DEPARTMENT OF BOTANY

SYLLABI

COURSE STRUCTURE – DEPARTMENT OF BOTANY

Three year B.Sc. Degree Course in BOTANY

Semester	Core		Elective			
I	**BOT-I.C-1** Plant diversity	**BOT-I.C-2** Cell Biology and Biomolecules	--------	--------	--------	--------
II	**BOT-II.C-3** Plant Anatomy and Embryology	**BOT-II.C-4** Microbiology	--------	--------	--------	--------
III	**BOT-III.C-5** Physiology of Plants		**BOT-III.E-1** Ecology and Conservation	**BOT-III.E-2** Systematics of flowering plants and Phylogeny	**BOT-III.E-3** Enzymes and their metabolic pathways	**BOT-III.E-4** Herbal Cosmetology
IV	**BOT-IV.C-6** Cytogenetics		**BOT-IV.E-5** Plant Breeding and Biostatistics	**BOT-IV.E-6** Techniques and Instrumentation in Botany	**BOT-IV.E-7** Plant pathology	**BOT-IV.E-8** Algal Biotechnology
V	**BOT-V.C-7** Plant Molecular Biology		**BOT-V.E-9** Bioinformatics	**BOT-V.E-10** Seed Technology	**BOT-V.E-11** Plant Drug Technology and Pharmacognosy	**BOT-V.E-12** Organic Farming
VI	**BOT-VI.C-8** Plant Genetic Engineering		**BOT-VI.E-13** Plant tissue culture	**BOT-VI.E-14** Horticulture, Floriculture and Landscaping	**BOT-VI.E-15** Economic Botany	**BOT-VI.E-16** Applied Mycology

COURSE TITLE: PLANT DIVERSITY (THEORY) W.e.f. July 2022
COURSE CODE: BOT-I.C-1.
MARKS: 100 (75 theory + 25 Practical)
CREDITS: 4 (3 theory + 1 Practical) COURSE
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:
This paper provides knowledge on morphology, structure and importance of the lower group of organisms. Education and awareness about plant diversity, its role in sustainable livelihoods.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able:
CO 1: State, describe and explain the characters and evolutionary aspects of different plant groups of lower plants.
CO 2: Define, Describe, correlate and compare the lower plant groups and fossils. CO 3: Position a given lower plant as per the classification studied.
CO4: Sketch the morphology and anatomy of selected lower plants.

Sr.No.	UNITS, TOPICS AND SUB-TOPICS	Hours
MODULE 1: ALGAE AND FUNGI		15
UNIT I: ALGAE		
1.1	Five kingdom classification	
1.2	Classification of algae (Cyanobacteria, Chlorophyta, Phaeophyta and Rhodophyta) following Lee (1999) upto groups with general characters and examples	
1.3	Endosymbiotic theory: origin of plastids	
1.4	Cyanophyceae:Distribution,systematic position and life cycle of *Nostoc* and Charophyta: *Chara*	
UNIT II: FUNGI		
2.1	General characteristics, Classification, economic importance. Systematic position, life history of *Puccinia* and *Penicillium*	
MODULE 2: BRYOPHYTES AND PTERIDOPHYTES		**15**
UNIT III: BRYOPHYTES		
3.1	General characters, brief classification and alternation of	

	generation	
3.2	Study of morphological and anatomical studies and reproductive character of *Riccia, Marchantia , Anthoceros and Funaria.*	
UNIT IV: PTERIDOPHYTES		
4.1	General characters, brief classification, stelar evolution, alternation of generation.	
4.2	Structure, reproduction, life history and systematic position of *Psilotum*, *Lycopodium* and *Marsilea*.	
MODULE 3: GYMNOSPERMS, PALEOBOTANY, LICHENS AND ECONOMIC IMPORTANCE.		15
UNIT V: GYMNOSPERMS, PALEOBOTANY, LICHENS AND ECONOMIC IMPORTANCE.		
5.1	General characters, brief classification, alternation of generation of Gymnosperms	
5.2	Systematic position, life history of *Pinus* and *Gnetum*	
5.3	Fossils and fossilization, importance of fossils (with a mention of Birbal Sahni institute)	
5.4	Lichens: Structure, Ecological and economic importance of lichens	
5.5	Economic importance of Cyanobacteria, algae, fungi, bryophytes, pteridophytes and gymnosperms.	
	TOTAL	**45**

