B. Sc., BOTANY

SYLLABUS

(WITH EFFECTIVE FROM 2018–2019)

B. Sc. BOTANY PROGRAMME – Course Structure under CBCS Pattern

(For the candidates admitted from the academic year 2018-2019 onwards)

Sl. No	Sem	Paper	Hrs/ Week	Credit	Exam Hrs.	Marks		
						Internal	External	Total
1	I	Part - I	6	3	3	25	75	100
2	I	Part - II	6	3	3	25	75	100
3	I	CCI - I – Plant Diversity – I (Algae, Fungi and Lichen)	6	5	3	25	75	100
	I	Allied Paper – I (Bot for Zoology Students)	3		3	25	75	100
	I	Allied Practical – II * (Bot for Zoology Students)	2					
4	I	Environmental Studies	2	2	3	25	75	100
	I	Soft Skill Paper – I	2	4	3	20	75	100
5	II	Part - I	6	3	3	25	75	100
6	II	Part - II	6	3	3	25	75	100
7	II	CC -II- Plant Diversity – II (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	6	5	3	25	75	100
8	II	CC –III - Practical – I* - Paper – I & II	3	4	3	40	60	100
9	II	Allied Paper – I (Bot for Zoology Students)	3	5	3	25	75	100
10	II	Allied Practical – II * (Bot for Zoology Students)	2	5		40	60	100
11	II	Value Education	2	2	3	25	75	100
12	II	Soft Skill Paper – II	2	4	3	25	75	100
13	III	Part – I	6	3	3	25	75	100
14	III	Part – II	6	3	3	25	75	100
15	III	CC IV - Anatomy and Embryology	5	4	3	25	75	100
	III	Allied Paper – III*(Bot for Chemistry Students)	3					
	III	Allied Practical – IV* (Bot for Chemistry Students)	3					
16	III	Non Major Elective Paper – I ..... (Botany Students)	7	5	3	25	75	100
17	IV	Part – I	6	3	3	25	75	100
18	IV	Part – II	6	3	3	25	75	100
19	IV	CC VI - Cytology, Genetics and Evolution	5	4	3	25	75	100
20	IV	CC V - Major Practical – II*	3	4	3	40	60	100
21	IV	Allied Paper – III* (Bot for Chemistry Students)	3	5	3	25	75	100
22	IV	Allied Practical – IV* (Bot for Chemistry Students)	3	5	3	40	60	100
23	IV	Soft Skill Paper – II-	4	4	3	25	75	100
24	V	Major Paper – VII - Morphology and Taxonomy of Angiospers	4	4	3	25	75	100
25	V	CC VIII - Plant Ecology and Phytogeography	4	4	3	25	75	100
26	V	CC IX – Microbiology and Plant Pathology	5	4	3	25	75	100
	V	Major Practical – III*	3					
	V	Major Practical – IV*	3					
27	V	Elective Paper – I – Forestry and Nursery Technique	5	5	3	25	75	100
	V	Elective Paper – I – Mushroom Cultivation						
28	V	Non Major Elective Paper – II – Medical Botany For Zoology Students	2	2	3	25	75	100
29	V	Soft Skill Paper – III –	4	4	3	25	75	100
30	VI	Major Paper – X – Horticulture and Plant Breeding	5	5	3	25	75	100
31	VI	Major Paper – XI- Plant Physiology, Biochemistry and Biophysics	5	5	3	25	75	100
32	VI	Major Paper – XII – Biotechnology	4	4	3	25	75	100
33	VI	Major Practical – III*	3	4	3	40	60	100
34	VI	Major Practical – IV*	3	4	3	40	60	100
35	VI	Elective Paper – II- Biostatistics and Bioinformatics	5	5	3	25	75	100
	VI	Elective Paper – II- Natural Products and Human Welfare						
36	VI	Elective Paper - III - Bioinstrumentation	4	4	3	25	75	100
	VI	Elective Paper - III - Biofertilizer and Biopesticide						
37	VI	Gender Studies	1	1	3	25	75	100
		Extension Activities		1				
			180	140				
		* Exams will be held at the end of even semester						3700

Program outcomes:

- Undergraduate students can grasp the knowledge on diversity and their role in environment. They can understand internal organization of cells, tissues and functions of life forms.
- Students can also acquire knowledge on the applied sciences like horticulture and gardening and microbes.
- Students can pursue either an academic career in institutions as lecturers and professors or a scientific career in various scientific positions such as Plant Scientists, Weed Scientists etc.
- They can also go and work as researchers and as administrators.
- They have also the potion in Botanical Survey of Indiaand other Gobvernment departments by competitive examinations such as UPSC, TNPSC etc.

Program Specific Outcomes:

- Students will have the capability to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for botany.
- Students will be able to explain how organisms function at that level of the gene, genome, cell, tissue, organ and organ –system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behavior of different forms of life.
- Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae and fungi that differentiate them from each other and from other forms of life.
- Students will have excellent research skills (field, laboratory, plant growth facilities and library.
- Students can be able to know Communications skills to discuss and analyze problems using oral and written communication skills.
- Students will acquire the knowledge about the cultivation of medicinal and aromatic plants

Semester I

CORE COURSE I – PLANT DIVERSITY – I
(Algae, Fungi and Lichen)

Course Code : 18UBT1 ◈ Hrs / week : 6 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To understand the salient features of Algae and Fungi
- To study the structure and reproduction of various genera mentioned in the syllabus.

Course outcomes:

- Study and impart knowledge about Ultra - structure of Prokaryotic and Eukaryotic cells and their composition.
- Imparting knowledge on economic values of algae.
- Understanding the general features distribution and mode of nutrition of fungi.
- Students able to understand about thallus organizations, vegetative and sexual reproduction.
- They learn the importance lichen as an indicator of pollution.

Unit I – General features of algae

General characteristics of algae. Classification (Smith, 1955). Occurrence of Algae, Cell structure of prokaryotic algae (cyanophyceaen cell) and eukaryotic algae (chlorophycean cell). Detailed study of the following genera: occurrence, distribution, structure and reproduction of *Oscillatoria, Chlamydomonas and Oedogonium.*

Unit II – Structure and life cycle of algal species

Detailed study of the following genera: occurrence, distribution, structure and reproduction of *Caulerpa, Sargassum* and *Gracilaria* (developmental studies on sex organs not required).

Unit III – Characteristics and economic importance of fungi

General characteristics - Classification (Alexopoulos and Ainsworth, 1972). Mode of nutrition - Reproduction methods- Economic importance of fungi.

Unit IV - Structure and reproduction of fugal species

Detailed study of morphology and reproduction of the following genera: *Penicillium, Albugo, Peziza, and Polyporus.*

Unit V – Structure and reproduction of Lichens

Lichens: occurrence, distribution, classification, types, structure, vegetative and sexual reproduction (with reference to fruticose lichen - *Usnea*).

Text Book:

- Pandey, BP. 2005. Simplified course in Botany, S. Chand and Company Ltd., New Delhi.

References:

- Sharma, OP. 1992. Text Book of Algae. Tata Mc Graw Hill, New Delhi.

- Gangulee, HC. & Kar, AK.1989. College Botany, Vol-II, Books & Allied Pvt. Ltd., Calcutta.
- Singh V, Pande PC & Jain OK. A text book of Botany, Rastogi Publications, Meerut.
- Smith, GM. 1955. Cryptogamic Botany Vol-1&II, McGraw Hill, New York.
- Hale, ME Jr. 1983. The biology of Lichens, New Age International publishers, New Delhi.

E–Books:

- https://www.schandpublishing.com/books/higher-education/commerce-management/public-finance/9789352710805/#.Wwz_pUiFPIU
- https://www.abebooks.com/book-search/title/introduction-to-the-algae-structure-and-reproduction/
- https://books.google.co.in/books?id=YsJs9eiNKdAC&pg=PA138&lpg=PA138&dq=Bold,+H.C.+%26+Wynne,+M.J.+1985.+Introduction+to+the+Algae.+Prentice+Hall+of+India,+New+Delhi.&source=bl&ots=04B4qBMbX_&sig=h2T1O9eo9zFlJ4Pc1YvPU5wFiyw&hl=en&sa=X&ved=0ahUKEwiJh5TbsarbAhWHLo8KHZH8A3oQ6AEIQzAG#v=onepage&q=Bold%2C%20H.C.%20%26%20Wynne%2C%20M.J.%201985.%20Introduction%20to%20the%20Algae.%20Prentice%20Hall%20of%20India%2C%20New%20Delhi.&f=false

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester I & II

CORE COURSE II – PRACTICAL I – PLANT DIVERSITY I & II

(Algae, Fungi, Lichen, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)

Course Code : 18UBT2P ◈ Hrs / week : 3 ◈ Credit : 4 ◈ Marks : 40 + 60 = 100

Objectives:

- To understand the micro slide preparation methods.
- To understand the dissection procedure of diversity.

Course outcomes:

- Experiencing in handling specimens and preservation of algae, fungi etc.
- Imparting knowledge on identification characters of algae and fungi
- Acquiring knowledge on diversity of pteridophyte and gymnosperms.
- Understanding symbiotic relationship of algae and fungi in lichen
- Acquiring knowledge on fossil evidence for studying primitive plants.

Algae

- Microscopic observation of algal types and permanent slides included in the syllabus.
- Section cutting of *Caulerpa, Sargassum* and *Gracilaria* thallus.
- Identification of algal types in the algal mixture (only microscopic types).

Fungi

- Microscopic observation of slides of genera included in the syllabus.
- Section cutting of *Albugo* infected leaf, *Polyporus* and apothecium of *Peziza*.

