TAMIL NADU OPEN UNIVERSITY

Syllabus and Regulations

B.Sc., Botany [Semester Pattern]

Effective from the Academic Year 2020 - 2021

School of Science

Tamil Nadu Open University

Saidapet, Chennai - 600 015

REGULATIONS AND SYLLABUS

(This will come into force from the academic year 2020-2021 onwards)

1. Eligibility for Admission:

Candidates should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Government of Tamil Nadu or any other examination accepted by the syndicate, as equivalent thereto, with Botany or biology as one of the subjects in Higher Secondary Education. Admission will be in academic year alone.

2. Duration of the course:

The students shall undergo the prescribed course of study for a period of three academic years.

3. Programme Outcomes:

1. Critical Thinking: Apply the knowledge of biology to make scientific queries and enhance the comprehension potential.
2. Effective Communication: Successful transfer of scientific knowledge both orally and in writing.
3. Social Interaction: Function as an individual, as a member or a leader to perform a task in class room situation or during field study.
4. Effective Citizenship:Responsible for learning, develop honesty in work and respect for self and others.
5. Ethics: Convey and practice social, environmental and biological ethics.
6. Environment and Sustainability: Insist the significance of conserving a clean environment for perpetuation and sustainable development.
7. Self-directed and Life-long Learning: study incessantly by self to cope with growing competition for higher studies and employment.

4. Programme Specific Outcomes:

1. Educate students in and around Tamil Nadu, about plant science.
2. Inculcate strong fundamentals on modern and classical aspects of Botany.
3. Build life skills in Edible mushroom cultivation, Biofertilizer production, Greenhouse maintenance and Seed technology through value-added courses.

4. Create platform for higher studies in Botany.
5. Facilitate students to take-up successful career in Botany.

5. Medium of instruction: English

6. Subject of study:

Part 1: Tamil – 4 papers

Part 2: English – 4 papers

Part 3: Major (Botany) Theory 12 papers, Practical 4 papers.

Ancillary I – Zoology – 2 Papers

Ancillary II – Chemistry– 2 Papers

Non Major Elective – 2 Papers

CCE – 1 Paper

7. Scheme of Examinations: Maximum Marks: 100 (Spot Assignment 30 + External 70 (35% Minimum))

Passing Minimum

(i) For theory examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 25 marks in the Term End Examinations (TEE) in each theory paper and secures not less than 13 marks in the Continuous Internal Assessment (CIA) and overall aggregated marks is 40 in both the external and internal taken together.

Continuous Internal Assessment (CIA)		Term End Examination (TEE)		Overall Aggregated Marks	Maximum Marks
Minimum Pass Mark	Maximum Mark	Minimum Mark	Maximum Mark	CIA + TEE	
13	30	25	70	40	100

(ii) For practical examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 40 marks in the University practical examination and the mark distributions on results, record note book, procedure writing and Vivo-voce taken together is required to pass the examinations.

8. Classification of Successful Candidates:

Candidates who have pass all the courses prescribed and who secure 60 percent and above in the aggregate of marks in Core and Ancillary courses will be placed in the First class. Those securing 50 percent and above but below 60 percent in the aggregate will be placed in the Second class. All other successful candidates will be placed in the Third class.

Allocation of Courses and Credits

Courses	**Course Title**	**Code**	**Marks**		Max. Mars	Credit
			CIA	**TEE**		
First year Semester - I						
Language	Tamil	BFTM 11	30	70	100	3
Language	English	BFEG 11	30	70	100	3
Core Major I	Plant Diversity – 1	BBOTS 11	30	70	100	4
Core Practical	Plant Diversity - I (Exam at 2nd Semester)					
Allied	Animal Diversity - 1	BZOSA 11	30	70	100	4
First year Semester - II						
Language	Tamil	BFTM 21	30	70	100	3
Language	English	BFEG 21	30	70	100	3
Core Major II	Plant Diversity – 1I	BBOTS21	30	70	100	4
Core Practical	Plant Diversity I & II	BBOTS21 P				4
Allied	Economic Zoology	BZOSA 22	30	70	100	4
Elective SBE	Office Automation/ Open Source Technology	BCAS – 13/ BCAS - 22	30	70	100	2
Second year Semester - III						
Language	Tamil	BFTM 31	30	70	100	3
Language	English	BFEG 31	30	70	100	3
Core Major III	Morphology, Plant Anatomy and Embryology	BBOTS31	30	70	100	4
Core Major IV	Microbiology and Plant Pathology	BBOTS32	30	70	100	3
Core Practical	Morphology, Anatomy Microbiology, Plant Pathology(Exam at 4th Semester)					
Allied	General Chemistry - I	BCHESA 31	30	70	100	4
Elective	Generic Non Major		30	70	100	2

Second year Semester - IV						
Language	Tamil	BFTM 41	30	70	100	3
Language	English	BFEG 41	30	70	100	3
Core Major V	Plant Taxonomy and Economic Botany	BBOTS 41	30	70	100	4
Core MajorVI	Ecology, Forestry and Evolution	BBOTS42	30	70	100	3
Core Practical	Morphology, Anatomy Microbiology, Plant Pathology, Taxonomy, Ecology	BBOTS41 P			100	4
Allied	General Chemistry - II	BCHESA 41	30	70	100	4
Part IV	Environmental Studies	CCE	30	70	100	4
Third year Semester - V						
Core Major VII	Cell Biology, Genetics and Plant Breeding	BBOTS 51	30	70	100	4
Core Major VIII	Molecular Biology and Genetic Engineering	BBOTS52	30	70	100	4
Core Major IX	DSC - Biochemistry and Nanobiotechnology	BBOTS53	30	70	100	3
Third year Semester - VI						
Core Major X	Plant Physiology	BBOTS61	30	70	100	4
Core Major XI	Plant Biotechnology	BBOTS62	30	70	100	4
Core Major XII	DSC -Bioinstrumentation and Computational Biology	BBOTS63	30	70	100	3
Core Practical	Practical -5	BBOTS64 P			100	2
Core Practical	Practical -6	BBOTS65 P			100	2
	Total	**31**			**3100**	**104**

* Suitable courses from online platforms such as SWAYAM or NPTEL or MOOC are to be offered. An option is also given for the students to freely choose similar soft skills offered from other departments at TNOU. Essential soft skill courses include a variety of social skills, including communication skill, emotional intelligence, conflict resolution or any applied Botany providing self-employment opportunities etc.

Elective Courses:

1. Ability Enhancement Compulsory Courses (AECC) – (i) Soft skill/ Information Technology Essential
   (ii) Environmental Science
2. Skill Enhancement Courses (SEC) – Core Practical - I, II, III & IV
3. Generic Elective (GE) – Candidates may choose one paper from the list given by the University
4. Discipline Specific Elective (DSE) – IX and XII

Blue Print of the question paper (Major and Ancillary)

9. Question Pattern for Theory Examinations:

Max. Marks: 70 Passing Minimum: 35% Time: 3 hours

PART - A (5× 2 = 10 marks)
Answer ALL the questions

1. From Unit - I
2. From Unit - II
3. From Unit - III
4. From Unit - IV
5. From Unit - V

PART - B (4× 5 = 20 marks)
Answer any FOUR questions out of Seven questions in 150 words
All questions carry equal marks

6. From Unit - I
7. From Unit - II
8. From Unit - III
9. From Unit - IV
10. From Unit – V
11. From any unit
12. From any unit

PART - C (4 × 10 = 40 marks)
Answer any Four questions out of Seven questions in 500 words.
All questions carry equal marks.

13. From Unit - I
14. From Unit - II
15. From Unit - III
16. From Unit - IV
17. From Unit - V
18. From any unit
19. From any unit

Practical: (External only)

Time: 3 hours Max.marks:100

1. Major question – system/experiment - 35 marks
2. Minor question – analysis/mounting/experiment - 15 marks
3. Spotters (5 only) (5 x 6) - 30 marks
4. Record note book (Includes Herbarium) - 20 marks

1. Programme Outcomes: (PO)

PO1. Critical Thinking: Apply the knowledge of biology to make scientific queries and enhance the comprehension potential.

PO2. Effective Communication: Successful transfer of scientific knowledge both orally and in writing.

PO3. Social Interaction: Function as an individual, as a member or a leader to perform a task in class room situation or during field study.

PO4. Effective Citizenship: Responsible for learning, develop honesty in work and respect for self and others.

PO5. Ethics: Convey and practice social, environmental and biological ethics.

PO6. Environment and Sustainability: Insist the significance of conserving a clean environment for perpetuation and sustainable development.

PO7. Self-directed and Life-long Learning: study incessantly by self to cope with growing competition for higher studies and employment.

2. **Programme Specific Outcomes (PSO)**

PSO1. Educate students in and around Tamil Nadu, about plant science.

PSO2. Inculcate strong fundamentals on modern and classical aspects of Botany.

PSO3. Build life skills in Edible mushroom cultivation, Biofertilizer production, Greenhouse maintenance and Seed technology through value-added courses.

PSO4. Create platform for higher studies in Botany.

PSO5. Facilitate students to take-up successful career in Botany.