COURSE TITLE: PLANT DIVERSITY (PRACTICAL)
COURSE CODE: BOT-I.C-1
MARKS: 25
CREDITS: 1
PRACTICAL SESSIONS: 15

Sr. No	Module 4: Topics	Practical Sessions
1.	Morphological study of algal and Blue green algal forms: *Oscillatoria/Nostoc, Chara, Sargassum, Polysiphonia*	03
2.	Morphological study of fungal forms: *Puccinia, Penicillium, Albugo* and *Rhizopus*	03
3.	Study of lichens (Permanent slide/ specimen)	01
4.	Study of fossils: (Permanent slide/ specimen)	01
5.	Morphological and anatomical study of: i. Bryophyte (preferably *Riccia* or *Anthoceros*) ii. Pteridophyte (preferably *Selaginella*) iii. Gymnosperm (preferably *Cycas*)	05
6.	Mini project: Collection and field study of locally available Algae, Bryophytes, Pteridophyte, Gymnosperms and Lichens	02
	Total	15

REFERENCES:

1. Alexopoulos, Constantine J.;Mims, Charles W. (1983). *Introductory Mycology*; 3rd edition; New Delhi: Wiley Eastern Limited.
2. Fritsch, F.E.,(1956). *The structure and reproduction of the Algae*; Volume I and II. Cambridge University Press.
3. Kar, Ashok Kumar; Gangulee, Hirendra Chandra (2006). *College Botany:* Volume II; 2nd Edition; Kolkata: New Central Book Agency (P)Ltd.
4. Parihar N.S., (2012); *An introduction to Embryophyta: Pteridophytes*.Vol II, fifth edition, Surjeet Publications.
5. Parihar N.S., (2013); *An introduction to Embryophyta: Bryophyta*.Vol I, fifth

edition, Surjeet Publications.
6. Prescott G. W., (1984); *Algae:* A review; Lubrecht& Cramer Ltd.
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8. Sharma, O. P. (2017). *Diversity of Microbes and Cryptogams- Pteridophyta.* McGraw Hill Education.
9. Sharma, O. P. (2017). *Diversity of Microbes and Cryptogams.* McGraw Hill Education.
10. Smith, Gilbert M. (1955). Cryptogamic Botany Bryophyta & Pteridophyta Volume 2; 2nd Edition; McGraw-Hill book Comp.Tokyo.
11. Smith, Gilbert M. (1955). Cryptogamic Botany Algae & Fungi Volume 1;2nd
12. Vashistha, B.R. (2016). *Botany for Degree Students Fungi* . S Chand & Company .
13. Vasishtha B.R. And Sinha A. K. (2005). *Botany for degree students* Part 1 Algae; 1st Edition S. Chand & Company Ltd.

Web References:

1. http://www.mycolog.com/
2. https://www.algaebase.org/
3. https://www.conifers.org/
4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5. *www.bsip.res.in*

COURSE TITLE: CELL BIOLOGY AND BIOMOLECULES (THEORY)
W.e.f. July 2022
COURSE CODE: BOT-I.C-2
MARKS: 100 (75 Theory+ 25 Practicals)
CREDITS: 4 (3 Theory+ 1 Practical) COURSE
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:

This course will provide a detailed discussion on a wide range of topics in Cell biology & Bio- molecules emphasizing experimental approaches and key experiments that have provided important insights. The course is aimed at conveying an understanding of how cellular structure and function arise as a result of the properties of cellular macromolecules. Emphasis will be on the dynamic nature of cellular organization, structure and function.