Lichen

- Observation of different thalli of Lichens.
- Microscopic observations of permanent slides of *Usnea*.

Bryophytes

- Section cutting of gametophytes of *Riccia*, *Anthoceros and Funaria.*
- Microscopic observation of slides of genera included in the syllabus.

Pteridophytes

- A study of the morphology, anatomy of the vegetative and reproductive parts of the sporophyte and gametophytes (wherever available) of living genera included in the syllabus and analysis of their slides.

Gymnosperms

- A study of the morphology, anatomy of the vegetative and reproductive parts of the sporophyte and gametophytes (wherever available) of living genera included in the syllabus and analysis of their slides.

Paleobotany

- Observation of slides of fossil forms given in the syllabus

One day tour/field visit to collect the living flora included in the syllabus within the Tamil nadu and submitted the specimens with detailed report.

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	M	S	S
CO3	S	M	S	S	S
CO4	M	S	S	M	S
CO5	S	S	S	S	M

*S- STRONG, M- MEDIUM, L- LOW

Semester II

CORE COURSE III – PLANT DIVERSITY II
(Bryopytes, Pteridophytes, Gymnosperms and Paleobotany)

Course Code : 18UBT3 ◈ Hrs / week : 6 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To study the salient features of plants belonging to Bryophytes, Pteridophytes and Gymnosperms.
- To study the fossilization process and formation of different types of fossils.

Course outcomes:

- Students understand the general features distribution and economic importance of Bryophytes.
- They understand about external, internal and development of reproductive structures in Pteridophytes.
- They gain the knowledge on the Lifecycle of Pteridophytes.
- Students will get the knowledge on general features distribution and economic importance of Gymnosperms.
- Understanding fossils and their values in evolution study

Unit I – Structure and lifecycle of Bryophytes

General characteristics. Classification (Rothmaler, 1951), vegetative reproduction and economic importance. Detailed study of the following genera: occurrence, distribution, common species, structure and reproduction of *Riccia, Anthoceros* and *Funaria* (developmental studies on sex organs not required).

Unit II – Classification and importance of Pteridophytes

General characteristics, classification (K.R. Sporne). Stelar evolution. Ecological and economical importance of Pteridophytes.

Unit III – Lifecycle of Pteridophytes

Morphology, Anatomy, Reproduction and life cycle of *Lycopodium*, *Selaginella* and *Marsilea*.

Unit IV – Structure and reproduction of Gymnosperms

General Characteristics, Classification (K.R.Sporne). Morphology, Anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum*. Economic importance.

Unit V – Fossil plants

Geological time scale. Process of fossilization. Brief study of the following fossils- *Rhynia*, *Lepidocarpon* , *Calamites* and *Williamsonia*

Text Books:

- Vasishta PC, Sinha AK & Anilkumar. 2005. Botany for degree students, Gymnosperms. S Chand And Company Ltd., New Delhi.
- Pandey, BP. 1998. A text book of Botany Vol. II. S. Chand & Co. Ltd. New Delhi.

Reference:

- Rashid, A. 1976. An Introduction to Pteridophytes. Vikas Publishing House, New Delhi.
- Sporne, KR.1967. The Morphology of Gymnosperms, Hutchinson & Co., London.
- Sporne, KR.1975. The Morphology of Pteridophytes, Hutchinson & Co., London.
- Arnold, C.R. 1947 (Rep. 1979). An Introduction to Paleobotany. Mc Graw Hill Publishing Co. Ltd., New Delhi.

E–Books:

- https://www.schandpublishing.com/books/higher-education/commerce-management/public-finance/9789352710805/#.Wwz_pUiFPIU
- https://www.abebooks.com/book-search/title/introduction-to-the-algae-structure-and-reproduction/
- https://www.schandpublishing.com/books/higher-education/biology/college-botany-volume-ii/9788121906012/#.W0LrB9IzbIU

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	M	M	M
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	M	S	M	L

*S- STRONG, M- MEDIUM, L- LOW

Semester III

CORE COURSE IV –ANATOMY AND EMBRYOLOGY

Course Code : 18UBT4 ◈ Hrs / week : 5 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Objectives:

- To impart knowledge about the various components and characters of wood.
- To study the basic principles of embryo

Course outcomes:

- Students able to understand meristematic tissue.
- They can differentiate primary and secondary meristem and their function.
- They can able to understand the structure and function of vascular cambium.
- They can able to explain the difference between dicot and monocot embryo.
- Students will be able to understand the importance of polyembryony.

Unit I –Tissues

Meristems, classification, shoot and root apex organization. Theories of shoot and root apex. Tissues - Types - Simple permanent - Simple permanent and Complex permanent tissues – Structures and their functions.

Unit II – Anatomy of root and stem

Primary and Secondary structure of dicot and monocot stem and roots. Leaf - Anatomy of monocot and dicot. Nodal Anatomy - unilacunar, trilacunar and multilacunar.

Unit III – Wood anatomy

Anamolous secondary growth of Achyranthus, Boerhaavia and Dracaena. Wood Anatomy – secondary xylem, Sap and heart wood, soft and hard wood. Physical and Chemical properties of wood.

Unit IV – Development of gametophytes

Microsporangium, Microsporogenesis - Development of male gametophyte. Megasporangium, Megasporogenesis. Development of female gametophyte - Monosporic (Polygonum), bisporic (Allium), tetrasporic (Peperomia)

Unit V – Fertilization

Pollination – types. Fertilization. Development of dicot embryo, Development of monocot embryo. Types of endosperms. Apomixis – types and significance, Polyembryony and their significance.

Text Books:

- Pandey B.P. 2007. Plant Anatomy, S. Chand & Co. De, New Delhi.
- Bhojwani, SS. & Bhatnagar, SP. 1994. Embryology of Angiosperms, Vikas Publishing House (P) Ltd., New Delhi.
- HP Brown, AJ Panshin & CC. Farsaith, 1981. Text book of Wood Technology, Mc Graw Hill Inc. New York.
- Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill, New York.

References:

- Cuttler, EG. 1969. Plant Anatomy - Part I Cells & Tissue. Edward Arnold Ltd., London.
- Esau K. 1985. Plant Antomy (2nd ed.) Wiley Eastern Ltd. New Delhi.
- Maheshwari, P. (ed.) 1963. Recent advances in embryology. Intl. Soc. Pl. Morphol, New York.
- Pullaiah, T., Lakshminarayana, K. and Hanumantha Rao, K. 2001. Text Book of Embryology of Angiosperms, Regency Publications, New Delhi.
- Raghavan, V. 1979, Experimental embryogenesis of vascular plants.
- Cambridge University Press, Cambridge. U.K.

E–Books:

- https://www.abebooks.co.uk/servlet/BookDetailsPL?bi=20569837712&searchurl=tn%3Dhandbook%2Bof%2Bthe%2Bbritish%2Bflora%26sortby%3D17%26an%3Dbentham%2Bg&cm_sp=snippet-_-srp1-_-title1
- https://trove.nla.gov.au/work/16054012
- https://books.google.co.in/books/about/A_Text_Book_Ofbotany_Plant_Anatomy_and_E.html?id=uMOglvnKUpQC&redir_esc=y

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	M	M	S
CO4	S	S	M	M	S
CO5	S	S	M	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester III

NON MAJOR ELECTIVE I – COMPUTER APPLICATION IN BIOLOGICAL SCIENCE

(For Botany Students)

Course Code : 18UBTN1 ◈ Hrs / week : 7 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- This course aims at providing basic knowledge of computer and operating systems and their application in biological sciences such as packages related to data analysis, data processing and generating graphs.
- It also provides sufficient knowledge on the recent advances in Bioinformatics.

Course outcomes:

- Learning the basics of computer parts and their applications
- acquiring knowledge about networking
- Students can able to learn about the multimedia
- gaining knowledge on e-resources
- They adding knowledge about gene banks

Unit I – Basics of computer

History of computers – Types of Computers – Hardware (Input, Output, Storage Devices and Processing Unit) – Software –Types of Software used in Biological Sciences

Unit II – Browsers

Email – Web Browsers – Search Engines – Web Sites – Video Conferencing

UNIT III – Multimedia

Multimedia Definition – Needs, Benefits and Problems – Multimedia Platforms – Sounds and Pictures.

UNIT IV – E–Resources

E.book, E.Journals, Digital Library and their application in Biological sciences.

UNIT V – Biological data

Biological Data Bank: DNA, RNA and protein sequence Data Bank, Gene bank.

Text Books:

- D.P. Curtin, K. Sen and C. Morin. 1999 – Information Technology – The breaking wave, TMH.

References:

- Bartee “Digital Computer Fundamentals” Tata McGrawHill1996.
- Internet Programming – Kris Jamsa Ken Cope. Galgotia Publications PVT. Ltd., 1995
- Judith Jeffcoate Multimedia in Practice Technology and Application Prentice
- Simon J Gibbsand Dionysion C T sinchrikzis – Multimedia Programming.

- David W Mount (2001) Bioinformatics, Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
- Higginns D and Taylor (2000) Bioinformatics – sequence, structure and databanks – a practical approach, Oxford University Press.

E–Books:

- https://www.amazon.in/Biostatistics-Computer-Application-Bioinformatics-Kumaresan/dp/938245991X
- https://www.researchgate.net/profile/Kailas_Mali/publication/209729264_Textbook_of_Computer_applications_and_biostatistics/links/54329b770cf20c6211bc64c9/Textbook-of-Computer-applications-and-biostatistics.pdf?origin=publication_detail

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	M	S	S	S
CO2	M	M	S	S	S
CO3	M	M	S	S	S
CO4	M	M	S	S	S
CO5	M	M	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester III

NON MAJOR ELECTIVE I – ETHNOBOTANTY
(For Botany Students)

Course Code : 18UBTN1 ◈ Hrs / week : 7 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- Bring out the relevance of ethnobotany in the present context
- Know about the major and minor ethnic groups or Tribals of India, and their life styles.

