions of ER, Golgi complex, ribosome and cytoskeletons, Structure and functions of nucleus and nucleolus.

**UNIT – III CELL CYCLE AND DIVISION:**

Cell cycle- events of cell cycle, Molecular structure and functions of DNA and RNA. Cell divisions - Mitosis and Meiosis. Genetic regulation of cell cycle in Yeast, Cellular check points, DNA replication, DNA polymerases, eukaryotic system, origin, elongation and termination mechanisms, replication models Cairn's model, linear DNA model, rolling circle model, inhibitors of replication.

**UNIT – IV GENE EXPRESSION:**

Expression of genome, Transcription, RNA polymerase. Prokaryotic and eukaryotic transcription, promoters mediated initiation, RNA polymerases I, II and III, elongation and termination, post transcriptional processing, genetic code, Wobble's hypothesis, elongation and termination of translation.

**UNIT – V REGULATION OF GENE EXPRESSION:**

Process of transcriptional regulation, Eukaryotic regulation, response elements, DNA binding domains – promoters, repressors, coactivators, corepressors, enhancer elements. DNA repair mechanisms. Post - translational modification of proteins. Protein folding-self-assembly and role of chaperones. Principles of gene regulation: *lac* and *trp* operons of *E. coli*. Gene families and hormonal control in eukaryotes.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Cell and molecular biology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world

collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Ajoy Paul Text Book of Cell and Molecular Biology, Books and Allied (P)Ltd, 2007.
2. Buchanan BB Gruissem W Jones RL. Biochemistry and Molecular biology of Plants, IK International Publishers, New Delhi. 2000.
3. Freifelder D. Molecular Biology (2ndedition) Narosa Publishers, New Delhi. 1994.
4. Verma PS Agarwal VK. Molecular Biology (First edition), S. Chand and Company Ltd. New Delhi, (2009).
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8. Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing.
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14. https://www.britannica.com/science/plant-cell
15. https://www.frontiersin.org/articles/10.3389/fpls.2016.00984/full
16. https://www.vedantu.com/biology/plant-cell
17. https://www.britannica.com/science/mitochondrion
18. https://www.vedantu.com/biology/nucleus
19. https://le.ac.uk/vgec/topics/cell-cycle/the-cell-cycle-higher-education
20. https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/translation/a/intro-to-gene-expression-central-
21. https://www.nature.com/scitable/topicpage/rna-transcription-by-rna-polymerase-prokaryotes-vs-961/


**Course Outcomes:**

At the end of the course, students will be able to:

- Describe the ultra-structure and functions of plant cell.
- Examine the structural organization and function of organelles of a cell.
- Understand the cell cycle and cell division types in plants.
- Understand the central dogma of molecular biology.
- Record the mechanism of transcription, translation in prokaryotes and eukaryotes.

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**Third Year** **CORE COURSE VI** **Semester V**

**GENETICS, BIOSTATISTICS AND EVOLUTION**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To describe the Mendelian principles and Mutation and its role in evolution
- To compare the linkage and crossing over
- To apply the measures of central tendency and know about the collection and classification of data
- To discuss the importance of analysis of variance
- To rate the theories of evolution.

**UNIT – I GENETICS - I:**

Genetics-Monohybrid and Dihybrid cross. Deviation from mendelian ratio: Incomplete dominance (Mono-and dihybrid), lethal factor, complementary factor and epistasis (dominant), Multiple factor Hypostasis, multiple alleles. Mutations – types mutagens, physical and chemical mutagens. Mutation rate –its role in evolution. Gene units – Cistron, Recon, Muton, Codon and Operon.

**UNIT – II GENETICS - II:**

Linkage, crossing over, recombination, cytological proof of crossing over, mapping of genes on the chromosomes, sex linkage-Drosophila (eye colour), humans (colour blindness) and plants, cytoplasmic inheritance. Changes in chromosome structure, number and behaviour.

**UNIT – III BIOSTATISTICS:**

Introduction, Population and sample, variables, Collection of data, Classification and Tabulation of data, Diagrams and Graphs, Frequency distribution. Introduction, Measures of Central tendency – Mean, Median, Mode. Measures of dispersion – Range, Coefficient of Range, Standard deviation, Standard error, coefficient of variation.

**UNIT – IV BIOSTATISTICS:**

Random and Non – Random sampling, Test of Hypothesis and significance for small and large sample, Chi – square test and Goodness of fit, Analysis of variance (ANOVA – one way).

**UNIT - V EVOLUTION:**

Evolutionary concepts. Theories of Lamarck, Charles Darwin and the modern synthetic theories and biological evolution.

**UNIT - VI: CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Genetics, Biostatics and Evolution during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Sinnott, E.W., L.C. Dunn and J. Dobshansky (1958): Principles of Genetics (5th Edition) McGraw Hill Publishing Co., N.Y. Toronto, London.
2. Srb, A.M. Owen,R.D. and Edgar, R.S. (1979): General Genetics Eurasia Publishing House (P) ltd., New Delhi.
3. Palaniyappan, S. (1987): Marabiyal (Genetics-In Tamil) V.K. publishing House, Madras. Ahluwalia, K.B. (1990): Genetics Wiley Eastern Ltd., New Delhi, Bangalore, Bombay, Calcutta, Madras, Hydrabad.

4. Palaniyappan, S. (1987): Marabiyal (Genetics-In Tamil) V.K. publishing House, Madras. Ahluwalia, K.B. (1990): Genetics Wiley Eastern Ltd.,New Delhi, Bangalore,Bombay, Calcutta, Madras, Hydrabad.
5. Renganathan, T.K. and Shanmugavel, S. (1996): Genetics and Genetic Engineering Commercial Offset Printers, Sivakasi, India.
6. Daniel Sundararaj, D. and G. Thulsidas (1972): Introduction to Cytogenetics and Plant breeding (3rd edition) Popular Book Depot., Madras.