Tamil Nadu Open University

School of Sciences

Department of Botany

Chennai – 15

B.Sc., Botany - Syllabus I Year (Semester - I)

Course Title: Plant Diversity – I

Course Code: BBOTS11

Course Credits: 4 credits

Course Objectives (CO):

While studying the **Plant Diversity – I**, the student shall be able to:

CO1. Educate students in and around Tamil Nadu, about Lower plants.

CO2. Inculcate strong fundamentals on modern and classical aspects of Lower Plants

CO3. Increase the level of awareness about diversity of terrestrial and aquatic lower plants.

CO4. Enumerate the structure and life cycle of lower plants at the basic level.

CO5. Pin point the economic importance of lower plans at commercial, food and medical levels.

Course Leaning Outcome (CLO):

After studying the **Plant Diversity – I**, the student shall be able to:

CLO1. Discuss about importance of morphological structure, classification, reproduction and economic importance of Algae.

CLO 2. Study and impart knowledge about the general Characteristics, structure, reproduction, life history and economic importance of fungi. and the features of Lichens.

CLO 3. How to handle fungus as the essential component of commercial products.

CLO 4. Students able to explain about structure, classification, reproduction, life cycle and economic importance of Bryophytes.

CLO 5. Ecological significance of Lichens are important for the environment can be explained.

Block I: Algae

1.1 Algae General Introduction

1.2 General Classification of Algae

1.3 Life Cycle of Algae

1.4 Economic Importance of Algae

Block II: Type study

2.1Oscillatoria

2.2 Volvox

2.3 Sargassam

2.4 Polysiphonia

Block III: Fungi

3.1 Introduction to Fungi

3.2 General Classification of Fungi

3.3 Economic Importance of Fungi

3.4 Type study

Block IV: Bryophytes

4.1 Introduction to Bryophytes

4.2 General Classification

4.3 Reproduction and Dispersal

4.4 Economic Importance of Bryophytes

4.5 Type study

Block – V Lichens

5.1 Structure,

5.2 Types, distribution,

5.3 Reproduction and

5.4 Ecological significance of lichens with special reference to *Usnea*.

5.5 Economic importance of lichens

Books for Reference

1. Fritsch, F.E., 1935-45, The structure and reproduction of Algae. Cambridge University Press UK Vol. I & II
2. Smith, G.M., 1955, Cryptogamic Botany, Vol. I, Tata McGraw Hill book Co., N.Delhi.
3. Chapman, V.J. & Chapman, D.J., 1973, The Algae- 2nd edition Edward Arnold, London.
4. Alexopoulus C.J., Mims C.W., and Black Well M., 1996, Introductory Mycology, John Wiley and sons INC. Singapore.
5. Webster J., 1991, Introduction to Fungi.

6. Pelczar, Chan and Krieg, 1986, Essentials of Microbiology
7. VashistaSinha B.R., Singh, V.P., 2002, Botany for Degree students, Algae 9th revised edition, S. Chand & Company Ltd., New Delhi.
8. Chopra G.L., A Text book of Fungi, S.Nagin& Co. Meerut, India
9. Parihar, N.S., 1967, An introduction to Embryophyta Vol. II –Central Book depot, Allahabad
10. Dube, H., 1978, A text book of Fungi, Bacteria and Virus. Vikas Publishers.
11. AVSS Sambamurthy**,**2017.**Textbook of Algae,** IK. International Pvt Ltd.
12. Robert Edward Lee, Phycology, CAMBRIDGE UNIVERSITY PRESS, 2019.
13. Joanne Willey , Linda Sherwood , Christopher J. Woolverton, Prescott's Microbiology, McGraw-Hill Education (Asia), 2017.

Web links

1. https://www.britannica.com/science/algae/Ecological-and-commercial-importance
2. https://naturalhistory.si.edu/research/botany/research/algae/algae-classification
3. https://organismalbio.biosci.gatech.edu/biodiversity/fungi-2/
4. https://www.britannica.com/science/lichen
5. https://www.worldatlas.com/articles/what-is-the-economic-importance-of-algae.html

Course Title: Practical – I

(Algae, Fungi, Bryophytes, Lichens)

Course Objective:

CO1To classify the basic habit and habitat of lower plants

CO2To generalize the life cycle of Algae and fungi within its groups

CO3To correlate the economical importance of Algae and fungi

CO4To appraise the lower plant characteristics

CO5To construct and compose the values of the lower plants

Course outcome:

CLO 1. Observe and reproduce the microscopic technique, familiarize with the external and internal structure of lower and higher group organisms.

CLO 2. Locate and record the life cycle of Lichens and its types.

CLO 3. Classify the plant diseases causal organisms, and control measures.

CLO 4. To calculate and discover the Geological time scale

CLO 4. To anticipate and construct fossil and fossilization.

Algae, Fungi and Bryophytes

To make suitable micro preparations of the type study

To identify micro slides relevant to the syllabus

To identify Algae in algal mixture

Lichens

A study of vegetative and reproductive structure of genera included

Micro-preparation of *Usnea* to study vegetative and reproductive structures

Web links

1. https://courses.lumenlearning.com/bio2labs/chapter/fungi-lab/
2. https://www.britmycolsoc.org.uk/education/university/undergraduate-practicals
3. https://wcwc.ca/wp-content/uploads/2020/12/Algae-identification-lab-guide.pdf

II Semester

Course Title: Plant Diversity – II

Course Code: BBOTS21

Course Credits: 4 credits

Course Objectives (CO):

While studying the **Plant Diversity – II**, the student shall be able to:

CO1. Structure and life cycle of vascular cryptogams (Lower plants) has been explained.

CO2. Inculcate strong fundamentals on Pteriophytes life cycle in specific details

CO3. Teaching awareness about diversity of terrestrial and aquatic lower plants.

CO4. The geological time scale is parameter to the duration of life.

CO5. Fossilization is the method nature provides to know the time.

Course Outcome:

After completion of the **Plant Diversity - II**, the student will be able to:

CLO 1. Demonstrate an ing of archegoniatae, Bryophytes, Pteridophytes and Gymnosperms

CLO 2. Develop critical ing on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms

CLO 3. Plant evolution and their transition to land habitat is a basic concept in evolution need to be studied.

CLO 4. Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms.

CLO 5. Identify and experience of life is by means of Palaeobotany

Block I: Pteridophytes

1.1 Pteridophytes General Introduction

1.2 General Classification

1.3 Reproduction

Block II: Pteridophytes

2.1 Psilotum

2.2 Lycopodium

2.3 Selaginella

2.4 Marsilea

2.5 Equisetum

Block III: Gymnopserms

3.1 Generail Introduction

3.2 General Classification

Block IV: Gymnosperms

4.1 Cycas

4.2 Reproduction in Cycas

4.3 Pinus

4.4 Reproduction in Pinus

4.5 Gnetum

4.5 Reproduction in Gnetum

Block V: Palaeobotany

5.1 Introduction

5.2 Geological Time Scale

5.3 Origin of Land Plants

5.4 Fossils of Plant Parts

5.5 Types of Fossils

5.6 Fossil: Rhynia

Books for reference

1. Smith, G.M., 1955, Cryptogamic Botany Vol. I & II, McGraw Hill Company.
2. Sporne, K.R., 1976, Morphology of PteridophytesB.I.Publishers
3. Arnold, C.A., 1947, An introduction to Palaeobotany, McGraw Hill Publisher.
4. Parihar, N.S., 1967, An introduction to Embryophyta Vol. I & II Central book depot, Allahabad.
5. Vashista, P.C., 1976, Botany for Degree Students Vol. V (Gymnosperms) S.Chand& Co. New Delhi.
6. Sukla& Mishra, S.P., 1982, Essentials of Palaeobotany, Vikas Publishing House
7. John M Coulter , By (author) Charles J Chamberlain, Morphology of gymnosperms,Alpha Edition, 2019.

Web links

1. **https://www.vedantu.com/biology/pteridophytes**
2. **https://plantlet.org/classification-of-pteridophytes/**
3. **https://www.thoughtco.com/what-are-gymnosperms-4164250**
4. **https://www.embibe.com/exams/gymnosperms/**
5. **https://palaeobotany.org/**

Course – Title: Practical – II

Course Code: BBOTS 21P

Course credit: 4 Credits

(Pteridophytes, Gymnosperms and Palaeobotany)

Course Objective:

CO1. To learn and identify the lower plans through microscope.

CO2. To identify and the structure of fossils

CO3. To tje lives of high altitude plants

Course Outcome:

CLO1 Learn the microscopic technique, familiarize with the external and internal structure of lower and higher group organisms.

CLO2 Students get knowledge in fossil and fossilization.