COURSE OUTCOME:
Upon successful completion of the course, students will be able:
CO 1: Recognise, classify cell, explain cell theory, evolution and biogenesis
CO 2: Define, describe, classify and explain cytoskeleton, cell organelle, biomolecules.
CO 3: Define, describe, compare, explain, illustrate cell wall and plasma membrane
CO 4: Predict and interpret the importance of cell

Sr. No	TOPICS	Hours
Module I: Introduction to Cell, Ultra-structure and Function of Cell Wall and Plasma Membrane		**15**
1.1	Discovery and basic properties of cells Prokaryotic and Eukaryotic cell; Cell theory	
1.2	Cell evolution and biogenesis	
1.3	Structure and functions of cytoskeleton; Structure and function of Microtubule, Intermediate filaments,	
1.4	Microfilaments	
1.5	Structure and function of cell wall; Chemical composition of cell wall;	
1.6	Extracellular matrix and cell interactions; Gap -Junctions & plasmodesmata	
1.7	Structure and function of plasma membrane; Active and Passive transport of solute (channels & pumps); Cell signaling- molecules and receptors, signaling network.	

Module II: Study of Cell Organelles			**15**
2.1 2.2 2.3 2.4	Semiautonomy and gene control; Structure & functions of peroxisome, glyoxysome & lysosomes Nucleus and its Organization; Nuclear envelope, nuclear pore complex Nuclear matrix, Chromosomes and chromatin structure Structure and function of ribosome Endomembrane systems- Endoplasmic reticulum and Golgi complex		
2.5			
Module III: BIOCHEMISTRY OF AMINO ACIDS AND PROTEINS CARBOHYDRATES, LIPIDS			**15**
3.1 3.2 3.3	Definition & importance of biomolecules; types of bonds in bio- molecules; pH and buffers ; Water as a biological solvent Classification and biological functions of carbohydrates and lipids Classification and biological functions of amino acids and proteins		
		Total	**45**

COURSE TITLE: CELL BIOLOGY & BIOMOLECULES (PRACTICAL) COURSE CODE: BOT-I.C-2
MARKS: 25
CREDITS: 1
PRACTICAL SESSIONS: 15

Sr.No	MODULE IV: TOPICS	PRACTI CAL SESSIONS
1.	Study of cell structure in *Hydrilla* and *Tradescantia* staminal hairs	1
2.	Examination of prokaryotic cell, eukaryotic cell and cell organelles by EM graphs	1
3.	Preparation of temporary slides to observe different types of cells	2
4.	Staining and Preparation of slides	6
	Cytochemical staining of Nucleus- Acetocarmine Cytochemical staining of polysaccharides- Periodic Acid Schiff's (PAS) Cytochemical staining of Mitochondria – Jannis Green Cytochemical staining of Total proteins – Bromophenol blue Cytochemical staining of Histones – Fast Green	
5.	Determination of pH (of plant extracts) using pH meter	1
6.	Quantitative determination of carbohydrates (Anthrone reagent)	1
7.	Estimation of oil in fatty seeds using (Soxhlet apparatus)	2
8.	Estimation of proteins (Lowry's Method)	1
	Total	**15**

REFERENCES:

1. David L. Nelson.& Michael M. Cox. (2013). *Lehninger Principles of Biochemistry*, 4th ed. New York: W.H. Freeman & Co.
2. Donald Voet., Judith G. Voet and Charlotte W. Pratt. (2002). *Fundamentals o fBiochemistry*, 2nd edition, John Wiley and Sons Pvt Ltd.
3. Gupta, P.K. (1999). *A Text-book of Cell and Molecular Biology*. Meerut, India: Rastogi Publications.
4. Robert A. Horton. (2006).*Principles of Biochemistry*.4th ed. Pearson Prentice Hall.
5. Jeremy M. Berg, John L. Tymoczko and LubertStryer.(2002). *Biochemistry* 5th edition, , New York; W.H.Freeman & Company
6. Karp, G. (1999). *Cell and molecular Biology, Concepts and experiments* . 2nd edition. USA: John Wiley and Sons Inc.
7. Paul Flinch (1999). *Carbohydrates structure, Synthesis & Dynamics*.