**BIOSTATISTICS**

7. N. Ramakrishnan, Fundamentals of Biostatistics, Saras Publications, Nagercoil
8. Mandal & Nambiar, Agricultural Statistics, Agrobios Publications, Jodhpur
9. P. Parihar, Biostatistics &Biomentry, Agrobios Publications, Jodhpur
10. S. Palanichamy& M. Manoharan, Statistical methods for Biologists, Palani Paramount publications, New Delhi
11. Peter Norton, Introduction to Computers, Tata MC Graw Hill Publishing Co., New Delhi
12. Ramesh Bangia, The Complete Computer Course Cyber Tech. Publishers, New Delhi
13. M. Lotia, P. Nir & P. Lotia, Modern Computer Hardware course BPB Publishers, New Delhi
14. Texali, Lordstar, Professional 4.0 made simple. Tata Mc Graw Hill Publishing Co., New Delhi.
15. N. Gurumani, An Introduction to Biostatistics, MJP Publishers, Chennai – 5

**EVOLUTION**

16. Savage, J.M. (1969): evolution (2nd Edition) Amarind Publishing Cosec2 θ (P)Ltd., New Delhi, Bombay, Calcutta.
17. ottlieb, LD. And Jain, S.K. (1988): Plant Evolutionary Biology Chapman and Hill, London. Shukla,
18. R.S. and P.S Chandel (1996): Cytogenetics, Evolution and Plant Breeding S. Chand and Co., New Delhi.
19. Verma, P.S. and V.K. Agarwal (1999): Concepts of Evolution S. Chand and Co., New Delhi. Anna
20. Sproule (1998): Charles Darwin Scientists who have changed the world Orient Longmans, Hydrabad.
21. https://oxford.universitypressscholarship.com/view/10.1093/oso/9780198862291.001.0001/oso-9780198862291
22. https://unacademy.com/content/neet-ug/study-material/biology/monohybrid-and-dihybrid/
23. https://byjus.com/biology/incomplete-dominance/
24. https://www.britannica.com/science/allele
25. https://www.ncbi.nlm.nih.gov/books/NBK21114/
26. https://www.embibe.com/exams/linkage-crossing-over/
27. https://plantlet.org/introduction-to-biostatistics-scope-variable-data/
28. https://www.cuemath.com/data/mean-median-mode/
29. https://www.investopedia.com/ask/answers/042415/what-difference-between-standard-error-means-and-standard-deviation.asp
30. https://studiousguy.com/lamarcks-theory-of-evolution/
31. https://www.researchgate.net/publication/8466818_The_modern_theory_of_biological_evolution_An_expanded_synthesis

**COURSE OUTCOMES:**

- Describe the Mendelian principles.
- Contrast the linkage and crossing over.
- Acquire knowledge on the different measures of biostatistics.
- Understanding sampling methods and tests of hypothesis.
- Relate on theories of evolution.

**Third Year** **CORE COURSE VII** **Semester V**

**MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- Compare the knowledge on classification and nomenclature of plant
- To describe the characters of families and economic importance of Monocot and Dicot plants.
- To employ herbarium preparation, Binomial system of plants.
- To apply typification, author citation, rules of naming in plants and modern taxonomy.
- To discuss the pollination methods and mechanism of seed dispersion in Angiosperms.

**UNIT – I MORPHOLOGY:**

Leaf phyllotaxy, leaf Types, shapes and modifications, stem types and modifications (Underground, aerial and sub-aerial). Root types and modifications, inflorescence types, flower and its parts. Fruits classification.

**UNIT – II PRINCIPLES OF SYSTEMATICS:**

Introduction to principle of Taxonomy and their importance. Classification – Natural – Bentham & Hooker, phylogenetic – Armen Takhtajan and APG in brief - Merits and Demerits. Plant Nomenclature, ICBN, ICN and Binomial system, preparation, maintenance and importance of Herbarium.

**UNIT – III TAXONOMY:**

Study of the following families and their economic importance: Annonaceae, Capparidaceae, Anacardiaceae, Rutaceae, Leguminosae (Fabaceae, Ceasalpinaceae and Mimosaceae).

**UNIT – IV TAXONOMY:**

Study of the following families and their economic importance; Asteraceae, Rubiaceae Asclepiadceae, Solanaceae and Lamiaceae, Amaranthaceae, Nyctaginaceae, Aristolochiaceae, Euphorbiaceae – lilliaceae, Commelinaceae and Poaceae.

**UNIT – V ECONOMIC BOTANY:**

Study of binomial, family and morphology useful parts and uses of the following plant products fibre – *Canabis sativum* resin – *Ferule Osafoetida*, Timber – *Terminalia bellerica*, Pulses-*Cajanus cajan*, Oil – *Sesamum indicum*, Spices – *Piper nigrum*.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Morphology, taxonomy and Economic Botany during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Vasishta, P.C. 1994. Taxonomy of Angiosperms, R.S. Chand & Company.
2. Verma, B.K. (2011). Introduction to Taxonomy of Angiosperms. PHI Learning Pvt Ltd. New Delhi.
3. Sharma, O.P. (1993). Plant Taxonomy Tata McGraw Hill.
4. Subramaniyan N.S. Modern Plant Taxonomy.
5. Singh, V and Jain, J. Taxonomy of Angiosperms, Rastogi publication, Meerut.
6. Pandey B.P. Economic Botany, S.Chand & Company.
7. Hill, Economic Botany Tata MacGraw Hill and Co New Delhi.
8. Lawrence, G.H.M. 1969. Taxonomy of Vascular plants Oxford & IBH Publishing Co.N. Delhi.
9. Rendle, R.B. The Classification of flowing plants, Vol. I, II & III Oxford Clarendon.
10. https://open.lib.umn.edu/horticulture/chapter/2-1-plant-taxonomy/
11. https://ncert.nic.in/textbook/pdf/kebo105.pdf
12. https://soe.unipune.ac.in/studymaterial/pritiJadhavOnline/Morphology.pdf
13. https://academic.oup.com/aob/article-pdf/88/6/1153/7982266/881153.pdf
14. https://nativeplants.org/wp-content/uploads/taxonomy.pdf
15. https://fac.ksu.edu.sa/sites/default/files/bot222_8_oct_2017_ali.pdf
16. https://www.uou.ac.in/sites/default/files/slm/BSCBO-302.pdf
17. https://www.uou.ac.in/sites/default/files/slm/BSCBO-302.pdf