Practicals

1. Micro-preparation of the types prescribed in the syllabus
2. Identifying the micro slides relevant to the syllabus
3. Micro-preparation of the types prescribed in the syllabus
4. Identifying the micro slides relevant to the syllabus
5. Field visit to study the habitat (Hill station)
6. Identifying the male and female reproductive organs of Gymnosperms
7. Micro-preparation of the types prescribed in the syllabus
8. Identifying the micro slides relevant to the syllabus
9. Observing and identifying the fossil slides and specimen included in the syllabus

Web links

1. https://www.easybiologyclass.com/similarities-and-differences-between-pteridophytes-and-gymnosperms/
2. https://www.academia.edu/33116487/PRACTICAL_6_BRYOPHYTES_AND_PTERIDOPHYTES

Course – Title: Office Automation (Elective)

Course Code: BCAS - 13

Course credit: 2 Credits

COURSE OBJECTIVES (CO)

While studying the Office Automation course, the student shall be able to:

CO1. Know about the history, generation, applications, advantages, characters and memory units of Computers

CO2. Know about the introduction of word documents, formatting pages, paragraphs and shortcut keys

CO3. Understand the basics of MS Excel, menus, tool bars and spreadsheets.

CO4. Acquire knowledge on the introduction to MS Power Point, its templates, creating and formatting the presentation

CO5. Get awareness on the characteristics of Internet and E.mail.

COURSE LEARNING OUTCOMES (CLO)

After completion of the Office Automation course, the student will have the ability to:

CLO 1. Understand the history, generation, applications, advantages, characters and memory units of Computers

CLO 2. Get awareness on the introduction of word documents, formatting pages, paragraphs and shortcut keys

CLO 3. Understand the basics of MS Excel, menus, tool bars and spreadsheets

CLO 4. Acquire knowledge on the introduction to MS Power Point, its templates, creating and formatting the presentation

CLO 5. Get knowledge on the characteristics of Internet and E.mail.

Block I: Basics of Computer

Unit -1- History & Generation of Computer, Applications of Computer, Advantages of Computer, Characteristics of Computer, Memory Units.

Block II: MS-Word

Unit -2- Introduction to word –working with documents

Unit -3- Formatting page – formatting paragraph- shortcut keys

Block III: MS-Excel

Unit -4- MS-Excel: Basics – Menus – Tool Bars

Unit -5- Working with spreadsheets- shortcut keys.

Block IV: MS-Powerpoint

Unit -6- Introduction to presentation – Templates – Layouts

Unit -7- Creating and Formatting presentation.

Block V: Introduction to Internet and E.Mails

Unit-8- World Wide Web (www) - History, Working-Web Browsers and its functions, Concept of Search Engines, Searching the Web**. E-Mail:** Creating an email-ID, e-mail reading, saving, printing, forwarding and deleting the mails, checking the mails, viewing and running file attachments, addressing with cc and bcc.

Text Books:

1. MS-Office 2000 for everyone, Vikas Publishing House Pvt. Ltd, Reprint 2006.

Reference Books:

1. Nellai Kannan, MS-Office, Nels Publications, 3rd Edition, 2004.
2. John Walkenbach, Herb Tyson, Michael R.Groh, Faithe Wempen and Lisa A.Bucki , Microsoft Office 2010 Bible, Wiley India Pvt. Ltd , Reprint 2010.

Web Resource:

1. https://www.youtube.com/watch?v=NqgpZ_v4Ne8
2. https://www.youtube.com/watch?v=bLv1OvUcAoI
3. https://www.youtube.com/watch?v=FLst_k_eWkE
4. https://www.youtube.com/watch?v=S-nHYzK-BVg&t=2s
5. https://www.youtube.com/watch?v=6zVFrdxD0Jk&t=1469s
6. https://www.youtube.com/watch?v=Wo80PpySFuk
7. https://www.youtube.com/watch?v=xWlBX7TRcSo&t=19s
8. https://www.youtube.com/watch?v=IfEuYoO1mO0
9. https://www.youtube.com/watch?v=L2JUqOwfG2w&t=1s

10. https://www.youtube.com/watch?v=vwHGsVY_AlA&t=51s
11. https://www.youtube.com/watch?v=E9KtIb_YKXQ
12. https://www.youtube.com/watch?v=ynuVhMmqLuk
13. https://www.youtube.com/watch?v=fpy51JRdMTI&t=14s
14. https://www.youtube.com/watch?v=QiVSIvB1xis
15. https://www.youtube.com/watch?v=yoJPysX1xzU&t=1s
16. https://www.youtube.com/watch?v=yykWOpoci8U
17. https://www.youtube.com/watch?v=_hy2HxEIJnQ
18. https://www.youtube.com/watch?v=Gk641O5yPP8

Course – Title: Open Source Technology (Elective)

Course Code: BCAS - 22

Course credit: 2 Credits

COURSE OBJECTIVES

While studying the Open Source Technology course, the student shall be able to:

CO1: Describe about the open source software's.

CO2: Manipulate about the history, philosophy and license

CO3: Predict about community building, opening and starting the open source projects

CO4: Discover knowledge on the servers.

CO5: Observe about the ethical, social and financial impacts of open source software.

COURSE LEARNING OUTCOMES

After completion of the Open Source Technology course, the student can be able to:

CLO1: Illustrate the open source methodologies

CLO2: Classify the history, philosophy and license

CLO3: Formulate about the community building, opening and starting the open source projects

CLO4: Summarize knowledge on the servers

CLO5: Discover the ethical, social and financial impacts of open source software

BLOCK I: INTRODUCTION

Introduction: Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean no cost. - History: The Free Software Foundation and the GNU Project.

BLOCK II: HISTORY, PHILOSOPHY AND LICENSE

Open Source History, Initiatives, Principle and methodologies. - Philosophy: Software Freedom, Open Source Development Model - Licenses and Patents: What Is A License, Important FOSS Licenses (Apache, BSD, GPL, LGPL), - Patents Economics of FOSS: Zero Marginal Cost, Income-generation opportunities, Internationalization.

BLOCK III: COMMUNITY BUILDING

Community Building: Importance of Communities in Open Source Movement, Starting and Maintaining an Open Source Project, Open Source Hardwar.

BLOCK IV: SERVERS

Apache HTTP Server and its flavors - WAMP server (Windows, MySQL), - PHP, JAVA as development platform.

BLOCK V: ETHICS, SOCIAL AND FINANCIAL

Open source vs. closed source Open source government, Open source ethics - Social and Financial impacts of open source technology - Shared software, Shared source.

TEXT BOOKS

1. Sumitabha Das "Unix Concepts and Applications, Tata McGraw Hill Education 006
2. The Official Ubuntu Book, 8th Edition
3. Kailash Vedera, Bhavyesh Gandhi, "Open Source Technology", University Science press.

REFERENCE BOOKS

1. Paul Kavanagh, "Open Source Software: Implementation and Management", Elsevier Digital Press
2. The Linux Documentation Project : http://www.tldp.org
3. Docker Project Home : http://www.docker.com.

Web Links

1. https://en.wikipedia.org/wiki/Free_Software_Foundation
2. https://en.wikipedia.org/wiki/GNU_Free_Documentation_Lices
3. https://en.wikipedia.org/wiki/GNU_Project
4. https://en.wikibooks.org/wiki/FOSS_Open_Standards/Standards_and_Internationalization/Localization_of_Software
5. https://opensource.guide/starting-a-project/
6. https://www.oshwa.org/
7. https://en.wikipedia.org/wiki/Open-source_hardware

B.Sc., Botany - Syllabus – II year Semester - III

Course Title: Morphology, Plant Anatomy and Embryology

Course Code: BBOTS31

Course Credits: 4 credits

Course Objectives:

While studying the **Morphology Plant Anatomy and Embryology**, the student shall be able to:

CO1. To paraphrase the basic concepts in plant anatomy.

CO2. To distinguish the differences in plant tissues

CO3. Extend the components of tissues of root stem and leaf

CO4. Identify the various components of stem and wood during its secondary growth.

CO5.Be enlightened about the mechanism of pollination and basic structure of the embryo.

Course Outcome:

After completion of the **Morphology, Plant Anatomy and Embryology**, the student will be able to:

CLO1 Develop an ing of concepts and fundamentals of plant anatomy

CLO2. Examine the internal anatomy of plant systems and organs

CLO3. Develop critical ing on the evolution of concept of organization of shoot and root apex.