Course outcomes:

- Students can able to Learn about the Methodology of Ethnobotanical studies
- They can Gain knowledge on the role of ethnobotany in modern Medicine
- Acquiring knowledge on tribal medicine
- They will get traditional knowledge on medicinal plants
- They can get awareness on the conservation practices of medicinal plants

Unit I – Introduction to Ethnic knowledge

Ethnobotany – definition, history and its scope – Inter disciplinary approaches in herbal medicine – Collection of ethnic information.

Unit II – Human healthcare

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

Unit III – Remedial medicinal plants

Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion – *Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodon dactylo*n and *Sesamum indicum*.

Unit IV – Traditional knowledge of plants

Traditional knowledge and utility of some medicinal plants in Tamilnadu – *Cardiospermum halicacabum, Adathoda vasica, Azadirachta indica, Ocimum sanctum, Centella asiatica, Solanum trilobatum,* and *Aloe vera*.

Unit V – Utilization of Vegetable and Fruits

Nutritive and medicinal value of some fruits (Guava, Orange, Banana), vegetables (Tomato, Potato, Brinjal) and Greens (*Moringa, Solanum nigrum*).

References:

- Sinha, R. K. & Shweta Sinha , 2001. Ethnobiology, Surabhe Publications, Jaipur.
- Pal, D.C. & S. K. Jain, 1998. Tribal medicine, 206, Bidhan Sarani, Calcutta – 700 006.
- Jain, S. K, 1995. Contribution to Indian Ethnobotany. 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
- Jain, S.K., 1995. A Manual of Ethnobotany 2nd edition.

Online Resources:

- http://www.gallowglass.org/jadwiga/herbs/preparations.html
- http://shawnacohen.tripod.com/thetribaltraditions/id51.html

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	M	S	S
CO2	S	S	S	M	S
CO3	S	S	M	S	M
CO4	S	S	M	S	S
CO5	S	S	S	S	M

*S- STRONG, M- MEDIUM, L- LOW

Semester IV

CORE COURSE V – CYTOLOGY, GENETICS AND EVOLUTION

Course Code : 18UBT5 ◇ Hrs / week : 5 ◇ Credit : 4 ◇ Marks : 25 + 75 = 100

Objectives:

- To study the progress made in the field of cell, cell organelles and their functions.
- To understand the principle, the hereditary mechanism, the structure and functions of genetic materials.

Course outcomes:

- To study the cell wall content of plant cell.
- Understanding the ultra-structure of various organelle.
- Students are able learn about Mendelian principles.
- They will know about linkage and crossing over, mutation theories.
- Imparting knowledge on Evolution & Emergence of evolutionary thoughts.

Unit I – Ultra structure of cell organelles

Ultra structure of a Plant cell, Cell wall, Plasma membrane. Cell organelles – Strucrture and functions of Endoplasmic reticulum, Golgi complex, Chloroplast, Mitochondria, Nucleus, Lysosome and Ribosomes.

Unit II – Genetic material

Chromosomes – Morphology, Structure of Polytene, Lampbrush and B-Chromosomes. Nucleic acid – Structure and types of DNA and RNA, Nucleosomes. Cell division – Amitosis, mitosis and meiosis. Cellular inclusions - Starch grains, Aleurone grains, Inulin Crystals, Raphides and Cystoliths.

Unit III – Mendelian genetics

Mendelian genetics – Mendel's laws of inheritance –Monohybrid, Dihybrid Cross. Interaction of genes. Incomplete dominance and Complementary genes, interaction of genes- Epistasis and lethal genes. Multiple alleles. ABO blood group in man.

Unit IV – Determination of sex

Linkage and crossing over, chromosomes mapping, Cytoplasmic inheritance : Mitochondria- male sterility in maize. Sex determination in plants. Mutations: Chromosome aberrations. Polyploid types- aneuploids, euploids and allopolyploids.

Unit V – Theories of evolution

Introduction – Germplasm theory – Lamarckism - Neo-Lamarckism – Darwinism - mutation theory of devries - Natural selection - variation – speciation - species concept. Population genetics – gene pool, gene frequency and Hardy–Weinberg law. Factors affecting gene frequencies.

Text Book:

- Verma, P.S. & V.K. Agarwal, 2003, Genetics. S. Chand & Co.Ltd., New Delhi.

References:

- Freifelder, D. 1987. Essentials of Molecular Biology, Jones & Bartlett, Boston.
- Gardner, EJ., Simmons, MJ. & Snustad, D. 1991. Principles of Genetics, John Wiley & Sons Inc., 8th Edn., New York.
- Sinnott, EW., Dunn, LL. & Dobzhansky, T. 1997. Principles of Genetics, Tata Ma Graw Hill Publishing Co., New Delhi.

E–Books:

- https://onlinelibrary.wiley.com/doi/book/10.1002/9781118313718
- https://www.springer.com/in/book/9783642879302
- https://trove.nla.gov.au/work/16054012?q&sort=holdings+desc&_=1527503199193&versionId=23683670
- https://www.amazon.com/Chromosome-Atlas Flowering...Darlington/dp/B0014B1YJA

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	M
CO4	S	S	S	M	S
CO5	S	M	M	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester IV

CORE PAPER VI – PRACTICAL II – ANATOMY, EMBRYOLOGY, CYTOLOGY, GENETICS

Course Code : 18UBT6P ◈ Hrs / week : 3 ◈ Credit : 4 ◈ Marks : 40 + 60 = 100

Course outcomes:

- Experiencing in handling specimens and preservation of Angiosperms.
- Imparting knowledge on plant anatomical characters.
- Acquiring knowledge on Mental laws of genetic variations
- Understanding embryonic development in angiosperms
- Acquiring knowledge in plant breeding methods.

Anatomy

- Study of simple and complex tissues by using permanent slides.
- Study of primary structure and sectioning of Dicot stem, root, leaf, Monocot stem, root and leaf.
- Normal secondary thickening in Dicot stem and root.
- Anomalous secondary structures – *Achyranthus*, *Boerhaavia*, *Dracaena*. (Permanent slides)
- Stomatal types: Anomocytic, Anisocytic, Paracytic, Diacytic and Graminaceous. (Peel out From leaf).

Embryology of Angiosperms

- Structure of Anther (Young and Mature from *Datura* or Cassia flower)
- Types of ovules: Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous. (Permanent slides).
- Stages in Microsporogesis and Megasporogensis (Permanent slides onion flower Bud).
- Structure of Male gametophyte and Female gametophyte (Permanent Slides/photographs).
- Dissection of embryo and observe the globular and Heart shape
- Structure of Endosperm. Nuclear (Coconut water) cellular endosperm (Cucumber seed)

Cytology

- To observe the plant cell structure with onion epidermal peel out.
- Study of the photomicrographs of cell organelles
- Starch grains (Potato), Inulin Crystals(potato), Raphides (Petiole –Colacasia/ Nymphaea) and Cystoliths –(leaf peel out -Ficus/Momordica).
- Study the polytene and lamp brush chromosome structure through photograph
- Identification of different stages of mitosis by using squash and smear techniques – Onion Root tip.

Genetics

- Simple problems of monohybrid and Dihybrid ratios and factor interaction
- Construction of chromosome map – three point test cross

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	M	S	S	S	S
CO4	S	S	S	S	M
CO5	S	M	S	M	S

*S- STRONG, M- MEDIUM, L- LOW

Semester V

CORE COURSE VII – MORPHOLOGY AND TAXONOMY OF ANGIOSPERMS

Course Code : 18UBT7 ◈ Hrs / week : 4 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Objectives:

- To observe the variations among plants, especially angiosperms.
- To understand the way of description of a plant.
- To study the floral characters with an aim to identify the taxa authentically.

Course outcomes:

- Students can bale to recognize morphological charaters of vascular plants and they had the ability to identify the plant.
- They will study the floral parts of the parts of the plants
- Gaining proficiency in the use of keys and identification manuals for identifying any unknown plants to species level.
- Students learn the economic importance of flowering plants
- They can able to know the characteristics of angiospermic plants

Unit I – Morphology of leaf, root, stem

The plant body (Parts). Root types and Modification. Stem – Types Aerial and underground Stem modification. Leaf Morphology – Types, Venation, Phyllotaxy

Unit II – Morphology of flower and fruit

Inflorescence: Racemose types - Cymose types - Special type. Morphology of flower- Flower modified as shoot, floral parts and their arrangement, aestivation and placentation types- Floral Diagram and Floral Formula. Fruits: Types and classification

Unit III – Classification of Angiosperms

Binomial nomenclature, Systems of classification – Bentham & Hooker; Engler & Prantle. Merits and demerits of natural systems of classification. Herbarium - Preparation and advantages.

Unit IV – Features of Angiospermic families

Diagnostic characters and Economic Importance of the following Families:
Polypetalae: Cruciferae, Capparidaceae, Tiliaceae, Rutaceae, Anacardiaceae, Leguminosae (Fabaceae, Caesalpiniaceae, Mimosoideae) and Cucurbitaceae.

Unit V – Features of Angiospermic families

Gamopetalae: Rubiaceae, Asteraceae, Asclepiadaceae, Apocynaceae, Solanaceae, Acanthaceae, Verbenaceae, Labiatae and Convolvulaceae. **Monochlamydeae**: Amaranthaceae and Euphorbiaceae. **Monocotyledanae**: Gramineae and Cyperaceae.