**COURSE OUTCOMES:**

- Compare plant groups and recognize the role of Herbarium.
- Assess the importance of Herbaria and Botanical gardens.
- Employ the rule of ICBN in Botanical Nomenclature.
- Analyze the terms and concepts related to phylogenetic systematics.
- Examine the characters of families according to Bentham and Hooker's system of classification.

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**Third Year** **CORE PRACTICAL V** **Semester V**

**CELL AND MOLECULAR BIOLOGY & GENETICS BIOSTATISTICS AND EVOLUTION & MORPHOLOGY TAXONOMY AND ECONOMICS BOTANY**

**Code:** **(Practical)** **Credit: 4**

**COURSE OBJECTIVES:**

- The objective of this course is to familiarize students with the basic concepts.
- Applications of modern techniques used in Cell and Molecular Biology and Genetics, Biostatistics and evolution.
- The students will be able to understand the principle and working of statistical estimation.
- To study morphological characters of leaf, stipule, stem and root.
- Recognizing the taxonomic traits of the various plant groups.

**CELL AND MOLECULAR BIOLOGY:**

1. Observation of cells in onion peeling.
2. Observation of cell division in onion root tip and Rheo flower buds.
3. Differential staining methods for characterization of cells.
4. Isolation of total DNA from onion bulbs by using salt and detergent method.

**GENETICS, BIOSTATISTICS AND EVOLUTION:**

1) Monohybrid Experiment
2) Dihybrid Experiment
3) Incomplete Dominance

**BIOSTATISTICS:**

**STATISTICAL ESTIMATION:**

Tabulation of data, Diagrams and Graphs, Standard deviation, Standard error, Chi – Square and one way Anova.

**MORPHOLOGY:**

Study of Morphological Characters Leaf, Stipule, Stem and Root, Infloresunce, flower and Fruits.

**TAXONOMY:**

A detailed study of following Families Annonaceae, Capparidaceae, Rubiaceae, Anacardiaceae, Rutaceae, Leguminocae (Fabaceae, Ceasalpinceae and Mimosaceae). Asteraceae, Rubiaceae, Asclepiadaceae, Solanaceae and Lamiaceae, Amaranthaceae, Nyctaginaceae, Aristolochiaceae, Euphorbiaceae, Lilliaceae, Commelinaceae and Poaceae.

Botanical Tour (2-3 days) to floristic rich area in and around Tamil Nadu.

**REFERENCES:**


1. Karp,G (1995)Cell and Molecular Biology,John Wiley and Sons,New York
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.
3. Bessey, E.A (1979). Morphology and Taxonomy of fungi, Vikas publishing House Pvt.Ltd,New Delhi.
4. Lawrence, GHM. (1995). The Taxonomy of vascular Plants (Vol I-IV), Central Book, Dept., Allahabad.
5. Hill AW. 1951 Economic Botany - Mc Graw Hill, New Delhi.
6. Pandey, B.P., Economic Botany, S.Chand & Co., NewDelhi.
7. https://www.southalabama.edu/geology/haywick/GY112/112lect41.pdf
8. https://www.studocu.com/en-gb/document/university-college-london/biochemistry-and-molecular-biology/cell-molecular-biology-notes/10045497
9. https://uou.ac.in/sites/default/files/slm/BSCZO-103.pdf


**COURSE OUTCOMES:**

- Identify the following structures on the slides and explain the functions of plasma membrane, cytoplasm, nucleus, nucleolus, cell wall, and plastids.
- Understand the diversity of cells in their shapes and sizes.
- Acquire knowledge about the pattern of inheritance, understand the mechanism of gene action, learn the concept of biometrics and became aware of the importance of statistical tools and computer applications in life sciences.
- Acquisition of knowledge about conservation of economically important plants.
- Knew about Bioinformatics, scope and application; biological databases.

**Third Year** **MAJOR BASED ELECTIVE I** **Semester V**

**1. HERBAL BOTANY**

**Code:** **(Theory)** **Credit: 4**

**COURSE OBJECTIVES:**

- Employ the various Indian system of medicine
- Examine the drugs from various parts of plants
- Interpret the application of drugs
- Recognize the significance of plants in ethnobotanical practices
- To construct the interrelationship of humans and plants.

**UNIT – I HISTORY OF MEDICINAL PLANTS:**

Brief history of medicinal plants. Indian systems of medicines - Siddha, Ayurvedha and Unani. Classifications of crude drugs, Chemistry of drugs. Drugs from roots (*Rauwolfia*). Drugs form bark (Cinchona). Drugs from wood (*Ephedra*).

**UNIT – II SOURCES OF DRUGS:**

**Drugs from leaves** (Adathoda). **Drugs from flower**, (*Eugenia*). **Drugs from fruits and seeds** (wood apple and Coriander, Underground stem (Ginger).