CLO4. Analyze the composition of different parts of plants and their relationships

CLO5. Evaluate the adaptive and protective systems of plants

Block I: Morphology

1.1 Leaf:Phyllotaxy, simple, compound and modifications;

1.2 inflorescence-types;

1.3 Flower: description of floral parts;

1.4 Fruits-types.

Block II: Plant Tissues

2.1 Introduction

2.2 Meristem

2.3 Plant Tissue Classification

2.4 Dermal Tissue System

2.5 Ground tissue system

2.6 Vascular system 30

Block III: Root and Stem Anatomy

3.1 Root

3.2 Stem

3.3 Secondary Growth

3.4 Origin Lateral Roots

3.5 Formation of Adventitious Roots

Block IV: Leaf Anatomy

4.1 Introduction

4.2 Internal Structure of Leaf

4.3 Nodal Anatomy

Block V: Plant Reproduction

5.1 Introduction

5.2 Androecium

5.3 Gynoecium

5.4 Structure of Ovule

5.5 Megasporogenesis

5.6 Pollination

5.7 Fertilization

5.8 Embryogeny

5.9 Embryo rescue

Books for Reference

1. Esau, K., 1975, Plant Anatomy, Wiley Eastern Private Ltd., New Delhi.

2. Maheswari, P., 1971, An introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co.Ltd, New Delhi.

3. Vasishta, P.C., A Text Book of Plant Anatomy, Pradeep Publications, Jullunder.

4. Bhojwani, S.S. and Bhatnagar, S.P., 1978, The embryology of Angiosperms, publishing House, N.Delhi.

5. Edited by Clive Koelling, Plant Anatomy, Morphology and Physiology, Syrawood Publishing House 2016

Web links

1. https://www.encyclopedia.com/social-sciences/applied-and-social-sciences-magazines/plant-anatomy
2. https://agriculturistmusa.com/plant-embryology/
3. http://www.ppup.ac.in/download/econtent/pdf/JNL%20College%20(%20Pallavi%20for%20Botany%20B.Sc%20Part%20II)%20Topic-Plant%20embryology%20part%201.pdf
4. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Biology_(Kimball)/16%3A_The_Anatomy_and_Physiology_of_Plants
5. https://kpu.pressbooks.pub/plant-identification/chapter/introduction-to-plant-morphology/

Course Title: Microbiology and Plant Pathology

Course Code: BBOTS32

Course Credits: 3 credits

Course Objectives:

CO1. To enumerate the life cycle of micro organisms

CO2. To define the internal structure of Bacteria

CO3. To classify the commercial and medicinal value of micro organisms

CO4. The interpretation of Viruses has been a vital objective

CO5.To tabulate the plant diseases and its remedy

Course Outcome:

CLO 1. the principles and applications of microscopy and classification of micro organisms.

CLO 2. the ultrastructure and dynamism of cell.

CLO 3. Interpret the different structure of viruses and it's multiplications.

CLO 4. Inculcate the importance of plant disease.

CLO 5. Identify the causative organism, symptoms and control measure of plant disease.

Block I: Bacteria

1.1 The scope of microbiology - history of microbiology – classification of microorganisms- Whittaker's Five Kingdom concept

1.2 Bacteria: outline of bacterial classification-Bergey's manual of determinative bacteriology

1.3 Ultrastructure-Gram positive and gram negative bacteria, flagellation, nutrition, cell division,

1.4 reproduction, Endospore and

1.5 genetic recombination-Transformation, transduction and conjugation.

Block II Applied Microbiology

2.1 Microbial applications in Industries: diary, alcohol, acid and enzymes Diary Microbiology-composition of milk, dairy products-cheese and: yogurt

2.2 Food Microbiology : source and processing of the following fermented foods: Saurkraut and Kimchi tempeh, soysauce, sago and food spoilage

Block III Microbiology of water- Soil and Air

3.1 Bacteriological evidence of pollution, purification of water-sedimentation, filtration, disinfection-Sewage treatment-primary, secondary and tertiary

3.2Soil MicrobiologyMicrobiology of soil-soil profile, Rhizosphere, rhizoplane-plant-microbes interaction – *Rhizobium*

3.3 Microbiology of air, indoor and outdoor environments-control of microbes in air by Heat, moist heat, dry heat, chemicals, UV, filtration, Laminar air flow chamber.

Block IV: Viruses:

4.1 structure of TMV and bacteriophage;

4.2 bacteriophage replication-lytic

4.3 lysogenic cycles

Block V: Plant Pathology

5.1 Introduction to Plant Pathology

5.2 Classification of Plant Diseases

5.3 Mechanism of infection

5.4 Different types of Diseases and Control measures

5.5 Management of Plant Diseases

Books for Referemnce

1. Joanne Willey , Linda Sherwood , Christopher J. Woolverton, Prescott's Microbiology, McGraw-Hill Education (Asia), 2017.

2. Dube, H., 1978, A text book of Fungi, Bacteria and Virus. Vikas Publishers.

3. Pelczar, Chan and Krieg, 1986, Essentials of Microbiology

4.Rastogi Plant Pathology

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1. **https://www.britannica.com/science/microbiology**
2. **https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/1%3A_Introduction_to_Microbiology**
3. **https://conductscience.com/introduction-and-importance-of-microbiology/**
4. **https://aacijournal.biomedcentral.com/articles/10.1186/1710-1492-7-S1-S1**

5. https://wholisticmatters.com/immune-system-support-stress-management/?utm_source=google&utm_medium=cpc&utm_campaign=immune&utm_content=3#seasons&gclid=CjwKCAjwh4ObBhAzEiwAHzZYU25jWUc9QTUTkYQKyx6dTN__hAQJf3FnHGgzWTaMfscfwV-RsqHknBoCL9QQAvD_BwE

Course Title: Practical-III

(Morphology, Plant Taxonomy, Plant Anatomy, Embryology and Economic Botany)

Course Objective

CO1 To the and differential the higher plants

CO2 To know the commercial values of higher plants

CO3 To identify the internal structures of the higher plants

Course Outcome

CLO1Students able to the internal structure of monocot and dicot (stem, leaf and root), secondary thickening, anomalous secondary thickening (Dicot and Monocot) and nodal anatomy.

CLO2. Students get knowledge in internal structure of anther and isolation of endosperm

Morphology, Taxonomy and Economic Botany

Training in dissection, observation, identification and sketching on floral parts of plants belonging to the families mentioned in the syllabus. Description of plants using technical terms. Field visit to local area and submission of 25 Herbarium specimens.

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

Anatomy

Study of Plant Tissues, Parenchyma, Collenchyma, Sclerenchmya, Xylem and Phloem.

T.S. of Dicot stem, root and leaf.Study of monocot stem, root and leaf. Normal secondary Growth in dicot stem and root.Anamalous secondary growth in *Boearhaavia*, *Nyctanthes* and*Dracaena.* Nodal anatomy.

Embryology

T.S. of Anther

Types of Ovule

Stages of Dicot Embryo

Web Link

1. **https://www.ableweb.org/biologylabs/wp-content/uploads/volumes/vol-19/09-yeung/09-YEUNG.HTM**
2. **https://ncert.nic.in/textbook/pdf/kebo115.pdf**

Semester - IV

Course Title: Plant Taxonomy and Economic Botany

Course Code: BBOTS41

Course Credits: 4 credits

Course Objectives:

While studying the **Plant Taxonomy and Economic Botany**, the student shall be able to:

CO1.Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium

CO2. Evaluate the Important herbaria and botanical gardens

CO3. core concepts of Economic Botany and relate with environment, populations, communities, and ecosystem

CO4. Develop a basic knowledge of taxonomic diversity and important families of useful plants

CO5. Increase the awareness and appreciation of plants & plant products encountered in everyday life

Course Outcome:

After completion of the **Plant Taxonomy and Economic Botany**, the student will be able to:

CLO1. Interpret the rules of ICN in botanical nomenclature

CLO2. Assess terms and concepts related to Phylogenetic Systematics

CLO3. Generalize the characters of the families according to Bentham & Hooker's system of classification

CLO4. Appreciate the diversity of plants and the plant products in human use

CLO5. Able to summarize the economic importance of crops

Block I: Plant Morphology

Block I: Principles of Taxonomy

2.1 Introduction

2.2 Principles of Taxonomy

2.2.1 Binomial Nomenclature

2.2.2 Citation and Autority

2.2.3 Organised Nomenclature

2.3 Classification of Plants

Block III: Plant Description - Dicot

3.1 Introduction

3.2 Annonaceae

3.3 Brassicaceae

3.4 Rutaceae

3.5 Fabaceae

3.6 Lamiaceae

3,7Apiaceae

1.8 Rubiaceae,

1.9 Sapotaceae,

1.10 Convolvulaceae,

1.11 Asclepiadaceae,

Block IV: Plant Description - Monocot

4.1 Introduction

4.2 Arecaceae

4.3 Araceae

4.4 Liliaceae

4.5 Poaceae

4.6 Nympaeceae

Block V: Economic Botany

5.1 Introduction

5.2 Origin of Species

5.3 Economically important Plants

5.4 Ecologically important Plants

5.5 Economically important Medicinal Plants

5.6 Cultural Practices

5.6.1 Customary Practices

5.6.2 Herbal vendors

5.6.3 Sacred Groves

Books for Reference

1. Rendle, R.B., The Classification of flowering plants, Vol. I, II &III, Oxford-Clarendon.

2. Albert F.Hill, Economic Botany, Tata McGraw Hill Publishing Company.

3. Vasisha, P.C., 1994, Taxonomy of Angiosperms R.S. Chand & Company

4. Sharma, O.P., 1993, Plant Taxonomy, Tata McGraw Hill.

5. Pandey, B.P., Economic Botany, S.Chand& Company, New Delhi.

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1. https://www.botanicalartandartists.com/plant-evolution-and-taxonomy.html
2. https://open.lib.umn.edu/horticulture/chapter/2-1-plant-taxonomy/
3. https://botanicalsociety.org.za/the-science-of-names-an-introduction-to-plant-taxonomy/
4. https://www.employees.csbsju.edu/ssaupe/biol308/Lecture/introduction.htm
5. https://botany.org/home/resources/plant-talking-points/what-is-economic-botany.html

Course Title: Ecology, Forestry and Evolution

Course Code: BBOTS42

Course Credits: 3 credits

Course Objectives:

While studying the **Ecology, Forestry and Evolution** the student shall be able to:

CO1 Distinguish core concepts of biotic and abiotic components

CO2 Classify the soils on the basis of physical, chemical and biological components

CO3 Analysis the phytogeography or phytogeographical division of India

CO4 Evaluate energy sources of ecological system

CO5 Know the basic facts about forests and recognize diseases of commercial forestry

CO6 Evaluate the Marketing channels, costs, margins and price spread and its applications.