Text Books:

- Jeffrey, C. 1982. An Introduction to Plant Taxonomy, Cambridge University Press, UK.

- Pandey, BP. 1999. Taxonomy of Angiosperms, S.Chand & Co. Ltd., New Delhi.
- Gurcharan Singh, 2004. Plant Systematics: An Integrated Approach, Science Publishers Inc., New Hampshire, USA.

References:

- Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
- Harborne, JB & Turner, BL. 1984. Plant Chemosystematics, Acad. Press, London.
- Lawrence, GH. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.
- Samuel, BJ & Arlene, EL. 1987. Plant Systematics, Mc Graw Hill Inc. New York.

E–Books:

- https://www.abebooks.co.uk/servlet/BookDetailsPL?bi=20569837712&searchurl=tn%3Dhandbook%2Bof%2Bthe%2Bbritish%2Bflora%26sortby%3D17%26an%3Dbentham%2Bg&cm_sp=snippet-_-srp1-_-title1
- https://trove.nla.gov.au/work/16054012
- https://books.google.co.in/books/about/A_Text_Book_Ofbotany_Plant_Anatomy_and_E.html?id=uMOglvnKUpQC&redir_esc=y

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	M	M	M	S
CO5	S	S	M	M	S

*S- STRONG, M- MEDIUM, L- LOW

Semester V

CORE COURSE VIII – ECOLOGY AND PHYTOGEOGRAPHY

Course Code : 18UBT8 ◇ Hrs / week : 4 ◇ Credit : 4 ◇ Marks : 25 + 75 = 100

Objectives:

- To understand the basic concepts of ecosystem and biodiversity.
- To study the principle of sustainable utilization and management of bioresources.

Course outcomes:

- Understanding the ecological relationships between organisms and their environment.
- Students can obtain the knowledge on key concepts in evolutionary biology, the history of life on Earth, and phylogenetic relationships between organisms.
- They can able to understand the structure/function relationships in organisms.
- Gain the knowledge about Principles of Phytogeography
- Gather the information on plants distributed in India

Unit I – Principles of Ecology

Approaches to the study of ecology – Autecology – Synecology – Population, Community. Climatic Factors (Light factor, Temperature factor, Wind factor). Edaphic Factors (Soil, Topography, Minerals).

Unit II – Structure and function of Ecoystem

Ecosystems - components, Types of Ecosystem – aquatic (Pond), terrestrial (Grass land and Forest), Dynamic of eco systems – Food chain, Food web, Ecological pyramid, Primary and Secondary production, Energy flow in Ecosystem,

Unit III – Habitat Ecology

Morphological and Anatomical adaptation of Hydrophytes (Hydrilla, Nymphaeae), Mesophytes (Hibiscus, Mangifera) and Xerophytes (Cactus, Nerium), Halophytes (Rhizophora), Parasites (Cuscuta) and Epiphytes (Vanda).

Unit IV – Principles of Phytogeography

Phytogeography – Principles relating to distribution of plants, age and area hypothesis. Dispersal and migration, concept of Barriers, Continental drift, endemism, plant indicators.

Unit V – Plant distribution in India

Vegetational types of India - Tropical Rain forest, shola and deciduous forest - sand dunes, mangroves and scrub jungle, Phytogeographical regions of India. Remote sensing for vegetation analysis.

Text Book:

- Sharma P.D, 2009. Ecology and Environement, Rastogi Publications, Meerut.

References:

- Odum, E.P., 1970. Fundamentals of Ecology, 3rd edn, W.B. Saunders Ltd., UK.
- Melchias G 2001 Biodiversity and Conservation. Science Publishers Inc, NH USA.
- Krishnamurthy K.V. 2003. An advanced text book on Biodiversity Principle and Practice. Oxford and IBH Publishing Co., New Delhi.

E–Books:

- http://rastogipublications.com/index.php?route=product/product&product_id=216&search=ecology&category_id=20
- https://www.schandpublishing.com/books/higher-education/biology/a-textbook-plant-ecologyincluding-ethnobotany-soil-science/9788121905480/#.W0LsiNIzbIU

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	M	S	M	S
CO3	M	S	S	S	S
CO4	S	S	S	M	S
CO5	M	S	M	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester V

CORE COURSE IX – MICROBIOLOGY & PLANT PATHOLOGY

Course Code : 18UBT9 ◇ Hrs / week : 5 ◇ Credit : 4 ◇ Marks : 25 + 75 = 100

Objectives:

- To study the different types of micro-organisms and their activities.
- To understand and exploit their potentialities in agriculture, industry and other environmental aspects.
- To study the etiology and control of various plant diseases.

Course outcomes:

- To get knowledge about classification, characteristics, ultra structure of Prokaryotic and Eukaryotic microbes
- They can apply an appropriate microbiology laboratory techniques, methodologies, instruments and equipment in accordance with current laboratory safety protocol.
- Students can able to get the knowledge about organisms and causal factor responsible for plant diseases & methods of studying plant diseases.
- They can familiarize with some common plant diseases of India
- Students gaining knowledge on Host parasite interaction process

Unit I – Classification of microbes

Microbiology: Histroy and scope. classification of microorganisms – Whittaker's five kingdom concept – Bergey's manual of systematic bacteriology – outline only- Morphology, cell structure, nutrition and reproduction of bacteria.

Unit II – Structure and culture of microbes

Viruses – structure, classification and multiplication. Bacteria: Morphology, Ultra Structure, Nutrition, Respiration and Multiplication of Bacteria. Recombination of Bacteria - Transformation, Conjugation and Transduction.

Unit III – Application of microbes

Methods in microbiology: Staining methods (simple, differential and special staining); methods of sterilization (physical and chemical); types of culture media; pure culture methods (streak plate, spread plate and pour plate); bacterial motility; methods for enumeration (direct and indirect); bacterial growth curve.

Unit IV – Principles of pathology

Plant Pathology: History and importance of plant pathology. Identification of plant disease – Koch's postulates. Host-parasite interaction – Commensalism, Amensalism and Mutualism. Methods of Control of Plant disease- Cultural, Chemical and Biological methods.

Unit V – Plant diseases in crop plants

Plant Diseases – Definition. Study of plant diseases with respect to symptoms, causal organism, disease cycle and their management: Rice – blast disease; Banana – bacterial leaf blight, Citrus – bacterial canker; Groundnut – Tikka disease; Sugarcane - red rot.

Research in Plant Pathology - Contribution of Indian Plant Pathologists: Rangasami, G. Contribution of Research institutes – IARI (Indian Agricultural Research Institute).

Text Books:

- Pelczar, J., Chan, ECS & Krieg, R. 1999. Microbiology, Tata McGraw Hill, New Delhi.
- Sullia, SB & Shantharam, S. 2005. General microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Mehrotra R.S., 1994, Plant pathology, Tata Mc Grew publishing company Ltd.

References:

- Casida, LE.1989. Industrial microbiology, Wiley Eastern, New Delhi.
- Dubey, RC & Maheshwari, DK. 2004, A text book of microbiology.
- S. Chand & Company Ltd., New Delhi.
- Fraziel, NC.1974. Food Microbiology, II Edn., Tata McGraw Hill, New Delhi.
- Martin Alexander. 1978. Introduction to Soil Microbiol, Wiley Eastern, New Delhi.
- Rangasamy G. 1998. Diseases of crop plants in India. Prentice- Hall of India, New Delhi
- Harsfall JG & Cowling E B. 1979. Plant Disease, an advanced Treatise. Academic Press, NY.
- Mukherjee KG and Jayanti Bhasin, 1986. Plant diseases of India. Tata MacGraw-Hill Publishing Company Ltd. New Delhi.

E–Books:

- http://rastogipublications.com/index.php?route=product/product&product_id=69&search=microbiology
- https://www.schandpublishing.com/books/higher-education/biology/a-textbook-microbiology/9788121926201/#.W0LwytIzbIU

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	M	S	M	S
CO3	S	S	S	S	S
CO4	S	S	S	M	S
CO5	S	S	M	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester V

ELECTIVE COURSE I – FORESTRY AND NURSERY TECHNIQUES

Course Code : 18UBTE1 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To prepare students for careers in the forest services.
- To educate students to provide technical expertise to the establish nurseries.

Course outcomes:

- Students can able to learn the forest types and their utilization
- Students will get the ability to evaluate human dimensions of sustainable forest management, including the diverse universe of forest stakeholders, perspectives, and policies
- They can able to develop and implement well-justified forest management strategies that address a diversity of objectives at spatial scales ranging from stands to the entire planet.
- Students can develop their skills on the preparation of nursery bed and techniques.
- Experiencing in nursery techniques

Unit I – Types of forests

Forest – types in India. Silviculture – objectives – Silviculture technique for some important species – *Casuarina equisetifolia, Eucalyptus sp., Tectona grandis, Bamboo sp.* And *Azadirachta indica.*

Unit II – Principles of forestry

Fundamental principles of forest economics – Socio – economic analysis of forest productivity – forest valuation – role of ICFRE (Indian council for Forest Research and Education) in research and education. Indian forest act and its amendments. Objectives and principals of forest management.

Unit III – Protection of forestry

Role of Forest Protection in Indian Forestry - Injuries caused by human being - Animals - Insects - Birds - Adverse climatic factors. Injuries caused by plants - Forest fire. Fire protection methods. Integrated pest management methods.

Unit IV – Development of forest

Definition - Objectives of agroforestry - Classification of agroforestry systems - Allelopathy - Social forestry - its components and implementation at local and national levels - social attitudes and community participation- choice of species for agro and social forestry.