**UNIT – III APPLICATION OF DRUGS:**

A brief account of drugs acting on the central nervous system, drugs used in disorders of gastrointestinal tract and cardiovascular drugs. Cultivation of medicinal plants in India. Breeding methods applied to medicinal herbs

**Unit – IV PLANTS AND TRIBAL MEDICINE:**

Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* and g). *Rauvolfia sepentina*,

**UNIT – V ETHNO BOTANY:**

Introduction, concept, scope and objectives. The relevance of ethnobotany in the present context. Major ethnic people in Tamil Nadu. Ethnobotany as a source of drug. a) Reserpine b) Artemisin c) Gugulipid d) Strychnine

**UNIT – VI Current Contours (For Continuous Internal Assessment Only):**

Current developments related to the Herbal Botany during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Sana Loue, Research Ethics: Theory and Practice,
2. Jasanoff, S. The Ethics of Invention: Technology and the Human Future
3. R Subramanian, Professional Ethics, Oxford University Press.
4. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing
5. R.R. Gaur, R. Sangal, G.P. Bagaria. A Foundation Course in Human Values and Professional Ethics, Excel Books, Delhi.
6. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Delmar Cengage Learning
7. https://www.gpgcraipur.ac.in/books/A%20Textbook%20of%20Practical%20Botany%20II-bsc.pdf
8. https://ncert.nic.in/textbook/pdf/kebo105.pdf
9. https://www.researchgate.net/publication/303718980_BOTANICAL_IDENTIFICATION_OF_MEDICINAL_PLANTS_A_BIOSYSTEMATIC_CONTEMPLATION
10. http://www.wildflowers-and-weeds.com/Plant_Identification/Patterns_in_Plants.htm
11. https://www.britannica.com/science/wing-botany
12. http://www.westbengalforest.gov.in/upload/development/cm4.pdf
13. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1831906/


**Course Outcomes:**

- Appreciate the various Indian system of medicine.
- Identify drugs from various parts of plants.
- Restate the knowledge and application of drugs.
- Information on the ethnobotanical practices.
- Manage the significance of ethnobotany.

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**Third Year** **MAJOR BASED ELECTIVE I** **Semester V**

**2. HORTICULTURE AND LANDSCAPE GARDENING**

**Code:** **(Theory)** **Credit: 4**

**COURSE OBJECTIVES:**

- To state the basic principles and applications of horticulture
- To learn the techniques of propagation and growth regulators in horticulture
- To understand the practices in fruits and flower production technology and ornamental horticulture
- To discuss the basic concepts of landscape gardening.
- To value the basic principles of landscape gardening.

**UNIT – I BASICS OF HORTICULTURE:**

Introduction and values of horticulture - classification – kinds of soil and soil fertility - organic, inorganic fertilizers and biofertilizers - methods of application – irrigation systems - common garden pests and diseases - methods for controlling pest and diseases.

**UNIT – II PROPAGATION METHODS:**

Plant propagation methods – Sexual, asexual and vegetative methods - cutting, layering, grafting, budding, stock and scion relationship, - micropropagation - uses of plant growth regulators in horticulture

**UNIT – III COMMERCIAL HORTICULTURE:**

Importance, species, varieties and production technology of: Rose, Jasmine and Marigold; Mango, Banana and Citrus; Tomato, Brinjal and Cabbage. Ornamental horticulture: Cultivation, care and maintenance of cacti, succulents, ferns, palms and cycads.

**UNIT – IV BASICS OF LANDSCAPE GARDENING:**

Landscape gardening – Components of beauty in the landscape – Garden types – Principles in laying out a garden – Lawn making - Kitchen garden – Indoor garden – special group of garden plants – succulents and cacti Ornamental palms, Orchids, Rockery and water gardens – Bonsai cut flower decoration.

**UNIT – V LANDSCAPE GARDEN DESIGNING:**

Formal gardening - Informal gardening - Planning - Designing – #Garden features# - Walls, Fencing, Steps, Garden drives and paths, Hedges, Edges, Arches, Pergola, Flower beds, Shrubbery, Topiary, Borders. Establishment of garden - Lawn making - Green houses - Simple, Commercial, and Conservatories - Indoor gardening.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Horticulture and Landscape Gardening during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Kumaresan V. Horticulture and Plant breeding. Saras Publication, Nagercoil, 2009.
2. Kumar N. Introduction to Horticulture. Rajalakshmi Publications, Nagarcoil, 1994.
3. Edmond JB, Sen TL, Andrews FS, Halfacre RG. Fundamentals of Horticulture
4. (Foruth edition). Tata McGraw Hill Publishing Co., New Delhi, 1979.
5. Jitendra Sing. Basic Horticulture. Kalyani Publishers, Hyderabad, 2002.
6. http://www.agrimoon.com/wp-content/uploads/Introduction-to-Soil-Science.pdf


**COURSE OUTCOMES:**

Understand the knowledge on horticulture.

- Understand the concept of propagation method.
- Employ the knowledge on horticulture in commercialization.
- Acquire knowledge on landscape gardening.
- Design the strategies for effective gardening methods.

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**Third Year** **SKILL BASED ELECTIVE I** **Semester V**

**TECHNIQUES IN BIOLOGY**

**Code:** **(Theory)** **Credit: 2**

**COURSE OBJECTIVES:**

- Explain the Principles of microscopy
- To gain a knowledge about the pH and centrifugation
- To attain the knowledge about spectrophotometry
- Describe the structure and functioning of various biological instruments
- Recogonize knowledge in various biochemical methods

**UNIT – I IMAGING AND RELATED TECHNIQUES**:

Principles of microscopy; Light microscopy; Fluorescence microscopy; Electron Microscopy (a) Flow cytometry (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

**UNIT – II PH AND CENTRIFUGATION**:

pH meter: Principles and instrumentation, Centrifugation: Principles, types of centrifuges, types of rotors, differential and density gradient centrifugation, application. Sonication, Freeze drying.