CO7 Explain the role of public and private agencies in marketing of forest

Course Outcomes:

After completion of the **Ecology and Forestry**, the student will be able to:

CLO 1. Students learned about the interaction between biotic and abiotic components of the environment.

CLO 2. Know about the concept of energy flow in the ecosystem.

CLO 3. Students will acquire knowledge regarding vegetation and its analysis.

CLO 4. Know about different pollutions, consequences in the environment and its mitigation.

CLO 5. Students will know about the floristic regions and plant formation of the planet.

CLO 6. Students will deepen the vegetation types of Tamil Nadu.

Block I: Ecosystem and Ecological Adaptations

1.1 Introduction to Ecology

1.2 Components of Ecosystem

1.3 Energy Flow

1.4 Biogeochemical cycle

1.5 Introduction

1.6 Categories of Adaptations

1.7 Methods of studying vegetation

Block II: Environmental Pollution

2.1 Air Pollution

2.2 Water Pollution

2.3 Thermal Pollution

2.4 Noise Pollution

Block III: Forest Types

3.1 Introduction

3.2 Types of Forests

3.3 Importance of Forests

Block IV: Forest Management

4.1 Introduction

4.2 Aspects of Forest management

Block V : Evolution

5.1 Orgin of Life - chemosynthetic theory –evidences (any five).

5.2 Evolution: Evolutionary theories of Lamarck, Darwin, De Vries, Modern synthetic theory of evolution. Variation- Analysis and sources,

5.3 Adaptive radiation, Isolation mechanism, Concept of species- Allopatric and Sympatric. Isolating mechanisms.

Books for Reference

1. Eugene P Odum, Fundamentals of Ecology, Nataraj Publishers

2. Sharma, P.D., Ecology &Envirnoment, Rastogi Publications.

3. S.S. Negi, Forestry, New Delhi.

4.Michael Begon , Colin R. Townsend, Ecology : From Individuals to, Ecosystems, Hoboken, United States, 2020.

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2. https://www.britannica.com/science/forestry
3. https://agri-bsc.kkwagh.edu.in/uploads/department_course/FRST-121_Forerstry_notes.pdf
4. https://evolution.berkeley.edu/evolution-101/an-introduction-to-evolution/
5. https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/Unit_0%3A_Introduction_to_Botany/01%3A_Introduction/1.03%3A_Intro_to_Evolution
6. https://www.britannica.com/science/ecology
7. https://plato.stanford.edu/entries/ecology/

Course Title: Practical –IV

Course ode: BBOT S41P

Course credit: 4 credits

(Microbiology, Plant Pathology and Ecology)

Course Objective

CO1. To Know the environment in the context of vegetation

CO2. To ecological adaptation by plant systems

Course Outcome

CLO1. Students will develop skills on isolation of microbes from various sources and staining procedures.

CLO2. Acquired knowledge on the internal structure of diseased plant parts.

CLO3. To know about plant tissue culture media preparation.

CLO4. Student will enlightens regarding plant habitats and its anatomical features by micro preparation technique.

CLO5. Students will develop field skill pertaining to vegetation analysis.

Practical

1. Hybridization techniques - Emasculation, Bagging (demonstration only)
2. Morphological and anatomical studies of all plant diseases included in the theory syllabus
3. Ground nut disease, *Alternariaalternate* .
4. Neem extract against known pathogen
5. Study of morphological and structural adaptations of locally available hydrophytes, xerophytes, mesophytes and epiphytes and correlate to their particular habitats.
6. Hydrophyte: *Nymphaea, Hydrilla*
7. Xerophytes: *Nerium, Casuarina*
8. Mesophytes: *Tridax, Vernonia*
9. Epiphytes: *Vanda*
10. Study of following microclimatic variables in different habitats: soil and air temperature, wind velocity, relative humidity, rainfall and light intensity.

11. Permeability (percolation; total capacity as well as rate of movement) of different soil samples.
12. Saturation capacity and field capacity of different soil samples and rapid test for texture of soils.
13. Density and porosity and rate of infiltration of water in undisturbed soils.
14. Soil organic matter in different soil samples by titration method.
15. Determination of minimal area of quadrat size of species area curve method.
16. 8. Preparation of culture media for bacteria, fungi-sterilization procedures
17. Isolation of Microorganisms from rhizosphere, rhizoplane, phylloplane.
18. Isolation of pure culture from soil by serial dilution techniques.
19. Gram staining procedure
20. Hanging drop method
21. Map of phytogeographical regions of India

Web link

1. https://www.gpgcraipur.ac.in/books/A%20Textbook%20of%20Practical%20Botany%20II-bsc.pdf
2. https://study.com/academy/lesson/what-is-economic-botany-definition-elements.html

B.Sc., Botany - Syllabus – III year Semester-V

Course Title: Cell Biology, Genetics and Plant Breeding

Course Code: BBOTS 51

Course Credits: 4 credits

Course Objectives:

While studying the **Cell Biology, Genetics and Plant Breeding**, the student shall be able to:

CO1. Have conceptual ing of laws of inheritance, genetic basis of loci and alleles and their linkage.

CO2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.

CO3. Develop critical ing of chemical basis of genes and their interactions at population and evolutionary levels.

CO4. Analyze the effect of mutations on gene functions and dosage.

CO5. Examine the structure, function and replication of DNA.

Course Outcomes:

After completion of the **Cell Biology Genetics and Plant Breeding**, the student will be able to:

CLO 1. Acquire knowledge on ultrastructure of cell.

CLO 2. the structure and chemical composition of chromatin and concept ofcell division.

CLO 3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex linked inheritance.

CLO 4. the concept of 'one gene one enzyme hypothesis' along with molecular mechanism of mutation.

CLO 5. Interpret the concept of Lemarkism, Neo Lamarkism, Darwinism and also the concept of natural selection

Block I: The Cell

1.1 Introduction to Cell

1.2 Cell Theory

1.3 Structure of Cell

1.4 Cell Cycle

Block II: The Organelles

2.1 Introduction

2.2 Plastids Androecium

2.3 Mitochondria

2.4 Ribosomes

2.5 Chromosomes

2.6 Golgi body

2.7 Endoplasmic reticulum

2.8 Lysosomes

2.9 Peroxisomes

2.10 Vacuoles

2.11 Cilia and Flagella

Block III: The Nucleus and Cell Division

3.1 Nucleus

3.2 Cell Division

Block IV: Genetics

4.1 Introduction

4.2 History of Genetics

4.3 Mendelian Laws of Heredity

4.4 Linkage

4.5 Crossing over

4.6 Chromosomal mapping

4.6 Mutation

Block V: Plant Breeding

5.1 Plant Breeding: Objectives, Plant introduction, selection,

5.2 hybridization techniques, HybridVigor, heterosis, Interspecific and intergeneric.

5.3 Mutation -Polyploidy and its applications in plantbreeding. Breeding for crop improvement for Paddy, Groundnut and Sugarcane.

Books for reference

1. Power, C.B., 1984, Cell biology, Himalayas Publishing House, Mumbai.
2. De Robertis and De Robertis, 1998,, Cell and Molecular Biology,K.M.Verghese and company. 3. David Freifelder, 2nd Edition, Molecular biology, Narosa Publishing House,N.Delhi.
4. Gardner, E.J., Principles of Genetics, Wiley Eastern Company.
5. Verma, P.S. and Agarwal, V.K., 1986, Cell biology and Molecular biology, S.Chand& Company, New Delhi.
6. Gupta, P.K., 2007, Genetics Classical to Modern, Rastogi Publications, Meerut

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1. https://plato.stanford.edu/entries/cell-biology/
2. https://education.nationalgeographic.org/resource/resource-library-cell-biology
3. https://www.cdc.gov/genomics/about/basics.htm
4. https://learn.genetics.utah.edu/content/basics/
5. https://www.nifa.usda.gov/topics/plant-breeding

Course Title: Molecular Biology and Genetic Engineering

Course code: BBOTS 52

Course credit: 4 credits

Course Objective:

CO1. To Explain the structure and functions of Nucleic acids for the function of life

CO2. Describe the function s of RNA is essential for the subject

CO3. Gene regulation is a phenomena to predict the functions of life

CO4. To interpret the concept of Genetic Engineering

CO5. To demonstrate the methods for Genetic engineering

Course outcome:

CLO1. Infer the functions of Nucleic acids for the function of life the various concepts of

CLO2. To appraise the function s of RNA is essential for the subject

CLO3. Can elaborate the Gene regulation

CLO4. Restate the concept of Genetic Engineering

CLO5. Can categorize the methods for Genetic engineering

Block I: Nucleic acid –

1. Structure and properties (physical, chemical, spectroscopic and thermal). DNA- types (A, B, C &Z), Watson and Crick model of DNA, viral DNA, bacterial DNA, Mitochondrial and Chloroplast DNA.