Unit V – Management of nursery

Procurement of polypots, manure, clay and sand. Preparing seed beds – sowing seeds in poly pots and beds, transplanting, potting; irrigation, weeding, mulching, protection from pests and diseases.

Text Books:

- De Vere Burton L., 2000, Introduction to Forestry Science, Delmar publishers, N Y.

- J.L. Bowyer, R. Shmulsky and J.G. 2007. Haygreen. Forest Products and Wood Science: An Introduction, Blackwell Publishing Professional.

References:

- Negi, S.S., 1994, India's Forests, Forestry and Wildlife, Indus Publishing Com., New Delhi.
- Jha, L.K., 1996. Forestry for rural development, APH Publishing Corporation, New Delhi.

  Gopalswamy Iyyangar, 1970. Complete gardening in India, Kalyan Printers, Bangalore.

E–Books:

- https://www.amazon.com/Forest-Products-Science-Rubin-Shmulsky-ebook/dp/B0051BLT8A

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	M	S
CO2	S	M	S	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	M	S	M	S	M

*S- STRONG, M- MEDIUM, L- LOW

Semester V

ELECTIVE COURSE I – MUSHROOM CULTIVATION

Course Code : 18UBTE1 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To facilitate self-employment.
- To know the nutrient value of mushroom.

Course outcomes:

- know about nutritional and medicinal value of edible mushrooms & Poisonous
- Mushrooms
- They can learn about the Cultivation techniques of White button mushroom and Oyster Mushroom
- Gaining knowledge on the present status of mushroom industry in India.
- Motivation to be become entrepreneur in mushroom business.

Unit I – Importance of mushrooms

Introduction, History and Scope - Mushroom cultivation in India. Edible and Poisonous Mushrooms - characters of vegetative and fruit body. Nutritional and medicinal value of mushrooms.

Unit II – Techniques in mushroom cultivation

Spawning techniques: Isolation and culture of spores, Preparation of culture media. Developing mother spawn, large scale production of spawn.

Unit III – Cultivation of mushrooms

Cultivation technology of button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea*).

Unit IV – Storage techniques

Mushroom farm and the lay out- culture room, harvesting room. Post-harvest and Storage methods - Short term and long term storage methods and marketing

Unit V – Marketing of mushrooms

Economics of cultivation: Cost economics – Permanent medium scale mushroom farm. Mushroom recipes-soup, cutlet, vegetable curry, samosa, omlette and pulao.

Text Book:

- Nita Bahl, Handbook on Mushrooms, S.Chand & Co. Ltd.

Reference:

- Dubey, RC. A text book of biotechnology, S.Chand & Co. Ltd.
- Alice, D., Muthusamy and Yesuraja, M. (1999). Mushroom Culture. Agricultural College, Research Institute Publications, Madurai.
- Marimuthu, T. et al . (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.

- Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
- TewariPankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
- Tripathi, D. P. (2005). Mushroom Cultivation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

E–Books:

- https://www.amazon.in/Mushroom-Production-Processing-Technology-IST/dp/8177540068?channel=dyn%7Bifmobile%3Amobile%7D%26placement%3D%7Bplacement%7D%26target%3D%7Btarget%7D%26campaignid%3D%7Bcampaignid%7D&tag=googinremarketing54-21

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	M	M	S
CO2	S	M	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	M	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester V

NON–MAJOR ELECTIVE II – MEDICAL BOTANY (1 Year)
(For Zoology students)

Course Code : 18UBTN2 ◈ Hrs / week : 4 ◈ Credit : 2 ◈ Marks : 25 + 75 = 100

Objectives:

- To study the different systems of Indian medicines and the bioactive principles.
- To know the ethnopharmacological importance of medicinal plants.

Course outcomes:

- Know about history and relevance of herbal drugs in Indian system of medicine.
- Learn the macroscopic and microscopic characters, chemical constituents, adulterants, therapeutical and pharmaceutical uses of medicinal plants
- Students can learn the drugs obtained from plants
- They can understand the techniques for drug evaluation (Chemical, Physical and Biological), Phytochemical investigations, standardization and quality control of herbal drugs
- Students acquire the knowledge on the technique of medicinal gardening - Cultivation practices, and preparation and marketing of herbal preparations.

Unit I – Traditional system of medicine

History and scope and Classification of medicinal plants and properties – Ayurveda, Siddha, Homeopathy and Unani – Definition of medical terms – role .

Unit II – Cultivation of medicinal plants

Herbal gardens – conservation – propagation of medicinal plants – chemical constituents and medicinal uses of the following medicinal plants - *Ocimum, Azadirachta, Aloe, Phyllanthus*. Cultivation – processing – storage – marketing and utilization of medicinal plants.

Unit III – Science of medicinal plants

Pharmacognosy – classification of drugs – chemistry of drugs – *Gingiber, Withania, Coriandrum, Cinchona.*

Unit IV – Herbal drugs and their actions

Drugs – type and classification - aromatherapy. Phytochemistry – active principles from the following medicinal plants: *Ricinus communis* (laxatives), *Datura metal* (drug acting on nervous system), *Cardiospermum halicacabam* (Anti rheumatics).

Unit V – Herbal preparations

Making infusion and decoctions, lotions and washes – insect repellents, tincture – herbal syrups, compresses and plasters, liniments, herbal oils and ointments.

Text Books:

- James Green, 2000 Herbal Medicine-Maker's Handbook, Crossing Press, U.S.

- Weiss, Rudolf Fritz 2000 Herbal Medicine, 2nd Edition Thieme Medical Publishers.
- S. Somasundaram 1997. Maruthuva Thavaraiyal, Ilangovan Padhippagam, Palayamkottai.
- Kokate CK, Purokit AP and Gokahale, 2006. Pharmacognosy, Nirali Prakashan.
- S. Anbazhakan, Plant systematic and Medical Botany

References:

- Kumar NC *An Introduction to Medical Botany*. Emkay Publications, New Delhi.
- Roberts *Pharmacognosy* K.M. Vergheese Co. Bombay.
- Wallis TE *Text Book of Pharmacognosy*. R.S. Publishers, New Delhi.
- Shah CS and Qudry JS *A text book of Pharmacognosy*. BS Shah Prakasm, Ahmedabad.
- Afol CK and Kapur BM *Cultivation and utilization of Medicinal Plants*. CSIR, Jammu.
- Jown SK *Glimpses of Ethnobotany* Oxford & IBH, New Delhi.
- Hartman HT and Kester DE *Plant propagation – principles and practices*. Prentice Hall, New Delhi.
- Bhattachariee SK *Hand Book of Medicinal Plants*. Pointer Publications, Jaipur.

Online Resources:

- http://www.gallowglass.org/jadwiga/herbs/preparations.html
- http://shawnacohen.tripod.com/thetribaltraditions/id51.html
- h t t p: / / www. va su n dh a r a or i ssa . org/ Rese a r ch %20Repor t s/ GlobalisationAndMedicinalplantsOfOrissa.pdf
- http://www.emea.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003393.pdf
- http://www.bookganga.com/eBooks/Books?AID=5600445540161494332

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	S	S
CO2	S	M	S	S	S
CO3	S	M	S	S	S
CO4	S	S	S	S	S
CO5	M	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

CORE COURSE X – HORTICULTURE AND PLANT BREEDING

Course Code : 18UBT10 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- This course is designed to provide theoretical knowledge about the gardening to enable them to be self reliant knowledge and self employment.
- To study the importance of plant breeding in food production.
- To understand the methodology of plant breeding.

Course outcomes:

- Students can able to learn the importance of horticulture – career and occupational opportunities
- They will know about organic forming
- They can learn the techniques of irrigation and application of pesticides.
- Understanding the merits and demerits in clonal selection and pure line selection.
- Adding knowledge about applications of plant breeding.

Unit I – Importance management of Horticulture

Importance and scope of horticulture. Division of horticulture. Tools in horticulture. Soil and climate, irrigation methods and application of fertilizers in the field.

Unit II - Principles of gardening

Vegetable gardens. kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Principles of organic farming.

Unit III – Development of new plant

Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. Plant reproduction- Types: vegetative (cuttings, grafting, budding, layering).

Unit IV – Principles of plant breeding

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods- pureline and mass selection for self pollinated, cross pollinated and vegetatively propagated plants.

Unit V – Applications of plant breeding

Hybridization: Self pollinated, Cross pollinated and vegetatively propagated plants – Procedure, advantages and limitations. History, genetic basis of inbreeding depression and heterosis; Applications.

Text Books:

- Kumar N., 1990, Introduction to Horticulture, Rohini agencies, Nagercoil.
- Prasad, 2005, Principles of Horticulture, International Book Dept., Deharadun.
- Gupta PK 2002 Cytology Genetics Evolution and Plant Breeding. Deep and Deep Publications, 2002

Reference:

- Chauhan, D.V.S., 1968, Vegetable production in India, Ram Prasad, Agra.
- Edmund J.B. Senn T.L Andrews F.S & Halforce R.G., 1990, Funamentals of Horticulture 14th Edn., Tata McGraw Hill Co. Pvt., London.
- Gopalaswami Iyengar K.S., 1970, Complete Gardening in India, Kalyan Press, Bangalore.
- Chandrasekaran & Parthasarathy, (1990). Cytogenetics and Plant Breeding.
- Sinha,U. and Sinha, S., (1992).Cytogenetics, Plant Breeding and Evolution.
- J. R. Sharma (1996) Principles and Practice of Plant Breeding.
- Chaudhari, H.K., (1995) Revised Ed., Elementary Principles of Plant Breeding.