**UNIT – III SPECTROPHOTOMETRY:**

Principle involved in Spectrophotometer; Spectrophotometric techniques, Instrumentation: ultraviolet and visible spectrophotometry (single anddouble beam, double wavelength spectrophotometers), Infrared spectrometers - Luminometry and densitometry – principles and their applications - Mass Spectroscopy-principlesof analysis, application in Biology.

**UNIT – IV CHROMATOGRAPHY:**

Chromatographic techniques: Principle and applications – Column - thin layer – paper, affinity and gaschromatography - Gel filtration - Ion exchange and High performance liquid chromatography techniques– Examples of application for each chromatographic system - Basic principles of electrophoresis.

**UNIT – V MICROTECHNIQUES:**

Fixation, dehydration, embedding, hand sectioning, microtome sectioning, stain types, staining and mounting. Preparation of double staining using saffranin and fast green. whole mounts, temporary mounts, maceration and epidermal peeling.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Techniques in biology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
2. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.
3. K. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn) Edward Arnold, London.
4. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
5. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
6. Ruzin, S.E. (1999). Plant micro technique and microscopy. Oxford University Press, New York, U.S.A
7. Gray. P. Hand book of basic Micro technique, Tata McGraw Hill Co., New Delhi.
8. Alen Peacock, H.J Elementary Micro technique, Em Kay Publications, New Delhi.
9. Sass – J. E Botanical Microtechnique, Oxford & IBH Publishing House Co., New Delhi.
10. P Rasad & Prasad. Outlines of Micro technique, Em Kay Publications, New Delhi.


**COURSE OUTCOMES:**

- Illustrating the microscopy applications in research.
- Enrich the knowledge on pH and centrifugation.
- Comprehend the various spectrophotometry.
- Demonstration of various separation techniques.
- Application of instrumentation in biological techniques.

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**Third Year** **CORE COURSE VIII** **Semester VI**

**PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- Differentiation of C3 and C4 pathway to know about the nutrition requirements.
- To describe the respiration, nitrogen metabolism and growth regulator.
- To compare the structure and classification of carbohydrate and protein
- To state the role of enzymes
- To state the concept of thermodynamics law

**UNIT – I PLANT PHYSIOLOGY**:

Plant – Water Relations – Water Transport Processes – Diffusion, Osmosis, Water Potential – Transpiration and its Significance, Mechanism of stomatal movement. Mineral Nutrition: Nutrient Uptake and Transport Mechanism. Photosynthesis: Photosynthetic Apparatus, Photochemical reactions, Electron Transport Pathway, Photophosphorylation, Calvin cycle. C4 –pathway, Crassulcean Acid Metabolism, Photorespiration.

**UNIT – II PLANT PHYSIOLOGY:**

Respiration, Glycolysis, TCA Cycle, Electron Transport system, oxidative Phosphorylation –Anerobic respiration - Nitrogen Metabolism: Biological Nitrogen Fixation, Growth and Development: Physiological Role of Plant Growth Regulators: auxins, Cytokinins, Gibberellins Abscissic Acid and Ethylene. Physiology of Flowering- Photoperiodism and Vernalization. Seed Dormancy and Seed Germination.

**UNIT – III BIOCHEMISTRY**:

Structure and Classification, of carbohydrates, Structure, Characteristics and Classification of Amino Acids – protein and Non Protein Amino Acid Biosynthesis. Structure of Proteins Primary, Secondary, Tertiary and Quaternary Structure - Lipids: Classification and Structure, Biosynthesis of Fatty Acids, Saturated and Unsaturated Fatty Acids, Oxidation of Fatty Acids.

**UNIT - IV: BIOCHEMISTRY ENZYMES**

General aspects (Classification, Nomenclature and Structure) Mechanism of enzyme action Michaells Menton Equation and its Significance Kinetics Regulatory mechanisms, Isoenzymes.

**UNIT – V BIOPHYSICS:**

Thermodynamics, Laws- Redox Potential – Redox coupling, Bioenergetics – ATP, Entrophy and Enthalpy Photo Biology: Dual Nature of Light, Characteristics of solar Radiation, Solar Energy, Efficiency of Atoms, Absorption Spectra in Molecules – Energy states and Deexcitation.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Plant physiology, Biochemistry and Biophysics during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**

**PLANT PHYSIOLOGY**


1. Jain V.K. (1990) Plant Physiology S. Chand & Co New Delhi
2. ar H.D. and Singh H.N. (1990 Plant metabolism)
3. Fang F.K. (1982) Light Reaction path of Photosynthesis Vol. 35 molecular biology, Biochemistry and Biophysics – Springer.
4. Malik C.P. and Srinivastra (1995) Plant Physiology
5. Verman S.K. (1999) Plant Physiology S. Chand & Co, New Delhi
6. Palner J.J. (ed) 1984 the physiology and biochemistry of Plant respiration – Cambridge University Press, U.K.
7. Delvin R.M. (1969) Plant Physiology Holt, Rinechart & Winston & Affiliated east west Press (P) Ltd New Delhi
8. S. Salisbury F.B & C.W. Ross (1999) Plant Physiology CBS Publishers & Printers, New Delhi.