2. Dissociation and reassociation kinetics of DNA. DNA as genetic material, DNA synthesis and replication (prokaryote and eukaryote) – Enzymes involved, origin of replication, priming, DNA polymerases. Methylation of DNA.

3. Damage and Repair of DNA.

Block II: RNA-synthesis - types.

1. RNA polymerases-role. Transcription-(Prokaryote, Eukaryotes), Initiation, elongation, termination, post transcriptional changes in RNA. Genetic code-

2. Translation-ribosome assembly, formation of initiation complex, initiation factors, elongation and termination, Wobble hypothesis, translational proof-reading, translational inhibitors, post-translational modification of proteins.

Block III General principles of Gene Regulation,

1, Gene Regulation in prokaryotes, Operon concept, *lac* Operon, Positive and negative control, Catabolite Repression,

2. Gene Regulation in Eukaryotes, Transcriptional, Translational and Post translational control in eukaryotic cells. Gene silencing.

Block IV: Introduction to Genetic Engineering; techniques-

1. Restriction endonucleases- Ligation, Adapters and Linkers,

2. Cloning Vectors-Plasmids,Cosmids, Phagemids, YAC and BAC, cDNA Libraries, ISSR,PCR,

3. Hybridisation- Southern, Northern Western Blotting.

Block V: Genetic Engineering in plants,

1.Target cells for transformation,

2.Gene transfer technique using Agrobacterium,

3. Physical delivery methods : PEG stimulated, Microinjection and Macro infection, Micro projectile (Particle Gun), Electroporation, Liposome mediated gene transfer. Silicon Carbide.

4. GM plants- Bt-Brinjal, Bt- Cotton, Golden rice- Bioethical issues.\

Reference Books

1. Friefelder, D. 2005 Molecular biology. Second Edition.Narosa Publishing House.

2. Watson, J.D. et al., 2003 Molecular biology of the Gene. IV Edition. The Benjamin Cummings Pub.Co.

3. Gerald Karp 2002 Cell and Molecular Biology. John Wiley & Sons, NY.

4. Gupta, P.K. 2004 Cell and Molecular biology. III Edition, Rastogi Publications.

5. Friefelder,d. 2005. Molecular biology.Secondedition.Narosa pub. House.

6. Lewin, b. 1994. Genes v. Oxford university press.

7. Sobtir.c. And gobe. 1991. Eukaryotic chromosomes. Narosa publishinghouse.

8. Smith-keary,P. 1991. Molecular genetics.Macmillan pub. Co. Ltd. London.

9. Strickberger,M.W.1990. Genetics.Third edition. Macmillan publishing company.

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2. https://www.thermofisher.com/blog/ask-a-scientist/what-is-molecular-biology/
3. https://www.britannica.com/science/molecular-biology
4. https://www.yourgenome.org/facts/what-is-genetic-engineering/
5. https://nap.nationalacademies.org/read/23395/chapter/10#357

Course Title: Biochemistry and Nanobiotechnology

Course Code: BBOTS53

Course Credits: 3 credits

Course Objectives:

While studying the **Biochemistry**, the student shall be able to:

CO1. Comprehend different fundamental concepts related to plant biochemistry like plant cell organelles, photosynthesis, respiration and lipid metabolism etc.

CO2. Analyze the structure and properties of various enzymes

CO3. Evaluate the process of ATP Synthesis, nitrogen metabolism and lipid metabolism

CO4. different causes of environmental pollution and their remedies

CO5. Analyze microbiology of waste water and its implications

CO6. Examine the role of immobilized cells/enzymes in treatment of toxic compounds

Course Outcomes:

After completion of the **Biochemistry**, the student will be able to:

CLO 1. The student Acquires a general knowledge of the physical, chemical properties and metabolism of carbohydrates and lipids in living system.

CLO 2. The student knows basic knowledge of the biological importance of the biomolecules such as carbohydrates, lipids, protein, nucleic acid and enzymes.

CLO 3. The students will be able to the fundamental biochemical principles of enzymes, such as the structure and function of enzymatic process in living system.

CLO 4. the basic principles of plant tissue culture

CLO 5. Acquire knowledge on sources of biomass and bioenergy.

6. Get to know the genetic transformation methods and metabolic engineering

Block I: The Atom

1.1 Structure of Atom

1.2 Bonding

1.3 Isomerism

1.4 Carbohydrates

Block II: Proteins

2.1 Concept of Amino acids

2.2 Classification of Amino acids Androecium

2.3 Proteins

2.4 Lipids

Block III: Enzymes

3.1 Enzymes

3.2 Classification of Enzymes

3.3 Mechanism of enzyme action

Block IV: Secondary metabolites:

4.1 General classification of Major pathways,

4.2 Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids),Alkaloids, pigments (Carotenoids, Anthocynins).

4.3 Vitamins

Block V: Nanobiotech

5.1 Background of Nanoscience, influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

5.2 Nanoparticles, quantum dots, nanotubes and nanowires, Fundamentals of Bionanoparticles: Production, Size, Surface area, Suspension and Settling, Magnetic and Optical Properties, Biological Transport.

5.3 Biological nanoparticles production - plants and

Books for Reference

1.Conn, E.E.,Stumpf,P.K.,Bruening,G. and Doi,R.H., Outlines of Biochemistry 5th edition,Wiley India Ltd.,N.Delhi.

2. Lehninger, L., Biochemistry, Kalyani Publishers, Ludhiana, N.Delhi.

3. LubertStrayer, Biochemistry, Freeman International Edition San Francisco.

4. Primrose, S.B., 1987, Modern Biotechnology, Black well Scientific Publications, Oxford

5. Old, R.W. and Primrose, S.B., 1996, Principles of Gene manipulation – An introduction to Genetic Engineering, Black Well Scientific Publications, Oxford.

6. Jain, J.L., Jain, S., and Jain, N., Fundamentals of Biochemistry, S.Chand& Company, N.Delhi.

7. Dubey, R.C., Text book of Biotechnology, S.Chand& Company, N.Delhi.

8. Alison Snape , DespoPapachristodoulou , William H. Elliott , Daphne C. Elliott, Biochemistry and Molecular Biology, Oxford university press, 2018.

9. A.Rashid, Genetic Engineering of Crop plants, IK. International Pvt Ltd, 2019

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2. https://biochemistry.org/education/careers/becoming-a-bioscientist/what-is-biochemistry/
3. https://www.britannica.com/science/biochemistry
4. https://www.nanowerk.com/nanobiotechnology.php
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3571017/

Semester - VI

Course Title: Plant Physiology

Course Code: BBOTS61

Course Credits: 4 credits

Course Objectives:

While studying the **Plant Physiology**, the student shall be able to:

CO1. Water relation of plants with respect to various physiological processes.

CO2. Explain chemical properties and deficiency symptoms in plants

CO3. Classify aerobic and anaerobic respiration

CO4. Explain the significance of Photosynthesis and respiration

CO5. Assess dormancy and germination in plants

Course Outcomes:

After completion of the **Plant Physiology**, the student will be able to:

CLO 1. To become knowledgeable in plant and its water relations.

CLO 2. Students will able to gain knowledge on role of micronutrients in plant growth, their development and the mechanism of nitrogen metabolism.

CLO 3. To gain knowledge about chloroplast structure, photosynthetic pigments, the path of energy from the light reactions through Calvin cycle. Students are able to the process of translocation of

organic solutes in plants.

CLO 4. To the energy releasing steps in Glycolysis. Students will be familiar aboutthe mechanism of respiration.

CLO 5. To acquire knowledge in plant growth regulator and its uses, thephysiology of flowering and photoperiodism

Block I: Plant – Water Relation

1.1 Introduction

1.2 Water Potential

1.3 Absorption of Water

1.4 Imbibition

1.5 Diffusion

1.6 Osmosis

1.7 Aquaporin

1.8 Transpiration

1.9 Guttation

1.10 Ascent of Sap

Block II: Metabolism

Learning Objectives

2.1 Introduction

2.2 Photosynthesis

2.3 Calvin cycle

2.4 Hatch Slack Pathway

2.5 Respiration

Block III: Nitrogen Metabolism

3.1 Introduction

3.2 Ammonification and Nitrification

3.3 Nitrogen fixation

3.4 Amino acids

3.5 Lipids

Block IV: Growth Hormones

4.1 Introduction

4.2 Auxins

4.3 Cytokinins

4.4 Gibberellins

4.5 Ethylene

4.6 Abscisic acid

Block V: Photoperiodism

5.1 Introduction

5.2 Photoperiodism

5.3 Vernalization

5.4 Fruit Ripening

Books for Reference

1. Frank B. Salisbury and Celon W. Ross, Plant Physiology,GBS Publishers and distribution, New Delhi.

2. Jain, V.K., Plant Physiology, S.Chand& Company, N.Delhi.

3. Sinha, R.K., Modern Plant Physiology, Narosa Publishing House

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2. https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/Unit_3%3A_Plant_Physiology_and_Regulation
3. https://www.vedantu.com/biology/plant-physiology
4. https://www.lifeasible.com/custom-solutions/plant/analytical-services/plant-physiology-analysis/
5. https://learn.careers360.com/biology/plant-physiology-chapter/
6. https://www.geeksforgeeks.org/most-important-questions-on-plant-physiology/

Course Title: Plant Biotechnology

Course Code: BBOTS 62

Course credit: 4 credits

Course Objective:

CO1. To Extend the concepts and application of Biotechnological knowledge

CO2. To explain the concept of transgenic plants and combine with methods

CO3. Tabulate the biofuel production using biotechnology

CO4. To estimate the values of single cell proteins

CO5. To evaluate the biogas production using biotechnological tools

Course Outcome:

CLO 1. Plant Molecular Biology focuses on exploration of molecular basis of plant life.