E–Books:

- https://www.amazon.in/Horticulture-Green-World-Gail-Lang-ebook/dp/B00EOEHY7K/ref=sr_1_7?s=digital-text&ie=UTF8&qid=1531113481&sr=1-7&keywords=horticulture
- https://www.amazon.in/Gardening-Beginners-Perennial-Vegetables-Horticulture-ebook/dp/B01GF3UI9S/ref=sr_1_3?s=digital-text&ie=UTF8&qid=1531113444&sr=1-3&keywords=horticulture

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	S	S	S	S	S
CO4	S	M	S	S	S
CO5	S	S	M	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

CORE COURSE XI – PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS

Course Code : 18UBT11 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To study the recent aspects of various physiological processes in plants.
- To understand the application of physiology in agriculture.
- To fathom the chemical environment and the dynamics of the biological system.
- To elucidate the interrelationships of the various pathways.
- To understand how physical principles are applied to biological system.

Course outcomes:

- Students can able to know about the mechanisms of mineral nutrition for plant growth.
- They can understand the process of Photosynthesis, Respiration and Nitrogen metabolism
- Imparting knowledge about the Plant Growth hormones.
- Students will able to understood the structure and functions of primary metabolites.
- Know the principles of biophysics

Unit I – Relationship between plants & water

Introduction - Water potential and its components. Osmosis, Diffusion, Diffusion pressure deficit, Plasmolysis, Imbibition, Absorption - Mechanism of absorption, Active and Passive absorption, Ascent of sap. Transpiration - Types, Guttation, Stomata - Mechanism of stomatal action. Photoperiodism.

Unit II – Manufacturing of energy

Photosynthesis: Photosynthetic apparatus, pigments, Action and absorption spectrum, Light reaction – Non-cyclic and Cyclic Photophosphorylation, Dark reaction - Calvin cycle, Hatch & Slack pathway, CAM pathway – Factors affecting photosynthesis.

Unit III – Utilization of energy

Respiration - types of respiration, respiratory substrates, Mechanism of respiration, Glycolysis, Kreb's cycle, Electron transport pathway, Factors affecting respiration. Plant growth regulators - Structure and Physiological role of Auxins, Gibberellins, Cytokinins, Abscissic acid and Ethylene.

Unit IV – Primary metabolites

Carbohydrates: importance, classification, structure and properties. Amino acids and Proteins: importance, classification and structure. Lipids: importance, classification, structure and properties.
Enzymes: nomenclature, classification. Structure and properties. Mechanism of enzyme catalysis and enzyme inhibition.

Unit V – Principles in Biophysics

Physical forces and chemical bonds – Bioenergetics – Thermodynamics laws - Nature of lights – Solar radiation – Absorption and emission of light by pigments.

Text Books:

- Pandey, S.N. & Sinha, 2010, Plant Physiology, Vikas Publishing, New Delhi.
- Stryer Lubert, 2005, Biochemistry, W.H. Freeman & Co., NY
- Pranab Kumar Banerjee (2008) Introduction to Biophysics S. Chand, New Delhi.

Reference:

- Noggle, G.R. and Fritz, G.J. 2001, Introductory Plant Physiology, Prentaice - Hall, India.
- Devlin, R.M., 2000, Plant Physiology, Affiliated East West Press Pvt. Ltd.
- Epstein, E., 2000, Mineral Nutrition in Plants-Principles and Perspectives, Wiley.
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- Apps et al., 1992, Biochemistry, ELBS.
- Caret et al., 1993, Inorganic, Organic and Biological Chemistry, WMC Brown, USA.
- Rawn, David, 1989, Biochemistry, Neil Patterson USA.
- R.N. Roy A text book of biophysics. New Central Book Agency Pvt. Ltd, Calcutta.
- Mohan Arora Biophysics. Himalaya Publishing House, Bangalore.

E–Books:

- www.divbiolchem.org
- www.ercenzymes.com
- http://rastogipublications.com/index.php?route=product/product&product_id=113&search=plant+physiology
- https://www.schandpublishing.com/books/highereducation/biology/fundamentals-plant-physiology/9789352533343/#.W0LymtIzbIU

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	M	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

CORE COURSE XII – BIOTECHNOLOGY

Course Code : 18UBT12 ◈ Hrs / week : 4 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Objectives:

- To study the emerging trends in biotechnology such as gene therapy, DNA finger printing and molecular cloning
- To enumerate the role of 21st century science, biotechnology in increasing productivity of crop plants, to enhance the production of high value metabolites.

Course outcomes:

- Students will learn the techniques in biotechnology.
- Students are able to understand the gene cloning techniques
- Know about the techniques of tissue culture
- They will get the ability to explain– Industrial and Environmental process
- Students konw the patenting procedures for patenting biological products.

Unit I – Techniques in Biotechnology

Introduction: Definition, Scope and importance of Biotechnology, DNA structure – replication. Genetic engineering: Tools of genetic engineering – restriction enzymes, DNA ligase. Plasmids and cosmids. Polymerase chain reaction.

Unit II – Techniques of gene cloning

Procedure for gene cloning, isolation of specific genes, Methods of direct gene transfer – Particle bambardment, Electroporation, Micro injection and Liposomes. Screening of recombinant.

Unit III – Techniques of Tissue culture

Laboratory requirements of plant tissue culture, preparation of culture media and methods of culturing plant tissues- Micropropagation, somatic embryogenesis and somoclonal variations. Protoplast isolation and fusion. GM foods.

Unit IV – Industrial and Environmental Biotechnology

Microorganisms used in Industrial Processes- production of Lactic acid and Alcohol. Immobilized enzymes. Liquid waste treatment – Domestic and Industrial effluent. Biogas production.

Unit V – Criteria in Patenting

Biotechnology and Intellectual property: Intellectual property Rights (IPR) - Patents, Trade Secrets, Copyrights and Trademarks. Plant Genetic Resources. GATT, WTO and TRIPs. Patenteing of Biological materials.

Text Books:

- Anon. 1988. Animal cell Biotechnology, Academic Press, New York.

- Bernard R Glick & Jack J Pasternak. 2001. Molecular biotechnology principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.

References:

- Butler, M. 1987. Animal cell technology, Principles and Products, Open University Press, New York.
- Gamborg, OL & Phillips, GC. 1995. Plant cell, Tissue and Organ culture a Funtamental methods, Narosa publishing House, New Delhi.
- George, EF & Sherrington, PD. 1984. Plant propagation by Tissue culture, Exegetics Limited, London.

E. Books:

- https://www.schandpublishing.com/books/higher-education/biology/a-textbook-biotechnology/9788121926089/
- http://rastogipublications.com/index.php?route=product/product&product_id=57&search=biotechnology

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	M	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

CORE COURSE XIII – PRACTICAL III – MORPHOLOGY AND TAXONOMY OF ANGIOSPERMS, ECOLOGY AND PHYTOGEOGRAPHY AND MICROBIOLOGY AND PLANT PATHOLOGY

Course Code : 18UBT13P ◈ Hrs / week : 3 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Course outcomess:

- Experiencing in handling specimens and preservation of Angiosperms.
- Imparting knowledge on identification characters of Angiosperms.
- Acquiring knowledge on developing taxonomy keys for plant identification.
- Understanding microbiology techniques for culturing process.
- Acquiring knowledge plant disease control and prevention methods.

Morphology and Taxonomy of Angiosperms

- Describe the plant parts with suitable plants- Technical term habit, habitat form, types of leaves, with leaf shape, margin, texture, modification of leaf.
- Study the Types and modification of root and stem with suitable example Identify the following inflorescence and fruits: a) Inflorescence - Simple raceme, Spike, Corymb, Head, simple cyme, Cyathium and Hypanthodium. b) Fruits - Simple: Berry, Drupe, Pepo, hesperidium. (Indehiscent) – Nut. Dry- Legume, capsule (loculicidal). Aggregate
- Floral formula from floral description.
- Identify the families mentioned in the syllabus by noting their vegetative and floral Characters.
- Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family
- Study the products of plants mentioned in the syllabus of economic importance with Special reference to the morphology, botanical name and family.
- Prepare herbarium of 20 plants with field notes (internal assessment).
- Conduct Botanical tour for a minimum of 3 to 5 days under the guidance of a teacher and Submit field report.

Ecology and Phytogeography

- Study of morphological and anatomical adaptations of Hydrophytes, Xerophytes.
- Diagrammatic presentation of Food chain, Food web, Ecological pyramids and Pond ecosystem.
- Determination of BOD in different water samples
- Determining frequency, density and abundance of different species in plant community of the quadrat
- Phytogeographical regions of India.

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S

CO2	M	S	M	S	S
CO3	S	S	S	M	S
CO4	S	S	M	S	S
CO5	S	M	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

CORE COURSE XIV – PRACTICAL IV – PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS, HORTICULTURE AND PLANT BREEDING AND BIOTECHNOLOGY

Course Code : 18UBT14P ◈ Hrs / week : 3 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Course outcomes:

- Experiencing in handling laboratory equipment and apparatus.
- Imparting knowledge on experimental work in plant physiology.
- Acquiring knowledge on practical demonstration of plant physiological activity.
- Deep Understanding methods of qualitative and quantitively study for biochemical compounds
- Learning plant breeding and biotechnology tools.

Plant Physiology

Experiments to be performed by each student

- Determination of osmotic potential of plant cell sap by plasmolytic method.
- Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
- To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
- Measurement of rate of transpiration using Ganong's photometer
- Study of effect of wavelength of light on photosynthesis using Wilmott's bubbler
- Study of the effect of varying concentration of CO2 on photosynthesis
- Separation of photosynthetically active pigments using paper chromatography

Experiments for demonstration

- Ganong's respirometer
- Anaerobic respiration
- Clinostat

Biochemistry

- Estimation of starch by anthrone method
- Colorimetric estimation of chlorophyll pigments
- Estimation of oil in different oil seeds
- Colorimetric estimation of proteins (Lowry / Bradford method)
- Demonstration of the activity of peroxidase.