**BIOCHEMISTRY**


9. Lehninger A.L. (1985) Biochemistry Worth Publishers
10. Freifelder D (1985) Essentials of Modern biochemistry – Jones & Bariet.
11. Breet. C.T. and Hillman, J.R. (1985) Biochemistry of plant cell walls - Cambridge University Presses U.K. Bio Physics


**BIO PHYSICS**


12. Lchinager A.I (1971) Bioenergetics The Molecular basis Biological Energy Transformation – Addition wiley.
13. Casey E.J. (1962) Biophysics – Concepts and mechanism – Van Nonstmd reinfold Co & East – West press, New Delhi
14. Daniel M. and Peter R.C (1989) basic biophysics – Agro Botanical Publishers (India)


**WEB LINKS:**

15. http://www.esalq.usp.br/lepse/imgs/conteudo_thumb/Handbook-of-Plant---Crop-Physiology-Revised---Expanded-by-Mohammad-Pessarakli--2001-.pdf
16. https://www.jstor.org/stable/i40135622
17. https://ses.library.usyd.edu.au/bitstream/handle/2123/3578/Agriculture_2008.pdf?sequence=1&isAllowed=y

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**Third Year** **CORE COURSE IX** **Semester VI**

**PLANT ECOLOGY, PHYTOGEOGRAPHY AND ENVIRONMENTAL BIOTECHNOLOGY**

**Code:** **(Theory)** **Credit: 5**

**COURSE OBJECTIVES:**

- To recognize the concepts of ecosystem and cyclic flow of elements between organism and environment.
- To appraise the knowledge on plant distribution and their conservation.
- To state about Autecology and Synecology.
- To explain plant succession patterns and its ecological adaptations.
- To compare phytogeography vegetational types and phytogeographical regions of India.

**UNIT – I ECOLOGY:**

Introduction, Scope and History of Ecology Biotic and Abiotic factors and their influence on Vegetation. Basic concepts, Levels of Organization inter-relationship between the living world and the environment.

**UNIT – II ECOSYSTEM:**

Ecosystem concept process and components, Food chain, Food web, Principles function and models of Energy flow, Terrestrial and pond ecosystem. Ecological Pyramids types and function – Biogeochemical cycle (C, N, P).

**UNIT – III POPULATION ECOLOGY:**

Autecology and Synecology, Vegetation, Formation, Association, Consociation, Society, development of Vegetation – Migration, Ecesis – ecads, ectone, colonization – Methods of study in Vegetation (Quadrat and Transect) Plant succession, Hydrosere and Xerosere, Morphological and anatomical feature of Hydrophytes, Mesophytes and Xerophytes

**UNIT – IV PHYTOGEOGRAPHY:**

Phytogeography: Principles – Vegetation types in India, biogeographical time of India, Tropical rain forest, shoals and deciduous forest, Sand dunes, Mangrove and Scrub jungle, continental drift, Principle of Remote Sensing and its applications. Phytogeographical regions in India.

**UNIT – V ENVIRONMENTAL BIOTECHNOLOGY:**

Environmental Biotechnology: Basic concepts and issues of Environment, global environmental problems – Ozone depletion, UV-B, Green House Effect and acid rain due to Anthropogenic activities and their impact, Biotechnological approaches for environmental management. Decay behaviour and degradative plasmids, Molecular techniques in Bioremediation.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Plant ecology, phytogeography and Environmental biotechnology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Singh, J.S., Singh, S.P and Gupta, S (2006). Ecology Environment and Resource conservation, Anamaya Publications, New Delhi.
2. Wilkinson, D.M. (2007). Fundamental Process in Ecology an earth system Approach Oxford.
3. Odum, E (2008). Ecology Oxford and IBH Publisher.
4. Sharma, P.D. (2010). Ecology and Environment, (8th Ed) Rastogi Publications, Meerut.
5. Ambast, R.S. A text book of plant Ecology. Vikas publication, New Delhi.
6. Shukla, R.S. and P.S. Chandel, Plant Ecology and Soil Science, S. Chand and Co.
7. Sundara Rajan, S (2016). College Botany Volume – II. Himalaya Publishing House, New Delhi.
8. Daubenmier, R.F. (1970). Plants and Environment, A text book of plant Autecology. Wiley Easten Private Limited.
9. Daubenmier, R.R. (1970). Plant communities, Wiley Easter Private Limited.


**COURSE OUTCOMES:**

- Compare the concept of ecosystem, biogeochemical cycle and species selection.
- Discuss the environmental deterioration and possible measures for their revival.
- Apply the acquired knowledge about conserve plant species and natural resources in modern techniques.
- Record and register the diversity changes through remote sensing.
- Apply strategies for the conservation of Germplasm.

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**Third Year** **CORE PRACTICAL VI** **Semester VI**

**PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS & PLANT ECOLOGY, PHYTOGEOGRAPHY AND ENVIRONMENTAL BIOTECHNOLOGY**

**Code:** **(Practical)** **Credit: 4**

**COURSE OBJECTIVES:**

- To determine the chlorophyll, carotenoids and protein.
- To estimate the lipid, reducing sugar and amino acids by ninhydrin method.
- To understand the separation techniques.
- To acquire knowledge on electrophoretic apparatus.
- To study about plant ecology and phytogeography.

**PLANT PHYSIOLOGY**

1. Determination of water potential in different tissues.
2. Estimation of chlorophyll a, Chlorophyll b, and total chlorophyll by the Arnon's method.
3. Determination of carotenoids
4. Estimation of protein by Lowry's method
5. Estimation of total phenols
6. Hill reaction – demonstration

**BIOCHEMISTRY**

1. Extraction and estimation of lipid
2. Determination of reducing sugars in (grapes) fruit
3. Estimation of amino acids by ninhydrin
4. Separation and identification of amino acids by chromatography
5. Separation of dyes by Paper / TLC methods
6. Extraction of amylase and determination of its activity
7. Determination of peroxidase activity

**BIOPHYSICS**

1. Principle and methodology of pH meter, Spectrophotometer, Centrifuge,• Electrophoretic apparatus, permanent slide preparation

**PLANT ECOLOGY AND PHYTOGEOGRAPHY:**

1. Study of morphological and structural adaptations in locally available plant forms Hydrophytes – Hydrilla, Xerophytes – Nerium, Mesophytes - Tridax
2. Study of morphological features of epiphytes, Parasites and halophytes.
3. Studies of vegetation by quadrat, Line transect method.
4. Study of phytogeographical regions in India.
5. Determination of soil and water pH.