CLO 2. The course paper enlighten mainly on DNA, RNA, Protein, molecular systems and regulation of gene expression in prokaryotic and eukaryotic organisms.

CLO 3. Through this course paper students will be able to the function of cells at molecular level.

CLO 4. The students will be able to apply the molecular knowledge in metabolic engineering of transgenic plant to produce biologically important products.

CLO 5. Students will be able to pertain knowledge on molecular breeding methods that are coupled with genetic engineering techniques.

Block I: Plant Biotechnology

1.1 Plant Tissue culture

1.2 History of tissue culture

1.3 Types of culture

1.4 Callus culture

1.5 Embryo culture

1.6 Protoplast culture

1.7 Application

Block II: Transgenic plants - pest resistance, herbicidal resistance,

2.1 Disease resistant, abiotic and biotic stress tolerant, in improving crop yield, food quality-Golden rice,

2.2 Edible vaccines, Virus and Bacteria based transient gene expression systems.

2.3 Virus induced gene complementation, Virus

Block III: Biofuel –

3.1 Hydrogen Production, and the conversion of light energy Importance of biological production of hydrogen, photoproduction of hydrogen.

3.2 Cell free hydrogen production, Hydrogen production from Marine organisms, Microbial production of hydrogen.

Block IV: Single cell protein

4.1 (SCP) and their Nutritional value-Micro organisms used as SCP-*Spirulina, Chlorella*,

4.2 Yeast (*Saccharomyces cerevisiae*) – Mass cultivation of *Spirulina, Chlorella,* and Yeast.

Block V: Biogas production –

5.1 Methanogenesis.

5.2 Waste treatment – Aerobic and anaerobic.

5.3 Reusage of Sewage.

Books for Reference

1. Turner, P.C. A.G. MC Lennan. A.D. Bates And M.R.H. White. 1998. Instant Notes in Molecular. Biology. Viva Books Pvt. Ltd. Chennai.
2. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co, Clifornia.
4. De Robertis, E.D.P & De Robertis, E.M.F (1980) Cell and molecular biology, Holt Saunders International Editions, Philadelphia, Tokyo.
5. Balasubramanian, D., BRYCE, C. F. A., Dharmalingam, K., green, j. And Kunthala Jayaraman. (eds.) 1996. *Concepts in biotechnology.* University Press (India) Ltd.
6. Brown, C.W., I. Campbell and F.G. Priest. 1987. Introduction to biotechnology Blackwell scientific publications. Oxford.
7. Chawala, H. S. 2002. *Introduction to Plant Biotechnology*. Oxford & IBH Pubilishing Co. Pvt.Ptd. New Delhi.

8. Ignacimuthu, S. 1996. Basic Bio-Technology. Tata-McGraw, Hill Publishing Co. Ltd., New Delhi.
9. Ignacimuthu, S.J. 2012 Biotechnology –An introduction. Narosa Publishing House, New Delhi.
10. Dubey, R.C.1993. A Text book of Bio-Technology. S.Chand& Co. Ltd. New Delhi.

Web Link

1. **https://www.intechopen.com/chapters/40180**
2. **https://www.apsnet.org/edcenter/disimpactmngmnt/labexercises/PlantBiotechnology/Documents/PlantTissueCulture.pdf**
3. **https://www.thermofisher.com/in/en/home/life-science/cell-culture.html?gclid=CjwKCAjwh4ObBhAzEiwAHzZYUxnBPv7j3lib-swxDUuRpjp2HWZlCoJoOrPlfHIU3xCboXucYYB1xRoC6gIQAvD_BwE&ef_id=CjwKCAjwh4ObBhAzEiwAHzZYUxnBPv7j3lib-swxDUuRpjp2HWZlCoJoOrPlfHIU3xCboXucYYB1xRoC6gIQAvD_BwE:G:s&s_kwcid=AL!3652!3!591426427560!p!!g!!cell%20culture!1759362858!70775283318&cid=bid_clb_cce_r01_co_cp0000_pjt0000_bid00000_0se_gaw_nt_pur_con**
4. **https://www.intechopen.com/chapters/63134**
5. **https://www.microscopemaster.com/transgenic-plants.html**

Course Title: Bioinformatics and Techniques in Biology

Course Code: BBOTS 63

Course credit: 3 credits

Course Objective:

CO1. To illustrate the biological database for the basics of bioinformatics.

CO2. To explain the concept of microscopy and demonstrate its functions

CO3. To demonstrate the instruments of photometry

CO4. To sketch the Chromatography

CO5. Evaluate the role electrophoresis and centrifugation

Course Outcome:

CLO 1. Can recognize the of bioinformatics and online bioinformatics tool.

CLO 2. To explain and impart the knowledge online available biological databases.

CLO 3. Can sketch the mi9croscopy in detail

CLO 4. Able to label photometry and chromatography

CLO 5. Can summarize the electrophoresis and centrifugation tools .

Block I: Introduction to bioinformatics:

1.1 Biological Database – Protein and DNA sequence data base, Structure database, literature database, (Pubmed, NCBI, Medline).

1.2 Sequence Alignment, Database similarity searching; FASTA; BLAST, Proteomics – protein structure prediction (primary, secondary & tertiary), Human Genome Project.

Block II: Microscopy:

2.1 Compound Microscope , parts of compound microscope, bright field microscopy, dark field microscopy. Phase contrast microscopy, fluorescent microscopy,

2.2 Electron microscopy- TEM, SEM, Tissue preparation in light and electron Microscopy,

2.3 Camera Lucida - Micrometry-Microtomy- fixatives, dehydration,infiltration, preparation of paraffin block, Microtomes- types,Staining – single and double.

Block III: Colorimetry and Photometry-

3.1 Beer- Lamberts Law; colorimeter and spectrophotometer.

3.2 Electromagnetic Spectum. UV spectroscopy, NMR, Mass Spectroscopy. pH Meter.

Block IV: Chromatography :

4.1 Principles and applications, mobile and stationary phases, Rf value,

4.2 Paper chromatography, Gel filteration chromatography, TLC, HPLC, GLC and Ion-Exchange chromatography.

Block V: Electrophoresis and Centrifugation:

5.1 Principles and Applications. Separation of macromolecules by Agarose gel Electrophoresis, Poly Acrylamide Gel Electrophoresis, SDS - PAGE, Pulse Iso Electric focussing, Two dimensional gel Electrophoresis.

5.2 ypes of centrifuges, parts of centrifuges.Velocity gradient centrifugation, Isopycnic centrifugation, Differential centrifugation.

Reference Books

1. "Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery" by Rastogi.
2. "Bioinformatics: Principles and Applications" by ZhumurGhosh and BibekanandMallick
3. "Introduction to Bioinformatics" by Lesk
4. Williams, B. L. and Wilson, K. (1983). A Biologist's Guide to Principles Techniques of Practical Biochemistry. Edward Arnold, London. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

Web link

1. http://www.jaist.ac.jp/~bao/talks/IntroBioinformaticsE.pdf
2. https://www.khanacademy.org/science/biology/structure-of-a-cell/introduction-to-cells/a/microscopy
3. https://www.toppr.com/guides/chemistry/is-matter-around-us-pure/centrifugation/
4. https://www.vedantu.com/chemistry/electrophoresis-technique-used-for-dna-analysis
5. https://www.britannica.com/science/chromatography/Elution-chromatography
6. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Analytical_Chemistry_2.1_(Harvey)/10%3A_Spectroscopic_Methods

Course Title: Practical – V

Course Code :BBOTS 64P

Course credit: 2 credits

Course Objective

CO1. To the inside knowledge of the inheritance

CO2. To know the structures and organelles of a plant cell

CO3. To function of higher plant system**.**

Course outcome

CLO 1. The laboratory course gives practical knowledge to perusing students in the field of cytology, genetics and evolution.

CLO 2. A cell is the locus of behaviour and that this behaviour has structural basis. Students will be able to observe different cell organelles through electron micrographs from standard articles.

CLO 3. Student will able be to observe mitosis cell division through the cytological preparation from onion root tips.