Biophysics

- Principle and applications of pH meter. Centrifuge. Colorimeter. Electrophoresis.
- Spectrophotometer.

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	M	S	S	S
CO4	M	S	S	S	S
CO5	S	M	S	S	M

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

ELECTIVE COURSE II – BIOSTATISTICS AND BIOINFORMATICS

Course Code : 18UBTE2 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To learn the basics of statistics in Biological context.
- To apply the statistical principles in designing Biological experiments and solving biological problems.
- To know the various databases available.
- To learn sequence analysis.

Course outcomes:

- Learning basics of statistics and sampling techniques
- Students acquiring knowledge on the collection of data and interpretation.
- They get knowledge on the measures on Measures of central tendency.
- They will learn the basics of computer
- Students understanding the applications of bioinformatics

Unit I – Introduction to Biostatistics

Definition and Scope. Population and Sample, Sampling techniques-Random sampling. Frequency Distribution- Discrete and Continuous. Variables, measurements, functions, limitations and uses of statistics.

Unit II – Sampling of data

Collection of data primary and secondary -types and methods of data collection procedures -merits and demerits. Classification -tabulation and presentation of data -sampling methods.

Unit III – Analysis of data

Measures of central tendency -mean, median, mode, geometric mean –merits & demerits. Measures of dispersion -range, standard deviation, mean deviation, quartile deviation -merits and demerits; Co-efficient of variations. Correlation-types and methods of correlation. Test of Significance- Chi Square test for goodness of fit.

Unit IV – Basics of Computer

History of Computers, Types of Computers, Basic Computer Concepts, Computer Network (LAN, WAN), Data – Representation, Number Systems-binary, arithmetic, Operating System– Windows. Word Processing Software MS Office- Word, Excel and Power point.

Unit V – Applications of Bioinformatics

Definition and scope. Role of Internet in Bioinformatics. Biological database(Primary) Nucleotide sequence database(EMBL and NCBI). Protein sequence database(PIR, Swiss-PROT). Bioinformatics role in Human genome project and Arabidopsis thaliana.

Text Books:

- Nageswara Rao, G. 1983. Statistics for Agricultural Science Oxford & IBH Publishing company
- Attwood T.K. and Parry Smith D.J (1999), Introduction to Bioinformatics, Addison Wesley congman Ltd., England.

References:

- Gupta, S.P. 2008. Elementary Satistical Methods Sultan Chand & Sons, New Delhi.
- Ramakrishnan, P (2001) Biostatistics, Saras Publication, Nagercoil
- Arora PN and Malhon PK (1996) Biostatistics, Imalaya Publishing House, Mumbai
- Palanichami S and Manoharan M Statistical methods for biologists, Paramount publications.
- David W Mount (2001) Bioinformatics, Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
- Baxevanis AD and Francis BF (2001) Bioinformatics - A practical guide to the analysis of genes and proteins, Wiley Interscience.
- Rashidi HH and Buchler LK (2002) Bioinformatics, Basics, Applications in Biological Sciences and Medicine, CRC Press, London.
- Higginns D and Taylor (2000) Bioinformatics – sequence, structure and databanks – a practical approach, Oxford University Press.

E–Books:

- https://www.flipkart.com/research-methodology-methods-techniques-new-2018/p/itmfysawfghm7hzs?gclid=EAIaIQobChMIu5_2gaaR3AIVh4BwCh1Ufg44EAAYASABEgKpTfD_BwE&pid=9789386649225&lid=LSTBOK9789386649225FJU4RT&marketplace=FLIPKART&cmpid=content_book_8965229628_gmc_pla&tgi=sem%2C1%2CG%2C11214002%2Cg%2Csearch%2C%2C272257559753%2C1o1%2C%2C%2Cc%2C%2C%2C%2C%2C%2C%2C%2C&s_kwcid=AL%21739%213%21272257559753%21%21%21g%21295092701166%21&ef_id=WQ2IGAAAAISnWVaD%3A20180709053517%3As
- https://www.schandpublishing.com/books/highereducation/sciences/bioinformatics-genomics-proteomics/9789325978553/#.W0L0qdIzbIU
- https://www.schandpublishing.com/books/highereducation/biology/introduction-biostatistics-a-textbook-biometry/9788121923293/#.W0L06NIzbIU

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	M	S
CO2	M	M	M	M	S
CO3	M	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

ELECTIVE COURSE II – NATURAL PRODUCTS AND HUMAN WELFARE

Course Code : 18UBTE2 ◈ Hrs / week : 5 ◈ Credit : 5 ◈ Marks : 25 + 75 = 100

Objectives:

- To know the natural products in our environment and their utilization

Course outcomes:

- Imparting knowledge on application of microorganisms in industry
- Acquiring knowledge on medicinal products from plants
- Gaining knowledge about economically important products from plants
- Understood the medicinal plant's Bioactive components and their potential.
- Acquiring economic values of woody plants

Unit I – Microbes in industry

Application of micro organisms in industry - food, vitamins, enzymes, antibiotics and alcohol.

Unit II – Medicinal products from lower plants

Useful products of Algae (*Spirulina*), fungi (yeast), Gymnosperms- Wood (Pine), Drugs (Ephedrine), antioxidants, (*Green tea.)*

Unit III – Economic products from lower plants

Study of following plants and application of the following products: beverages (coffee), narcotics (poppy), fiber (cotton), oil-seeds (sesame), latex (rubber).

Unit IV – Plants and their actions

Medicinal plants: Bioactive compounds *Azadirachta*, *Withania, Rauwolfia*, and *Ocimum* - their pharmacological applications. Edible plants & their importance: Cereals (Wheat), Beverages (tea), Spices (Clove) fruits (mango)

Unit V – Economic values of woody plants

Traditional and economically important wood plants in India: *Bambusa, Dalbergia, Tectona.*

References:

- Hill AW *Economic Botany*. Tata McGraw Hill, New Delhi.
- Puri GS *Indian Forest Ecology.* Oxford Books and Stationary & Co.,
- Rama Rao SV *Soil Conservation in India*. ICAR, New Delhi.
- Dastur JF *Useful plants of India*. Tarapore.
- Baker GS *Plants and Cultivation*. Mac Millan Co., London.
- Sambamurthy AWS *Economic Botany.*

Online Resources:

- http://www.gallowglass.org/jadwiga/herbs/preparations.html
- http://shawnacohen.tripod.com/thetribaltraditions/id51.html

- h t t p: / / www. va su n dh a r a or i ssa . org/ Rese a r ch %20Repor t s/ GlobalisationAndMedicinalplantsOfOrissa.pdf
- http://www.emea.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003393.pdf
- http://www.bookganga.com/eBooks/Books?AID=56004455401614943332

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	M	S	S	M	S
CO4	S	S	S	S	S
CO5	M	S	M	M	S

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

ELECTIVE COURSE III – BIOINSTRUMENTATION

Course Code : 18UBTE3 ◈ Hrs / week : 4 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Objectives:

- To understand how physical principles are applied to biological system.
- To know the principles and applications of instruments.

Course outcomes:

- Students can able to check calibration on all instruments studied.
- Student can identify the proper careful handling and precautions for all types of instruments.
- Understating the instruments must be intelligently used to minimize errors
- Identifying various techniques and procedures needed with a particular instrument.
- Student will be able to do the calculations necessary with certain instruments.

Unit I – Principles and types of microscopy

Basic principles of Light microscope – Compound microscope, Phase contrast microscope, Scanning and Transmission Electron microscopes. Micrometry. Haemocytometer.

Unit II – sectioning and staining techniques

Microtechnique – preparation for microscopic slides – Whole mount, Smears, Squash. Microtomy: Fixation, Dehydration, Infiltration, Embedding, Sectioning. Stains and Staining techniques – Simple, double and compared staining.

Unit III – Techniques of separation

Centrifugation: Principles, components, mechanism and application of clinical, Refrigerated and ultracentrifuges.

Unit IV – Principles of chromatography

Chromatography: Basic principles, types – Paper, Column, Thin layer. Electrophoresis (SDS –PAGE). Blotting techniques – Southern, Northern and Western Blotting.

Unit V – Analysis of spectra

Principle and Application of Colorimetry and Spectrophotometer. Basic principles of pH meter and its applications.

References:

- Patki L.R, Bhalchandra B.L, Jeevaji I.H.(1987). An introduction to Microtechnique, S.Chand and company (Pvt)ltd, New Delhi
- Marimuthu, R. (2008). Microscopy and Microtechnique. MJP Publishers,Chennai Wilson K, Walker, J. (1994). Principle and techniques of practical biochemistry,4th ed) Cambridge university press, Cambridge
- Palanivelu P (2013). Analytical Biochemistry and Separtion techniques , 20th century publications ,Palkalai nage ,Madurai

- Khan, I.A., and Khannum, A., (1994).Fundamentals of Biostatistics, Vikas Pub., Hyderabad
- Sundar Rao P.S.S and Richard J(2011) introduction to Biostatistics and research methods , PHI learning private Ltd., New delhi
- Johansen, DA (1940). Plant Microtechnique, TATA McGraw Hill Book Co., Ins., New Delhi.
- Peter Gray (1964). Hand book of Basic Microtechnique. McGraw hill publication, New York
- Cooper.TG (1991).The Tools of Bio - chemistry, John Wiley & sons, London
- Dey P.M. and Harborne, JB (2000). Plant Biochemistry Harcourt Asia Pvt. Ltd.
- Plummer DT (2003).An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi

E–Books:

- https://epdf.tips/biotechnology-a-laboratory-course.html
- https://www.amazon.in/Bioinstrumentation-Webster/dp/8126513691

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	M	S	S	M
CO3	S	S	M	S	S
CO4	S	S	M	S	S
CO5	S	S	S	M	M

*S- STRONG, M- MEDIUM, L- LOW

Semester VI

ELECTIVE COURSE III – BIOFERTILIZERS AND BIOPESTICIDES

Course Code : 18UBTE3 ◈ Hrs / week : 4 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Objectives:

- Completion of the course will give an overview of relevance use of microbial biofertilisers and biopesticides.
- To discuss on the impact of products of biological based agriculture.
- To discuss on the importance of sustainable agriculture.