**REFERENCES:**


1. Taiz L and Zeiger E. Plant physiology (Second edition). The Benjamin/Cummings publishing company, Inc., California, New York, 1998.
2. Jain VK. Fundamentals of Plant Physiology (14th Ed), S. Chand and Company Ltd, New Delhi, 2012.
3. Jain JL. Jain S and Jain N. Fundamentals of Biochemistry. S. Chand and Company Ltd., New Delhi, 2008.
4. Narayanan P. Essentials of Biophysics, New Age International Publishers (P) Ltd., NewDelhi, 2000.
5. Stryer L. Biochemistry, W. H. Freeman and Co., New York, 1989.
6. https://uou.ac.in/sites/default/files/slm/BSCBO-203.pdf
7. https://uou.ac.in/sites/default/files/slm/BSCBO-303.pdf


**COURSE OUTCOMES:**

- Perform procedure of water estimation, chlorophyll, carotenoid and phenol.
- Estimate the lipid, reducing sugar and amino acids by ninhydrin level.
- Understand the separation techniques.
- Apply the knowledge on electrophoretic apparatus.
- Apply the knowledge on plant ecology and phytogeography.

**Third Year** **MAJOR BASED ELECTIVE II** **Semester VI**

**1. AGRIBASED ENTREPRENEURSHIP**

**Code:** **(Theory)** **Credit: 4**

**COURSE OBJECTIVES:**

- To value the skills required for trading of agricultural products
- To employ the basic concept of agribased entrepreneurship
- To acquire knowledge on quality controls
- To acquire knowledge on documentation and legal dimension
- To understand the export and Import trading

**UNIT – I Basic Concepts:**

Introduction to agriculture, Concepts and definitions of agricultural marketing, forms of agriculture, production, analysis of marketable areas, analysis of import and export statistics of agricultural products in India, macroeconomic forces

**UNIT – II Entrepreneur and Entrepreneurial Process:**

Concept and Types of entrepreneurship - characteristics of entrepreneurs and entrepreneurial skills - entrepreneurial process – Importance of entrepreneurship.

**UNIT – III Policy and Technology Advancements:**

Overview of world agricultural trade, issues impacting international agricultural trade, agricultural policy, technology advancement on agricultural products

**UNIT – IV Entrepreneurship Opportunities:**

Identification of business opportunities, creating small business, new product development and marketing, financing and managing the enterprise – MSME (Ministry of micro small and medium enterprises) classification and opportunities for rural entrepreneurship – Kadhi and village industries commission (KVIC) classification.

**UNIT – IV Planning Documentation and Legal Dimensions:**

Identifying foreign markets for agri export, marketing plan for exports, export documents and procedure, terms of payment and export finance, legal dimensions

**UNIT – V Export and Import Trading:**

Marketing of agricultural products – Methods, publicity and marketing mix. Schemes an supporting agencies for entrepreneurship. Institutional infrastructure for export promotion in India, export assistance - State trading in imports and exports.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Agribased Entrepreneurship during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCE:**


1. Mohanty S K, 2007.Fundamentalsof Entrepreneurship. Prentice Hall India Ltd. NewDelhi.
2. **Arvind Kumar Bhatt, 2016. Innovation and Entrepreneurship. Laxmi Publications Pvt. Ltd.** Mumbai**.**
3. Rajendra Prasad 2004 text book of Field Crop Production Volume I & II. Panda S C 2014 Agronomy of Fodder a forage crop, kalyani publishers, Ludhina.
4. Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall of India Pvt. Ltd., New Delhi.
5. file:///C:/Users/ELCOT/Downloads/Agri-Enterpreneurship-New%20Book.pdf


**COURSE OUTCOMES:**

- Evaluation of markets, map resources and conduct business planning
- Restate the basic principles of financial management, sales and risk management
- Understand the quality control measures of the import and export
- Support operations and financial record keeping
- Develop a business and manage relationships.

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**Third Year** **MAJOR BASED ELECTIVE II** **Semester VI**

**2. MUSHROOM CULTIVATION TECHNOLOGY**

**Code:** **(Theory)** **Credit: 4**

**COURSE OBJECTIVES:**

- To employ basic strategies in Mushroom cultivation technology.
- To acquire knowledge on spawn preparation and cultivation strategies.
- To explain basics in mushroom cultivation technology
- To learn about nutritional and economic values of mushroom
- To learn different types of mushroom cultivation

**UNIT – I INTRODUCTION:**

Introduction of Mushroom, Importance of Mushroom, History of Mushroom, Morphology of Mushroom. Classification and distribution of mushroom-Mushroom Types Edible-and-poisonous-mushrooms -life cycle of mushroom. Importance of Mushroom

**UNIT – II SPAWN PREPARATION**:

Isolation of pure culture; Nutrient media for pure culture; layout of spawn preparation room; raw material of spawn; sterilization; preparation of mother spawn and multiplication.

**UNIT - III CULTIVATION OF MUSHROOM:**

Layout of mushroom shed - small scale and large scale production unit. Types of raw material – preparation and sterilization; Mushroom bed preparation – maintenance of mushroom shed; harvesting method and preservation of mushrooms.