CLO 4. Working out problems related to genetics will be helpful to students, to solve the problems in plant biology.

CLO 5. Students will able to how life was survived on earth earlier and how the life has changed over the period.

CLO 6. Through Geological time scale students the sequence of geological periods in the history of earth.

CLO 7. Students will be able to the internal structures, determination of age of fossil through prefixed fossil slides.

Cell Biology

A study of Cell structure in Plants and its organelles using electron micrographs from standard publications. Study of mitosis and meiosis using squash and smear Technique.

Genetics

Problems on simple Monohybrid and Dihybrid ratios. Simple Problems on interaction of factors included in the theory

Biochemistry

For demonstration only

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

1. Colorimetric estimation of sugars
2. Calorimetric estimation of Starch

Separation of plant pigments by paper chromatography.

Weblink

1. https://biochemden.com/biochemical-techniques-basics/
2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf

Course Title: Practical - VI

Course code: BBOTS 65P

Course credit: 2 credits

(Plant Physiology, Molecular Biology and Plant Biotechnology)

Course Objectives:

CO1. Basic ing of the physiological mechanisms of plants.

CO2. It contains more experiments based on general and applied aspects.

CO3. Isolation, quantification and storage methods of DNA, RNA and plasmids will be helpful to students to carry out advanced studies like genetic engineering.

Course outcome:

CLO 1. The practical course paper elaborates fundamental skills and techniques in plant molecular biology.

CLO 2. These experiments will be helpful to student for better ing of the scientific principles and skillful implementation of the experiments.

CLO 3. Students enable to familiarize about the preparation of solutions of different strength. Ex. Buffer.

CLO 4. Student will be able to utilize all basic instruments used in molecular biology.

Practicals

1. Demonstration of centrifugation, UV-Spectrophotmeter,
2. Demonstration of Microtomic techniques.
3. Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Handerson-Hasselbach equation.

5. TLC using amino acids from purified samples and biological materials.

Molecular biology

1. Isolation, quantification and storage methods of DNA, RNA and plasmids will be helpful to students to carry out advanced studies like genetic engineering.

2. Students are capable to acquit practical knowledgeable in histo-chemical tests in starch, sugars and proteins.

3. Study of morphological and anatomical features of hydrophytes and xerophytes.

4. Study of morphological features of epiphytes, parasites and halophytes.

5. Study of vegetation by quadrat and line transect methods

6. Determination of photosynthetic rate in water plants under different CO2 concentrations.

7. Measurement of oxygen evolution under different coloured lights using Wilmott's bubbler.

Plant Physiology

1. Determination of osmotic pressure of onion/Rhoeo leaf.

2. Effect of light intensity on transpiration using Ganong'spotometer.

3. Determination of stomatal frequency and estimation of transpiration rate.

4. Determination of absorption and transpiration ratio of twigs.

5. Measurement of respiration rate using germinating seeds and flower buds with simple Respiroscope.

Web link

1. https://www.britannica.com/science/molecular-biology
2. https://study.com/academy/lesson/what-is-plant-physiology-definition-experiments.html

Allied Botany for B.Sc., Zoology

Course Title: Plant Diversity - I
Course Code: BZOS-12A
Course credit: 4 credits

Course Objectives:

To enable the students to

CO1. To Explain the character and life cycle of Algae

CO2. To identify the various forms of Fungi

CO3. To label the characters of Bryophytes

CO4. To examine the structure of various tissues and their functions

CO5. To discuss the internal structure of stem and root

Course Outcome:

CLO1. Student the lower plant at ancillary level

CLO2. Student can able to identify plant tissues and cells.

Block – I Algae

1. Introduction

2. General Characters

3. Structure and life cycle of the following (need not study the development of sex organs) a) Cyanophyceae - Oscillatoria b) Chlorophyceae - Oedogonium c) Phaeophyceae - Sargassum

4. Economic Importance of Algae

Blok – II Fungi

1. Introduction

2. General Characters

3. Structure and life cycle of the following a. Ascomycetes - Aspergillus b. Basidiomycetes - Agaricus

4. Economic Importance of Fungi (brief study)

Block – III Bryophytes

1. Introduction

2. General Characters

3. Structure and life cycle of Funaria (need not study the development of sex organs) PLANT

Block – IV: Tissues

1.Simple and Permanent tissues a) Parenchyma b) Collenchyma c) Sclerenchyma Structure and functions

2. Complex permanent tissues Structure, composition and functions of Xylem and Phloem

Bloc – V Stem, Root and Leaf

1) Primary structure of Dicot stem and Dicot root

2) Normal secondary thickening in Dicot stem and root

3) Structure of Typical Dicot leaf.

Reference Books:

1. Tayal, M.S. "Plant Anatomy",Third Edition, Rastogi Publications, Meerut, 2004.

2. Pandey, B.P. "College Botany Vol. I," Eighth Edition, S.Chand and Co., New Delhi, 2011.

3. Pandey, B.P. "College Botany Vol. II," Eighth Edition, S.Chand and Co., New Delhi, 2011.

4. Vashishta, B.R., Sinha,A.K. and Singh,V.P. "Algae", Nineth Edition S.Chand and Co., New Delhi, 2010.

Web links

1. https://www.britannica.com/science/algae/Ecological-and-commercial-importance
2. https://naturalhistory.si.edu/research/botany/research/algae/algae-classification
3. https://organismalbio.biosci.gatech.edu/biodiversity/fungi-2/
4. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Biology_(Kimball)/16%3A_The_Anatomy_and_Physiology_of_Plants
5. https://www.encyclopedia.com/social-sciences/applied-and-social-sciences-magazines/plant-anatomy

Course Title: Plant Diversity - II

Course Code: BZOS-22A

Course credit: 4 credits

Course Objective

CO1. To Compare the plant systems and its lives

CO2. To cite the internal structures and the functions of vegetation

CO3. To describe the role of plants in the environment

Course Outcome

Knowledge and ing of:

CLO 1. The range of plant diversity in terms of structure, function and environmental relationships.

CLO 2. The evaluation of plant diversity.

CLO 3. Plant classification and the flora

CLO 4. The role of plants in the functioning of the global ecosystem.

CLO 5. A selection of more specialized, optional topics. 6. Statistics as applied to biological data.

Block - I: Taxonomy

1. Binomial nomenclature - Classification of Plants - General outline of Bentham and Hookers system of classification

2. Study of the range of characters and plants of economic importance in the following families: Annonaceae, Fabaceae, Rubiaceae, Apocynaceae, Euphorbiaceae and Liliaceae.

Block- II: Embryology

1. Structure of mature anther.

2.Structure of mature ovule its types.

3.Structure of pollengrain.

4.Development of male gametophyte.

5.Embryo rescue - Fertilization.

Block - III: Plant Physiology

1.Absorption of water Physiological role of micro and macro elements - their deficiency symptoms
2.Metabolism – I - Photosynthesis - Light reaction - Dark reaction – C3 and C4 plants –
3.Respiration - Glycolysis, Kerb's cycle, Electron Transport chain -Cyclic and Non-Cyclic chain
4.Photorespiration.

Block - IV: Ecology

1. Ecosystem -- definition - basic components of ecosystem examples of ecosystem fresh water ecosystem.
2. Energy flow in ecosystem trophic level. Food chain - food web.
3. Environmental pollution. Major pollutants types of pollution air pollution. water pollution, soil pollution - control measures.

Block - V : Genetics

1.Genes-Alleles - Phenotype - Genotype-
2. Mendel's law of inheritance; Law of seggregation - Law of independent assartment-monohybrid and dihybrid ratio –Test cross-Back cross-
3. linkage and Crossing over - Single - multiple cross over –
4. Chromosomal mapping.

Books for Reference

1. Rendle, R.B., The Classification of flowering plants, Vol. I, II &III, Oxford-Clarendon.

2. Vasisha, P.C., 1994, Taxonomy of Angiosperms R.S. Chand & Company

3. Sharma, O.P., 1993, Plant Taxonomy, Tata McGraw Hill.

4. Bhojwani, S.S. and Bhatnagar, S.P., 1978, The embryology of Angiosperms, publishing House, N.Delhi.

5. Jain, V.K., Plant Physiology, S.Chand& Company, New Delhi.-

6. Sharma, P.D., Ecology &Envirnoment,Rastogi Publications.

7. Gupta, P.K., 2007, Genetics Classical to Modern, Rastogi Publications, Meerut.

Web links

1. https://agriculturistmusa.com/plant-embryology/
2. http://www.ppup.ac.in/download/econtent/pdf/JNL%20College%20(%20Pallavi%20for%20Botany%20B.Sc%20Part%20II)%20Topic-Plant%20embryology%20part%201.pdf
3. https://www.botanicalartandartists.com/plant-evolution-and-taxonomy.html
4. https://open.lib.umn.edu/horticulture/chapter/2-1-plant-taxonomy/
5. https://botanicalsociety.org.za/the-science-of-names-an-introduction-to-plant-taxonomy/
6. https://study.com/academy/lesson/what-is-plant-physiology-definition-experiments.html
7. https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/Unit_3%3A_Plant_Physiology_and_Regulation