Course outcomes:

- Acquiring general knowledge on biofertilizers
- Expertizing in production of bacterial biofertilizers
- Acquiring knowledge on developing Mycorrhizal biofertilizers
- Understanding the mechanisms of biofertilizers
- Expertizing in large scale production and commercialization

Unit I – General introduction

Biofertilizers - Introduction, scope. A general account of Biofertilizers organisms –Blue Green Algalbiofertilizers- *Azolla* as a biofertilizer - Isolation, Characterization, Mass cultivation and field application.

Unit II – Bacterial biofertilizers

Bacterial biofertilizers - Introduction, types, Isolation, Characterization, Mass production and field application of *Azospirillum*, *Azotobacter*, *Rhizobium* and *Phosphobacteria*.

Unit III – Mycorrhizal as biofertilizers

Mycorrhizal fungi - Introduction, scope. A general account of Ecto, Endo and Arbuscularmycorrhizae - Isolation, characterization and mass multiplication of Arbuscular mycorrhizae and its field application.

Unit IV – Mechanisms of biopesticides

Biopesticides-virus, bacteria and fungi– advantages, isolation, characterization, mechanism of action and application.

Unit V – Commercialization of Biopesticides

Large scale production of biopesticides – NPV, *Trichoderma viride*, *Beauveria bassiana*, *Pseudomonas fluorescens* and *Bacillus thrungiensis.*

Text Book:

- Sharma, A.K., 2003. Biofertilizers for sustainable agriculture, Agrobios.

Reference:

- NIIR Board, 2004. The Complete Technology Book on Biofertilizer and Organic Farming, National Institute of Industrial Research.
- Subba Rao, N.S. 2000 Soil Microbiology. Oxford and IBH Publishing Co. Ltd.

- Verma A and Hock B. 1995. Mycorrhiza. ISBN
- Yaacovokan, 1994 -Azospirillum, CBC press.
- Wicklow, D.T. and B.E. Soderstrom. 1997, Environmental and microbial relationships. Springer ISBN.

E–Books:

- http://ec.europa.eu/agriculture/organic/organic-farming/what-organic_en
- http://attra.ncat.org/organic.html#list
- http://www.epa.gov/agriculture/tbio.html

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	M	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW

Semester I & II

ALLIED COURSE I – BOTANY

(Plant Diversity, Cytology, Genetics, Anatomy, Embryology, Ecology, Evolution, Taxonomy and Physiology)
(For Zoology Students)

Course Code : 18UZOA1 ◇ Hrs / week : 3 ◇ Credit : 5 ◇ Marks : 25 + 75 = 100

Objectives:

- To understand the plant organization, their structure and function
- To understand the various physiological processes in plants
- To understand the external and internal metabolism of plants

Course Outcomes:

- Understanding the importance of Bio resources
- They can describe the characters of families with their economic importance
- Getting good knowledge about descriptive terms used in Taxonomy and classification
- Know about the plant diseases
- Get an overview about the Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.

Unit I – Plant diversity

General characters of algae, fungi, bryophytes, pteridophytes and gymnosperm. Structure and life history of the following genera – *Oscillatoria, Polyporus, Marchantia, Marsilea* and *Cycas.*

Unit II – Anatomy, Embryology, Ecology

Anatomy*:* Tissue (Simple, Complex) Anatomical structure monocot , dicot (Root and Stem)
Embryology : Structure of mature anther, structure of ovule, endosperm types
Ecology : Xerophytes – Nerium. Hydrophytes – Hydrilla,

Unit III –Morphology and Taxonomy

Phyllotaxy, Inflorescence types – Bentham & Hooker system of classification. Systematic floral characters and their economic importance of *Caesalpinaceae, Rubiaceae, Apocynaceae, Euphorbiaceae* and *Poaceae.*

Unit IV – Physiology

Physiology : Absorption water and minerals, transpiration, Photosynthesis, – photophosprilation (cyclic and non cyclic) electron transport system. Respiration – mechanism – glycolysis – Kreb's cycle anaerobic respiration.
Phytohormones : auxins, Gibberellic acid, cytokinins, photoperiodism and vernalization.

Unit V – Cytogenetics and evolution

Cytology : Ultrastructure of plant cell, cell wall, mitochondria, chloroplast, nucleus, Cell division – mitosis and meiosis.

Genetics : Mendal's law of monohybrid and dihybrid. Plant tissue culture and its application.
Evolution: Orgin of life, Lamark, Drawin theories

Text Books:

- Pandey BP. 1998. A Text Book of Botany Vol. II. S Chand, New Delhi.
- Lawrence, G.H.M.,1955, The Taxonomy of Vascular Plants, Central Book Depot., MacMillan, New York.
- Fahn.A. (1989) Plant Anatomy. Maxwell, Macmillan, Singapore.
- Bhojwani, S.S., (1981) Embryology, of Angiosperms, Vikar & Bhatnagar, New Delhi
- Satyanarayana U. 2007. Biotechnology. Books and allied (P) Ltd
- Verma P.S and Agarwal V.K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd
- Pandey, S.N. & Sinha, 2010, Plant Physiology, Vikas Publishing, New Delhi.

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- Pandey, S.N., S.P. Misra and P.S. Trivedi. 2002. A Textbook of Botany. Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
- Heywood, V.H., 1967, Plant Taxonomy. English Language Book Society, London.
- Esau, K., (1953) Plant Anatomy. Jon Willey & Sons Inc, New York.
- Maheshwari, P.,(1988) An Introduction to the Embryology of Angiosperms, McGraw-Hill.
- Pasupuleti M. 2006. Molecular Biotechnology. MJP Publishers
- Noggle, G.R. and Fritz, G.J. 2001, Introductory Plant Physiology, Prentaice Hall, India.
- Devlin, R.M., 2000, Plant Physiology, Affiliated East West Press Pvt. Ltd.

E-Books:

- https://www.abebooks.co.uk/servlet/BookDetailsPL?bi=20569837712&searchurl=tn%3Dhandbook%2Bof%2Bthe%2Bbritish%2Bflora%26sortby%3D17%26an%3Dbentham%2Bg&cm_sp=snippet-_-srp1-_-title1
- https://trove.nla.gov.au/work/16054012
- www.journals.elsevier.com/journal-of-molecular-biology/www.springer.com › Home › Life Sciences › Cell Biology
- www.divbiolchem.org
- www.ercenzymes.com
- http://rastogipublications.com/index.php?route=product/product&product_id=113&search=plant+physiology

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	S	S	S
CO2	S	M	S	S	S
CO3	S	S	M	S	S
CO4	S	M	S	S	M
CO5	M	S	S	M	S

*S- STRONG, M- MEDIUM, L- LOW

Semester I & II

ALLIED PRACTICAL – BOTANY
(For Zoology Students)

Course Code : 18UAO2P ◈ Hrs / week : 2 ◈ Credit : 4 ◈ Marks : 25 + 75 = 100

Course outcomes:

- Experiencing in handling specimens and preservation of different group of plants species.
- Imparting knowledge on morphology, taxonomy and biochemistry of plants
- Acquiring knowledge on diversity of pteridophyte and gymnosperms.
- Understanding ecological relationship in plants.
- Acquiring knowledge on cyto-genetics, evolution and molecular aspect in plant growth and development.

Algae and Fungi

- Microscopic observations of algal and fungal types and their slides included in the syllabus
- Section cutting of *polyporus* fruit body

Bryophytes

- Microscopic observation of slides of genera included in the syllabus.

Pteridophytes

- A study of the morphology, anatomy and structure of the vegetative and reproductive parts of the sporophytes and gametophytes (wherever available of *polytrichum* and *marselia*.

Gymnosperm

- Preparation of transverse section of the rachis and leaflet of cycas observe and record the internal structure.

Cytology and Genetics

- Study of the cell structure of plants and its organelles using electron micro-graphs from standard publication.
- Study of mitosis stages using photographs.
- Study of Mendal's monohybrid cross, dihibrid cross using photographs.

Anatomy

- Preparation of transverse section of the following plant parts to observe and record the internal structure.
- Primary structure of monocots stem and root
- Primar;y structure of monocot stem and root

Embryology

- Study; of permanent slides showing T.S of anther ovule types

Morphology

- Leaf : Study of phyllotaxy
- Inflorescence : Study of types included in the theory syllabus

Taxonomy

- Training in dissection, observation, identification, sketching of floral parts, construction of floral formula and sketching of floral diagram of plants belonging to the families mentioned in the theory syllabus. Description of the plants in technical terms.

Plant physiology

- Experiments included in the syllabus – demonstration only

Ecology

- Study of morphological and anatomical features of the following: Hydrophytes and Xerophytes.

Mapping with programme outcomes					
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	S	S	M	S	S
CO2	M	S	S	M	M
CO3	S	S	S	S	S
CO4	M	M	S	M	S
CO5	S	S	S	S	S

*S- STRONG, M- MEDIUM, L- LOW