**UNIT – IV NUTRIENT VALUES OF MUSHROOM:**

Protein, carbohydrate, fat, fibre, vitamins and amino acids contents; short and long term storage of mushroom; preparation of various dishes from mushroom. Medicinal value of mushroom – cultivation, extraction, isolation and identification of active principle from mushroom. Pharmacological and economic values of mushroom.

**UNIT – V TYPES OF MUSHROOM:**

Cultivation of following types of mushroom – milky mushroom; oyster mushroom, button mushroom and any one medically valuable mushroom. Disesaes and Pests of Mushroom.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Mushroom Cultivation Technology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
2. Tewan and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
3. Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
4. Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.
5. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.
6. Mushroom Cultivation in India- B.C.Suman and V.P.Sharma
7. Mushroom Growing for Everyone- G. Roy
8. Mushroom Production and Processing- V.N.Pathak, N.Yadav and M.Gaur
9. https://www.researchgate.net/publication/236011864_Button_Mushroom_Cultivation
10. http://agropedia.iitk.ac.in/content/mushroom-spawn-production-technology
11. https://www.bajkulcollegeonlinestudy.in/StudyMaterialFinal/Nutrition/100%206TH%20SEM-DSE4T-CLASSIFICATION%20OF%20MUSHROOM%20-%20SAINI%20MANDAL.pdf
12. https://www.verywellfit.com/mushroom-nutrition-facts-calories-and-health-benefits-4117115
    https://justagriculture.in/files/newsletter/2021/march/29.pdf


**COURSE OUTCOMES:**

- Understand the mushroom cultivation practices.
- Formulate a new strategy on small scale industry.
- Support the economy by mushroom cultivation.
- Gain a knowledge on nutritional and economical values of mushroom.
- Develop a small scale cultivation of mushroom.

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**Third Year** **PROJECT** **Semester-VI**

**Code:** **Credit: 3**

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

**ASSESSMENT/EVALUATION/VIVA VOCE:**

1. PROJECT REPORT EVALUATION (Both Internal & External)

   I. Plan of the Project - 20 marks

   II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc. and presentation of the report. - 45 marks

   III. Individual initiative - 15 marks

2. Viva-Voce / Internal & External - 20 marks

**TOTAL** **- 100 marks**

**PASSING MINIMUM:**

| | **Vivo-Voce 20 Marks** | **Dissertation 80 Marks** |
|---|---|---|
| Project | 40% out of 20 Marks (i.e. 8 Marks) | 40% out of 80 marks (i.e. 32 marks) |

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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**Third Year** **SKILL BASED ELECTIVE II** **Semester VI**

**SEA WEED TECHNOLOGY**

**Code:** **(Theory)** **Credit: 2**

**OBJECTIVES:**

- To describe the importance of seaweed cultivation and the strategies involved.
- To understand different seaweeds and their importance.
- To gain knowledge on seaweed farming and quality assurance.
- To understand seaweed ecology and management.
- To organize employment and improve the livelihood of fisherman community.

**UNIT – I INTRODUCTION:**

Seaweed – Definition – Significance – Benefits – Marine algae – Major bioactive compounds – Classification – Brown algae (Phaeophyta), Green algae (Chlorophyta), Red algae (Rhodophyta) – Characteristic features.

**UNIT – II STRUCTURE OF SEAWEEDS:**

(Thallus, Lamina, Sorus, Air bladders, Stipe, Holdfast, Haptera). Seaweed Reproduction (Asexual and Sexual). Economic importance of seaweeds.

**UNIT – III SEAWEED FARMING:**

Seaweed farming - bioreactors – methods of breeding seaweeds – collection and preservation techniques of seaweeds. Seaweed quality assurance, seaweed safety – illness associated with consumption – toxins, allergies and intolerances – health risks and threats.

**UNIT – IV AQUATIC ECOLOGY:**

Aquatic ecology – Biodiversity – Disaster management – Coastal zone management – Ecosystem – Services of seaweed farming.

**UNIT – V SEAWEEDS AND SOCIETY:**

Seaweeds and society – farming seaweeds for food and fuel by entrepreneurs – sustainable aquaculture – potential disadvantages of growing seaweed.

**UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):**

Current developments related to the Sea weed technology during the semester concerned to be kept abreast of continuously and cumulatively through collection, discussion and evaluation from news and events over the world collected through multiple reliable informative sources – Research articles, review materials, print, Internet, Interaction, Social media, Webinars and so on.

**REFERENCES:**


1. Fritsch, F.E. 2009. The Structure and Reproduction of the Algae. Cambridge University Press.
2. Maria, H.A., Rui, P. and Jean, F.S. 2014. Marine Algae, CRC Press.
3. Pereira and Joao, M.N. 2020. Marine Algae: Biodiversity Taxonomy Environmental Assessment And Biotechnology, T&F Publishers, India.
4. Sambamurthy, A.V.S.S. 2013. A Textbook of Algae, IK International Publishing House Pvt. Ltd.
5. Sustainable seaweed Technologies: cultivation, Biorefinery, and applications ( Advance in green and sustainable chemistry) Kindle Edition.
6. Biotechnological Application of seaweeds
7. http://en.wikipedia.org/wiki/Seaweed
8. http://www.oilgae.com/algae/types/marine_algae/marine_algae.html
9. https://en.wikipedia.org/wiki/Brown_algae
10. https://en.wikipedia.org/wiki/Red_algae
11. https://en.wikipedia.org/wiki/Green_algae
12. https://www.seaweed.ie/algae/chlorophyta.php


**COURSE OUTCOMES:**

- A complete understanding of sustainable seaweed farming.
- Development of practical knowledge about seaweed breeding.
- Understand the importance of seaweeds.
- Knowledge on seaweed farming related issues.
- Understand the seaweed ecosystem management.

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