The Netherlands: Kluwer Academic Pub.
8. U. Satyanarayana and U. Chakrapani. (2000). *Biochemistry*,4thedition., Kolkata: Elsevier Pub.
9. Verma P.S. and Agarwal V. K. (1998).*Cell Biology, Genetics, Molecular Biology, Evolution and ecology*. 14th Ed. New Delhi: S Chand Publishers.
10. Randall J. Weselake Email author Stacy D. SingerGuanqun Chen. (2018, July 19). *Introduction to Plant Biomolecules and Cellular Metabolism*. Retrieved Februaury 13, 2020, from Springer: https://link.springer.com/chapter/10.1007/978-1-4939-8616-3_2
11. (2013, November 11). Retrieved February 13, 2020, from NPTEL: https://nptel.ac.in/courses/102103012/
12. *BIOLOGY JUNCTION*. (2017, April 21). Retrieved February 13, 2020, from Structure & Function of the Cells: https://www.biologyjunction.com/cell++notes+bi.html.

Web References:

1. www.britannica.com
2. https://www.springer.com
3. https://www.biologydiscussion.com
4. www.cellbiologyjournal.org
5. www.academia.edu

COURSE TITLE: PLANT ANATOMY AND EMBRYOLOGY (THEORY)

COURSE CODE: BOT-II. C-3

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVE:

This paper deals to understand the plant anatomy and embryology of angiospermic plant. Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information. Practical component will provide an ample understanding of anatomical and embryological features.

COURSE OUTCOME: Students will be able to:

CO1: Define, describe and explain the basic plant anatomical and embryological features

CO 2: Compare the interrelatedness of organ-systems and their functions

CO 3: Examine the features through histological techniques.

CO 4: Define, describe, explain, and compare theories in organization of tissues

Sr.No.	TOPICS	Hours
	MODULE I: SHOOT, ROOT AND LEAF ANATOMY	**15**
1.1	Organization of Shoot apical meristem	
1.2	Apical cell theory, Histogen theory, Tunica-Corpus theory, Cyto-histological zonation.	
1.3	Organization of root apical meristem	
1.4	Korper-Kappe theory, Quiescent centre.	
1.5	Anatomy of leaf: epidermis, mesophyll and vascular tissue	
1.6	Stomata and its diversity, leaf abscission	
	MODULE II: WOOD STRUCTURE	**15**
2.1	Vascular cambium, Secondary xylem, Xylary elements	
2.2	Secondary phloem, Phloem elements and Periderm	
2.3	Conifer wood, Dicotyledon wood, wood anatomy-TS, TLS, RLS.	

Module III: Reproductive biology, Pollination and fertilization		**15**
3.1	Floral development: ABC model of flowering	
3.2	Structure and development of male gametophyte- Microsporangium Microsporogenesis& Pollen grains	
3.3	Structure and development female gametophyte – Megasporangium, Megasporogenesis, Forms of ovule-Monosporic, bisporic and Tetrasporic	
3.4	Mechanism of pollination and fertilization- types of pollination, germination of pollen grain, pollen pistil interaction, self-incompatibility	
3.5	Double fertilization, embryo (dicot and monocot) and endosperm formation. General account of Apomixis and Polyembryony	
	TOTAL	**45**

COURSE TITLE: PLANT ANATOMY AND EMBRYOLOGY (PRACTICAL)

COURSE CODE: BOT-II.C-3

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr.No.	Module 4: TOPICS	PRACTICAL
1.	Study of simple and complex tissues by using permanent slides/ EM graphs.	**2**
2.	Microscopic study of wood tissues in T.S, T.L.S. and R.L.S. (Permanent slides) and maceration (Any one species)	**3**
3.	Study of Meristems, Microsporogenesis and Megasporogenesis through permanent slides	**2**
4.	Mini Project- Study of diversity in leaf anatomy, stomata and female gametophyte exhibiting self-incompatibility.	**3**
5.	Embryo and Endosperm with haustoria mounting (*Tridax/ Cucurbit*).	**2**
6.	In vitro growth of pollen tube in *Portulaca/ Vinca.*	**1**
7.	Pollen studies: Chitaley's method for analysis in *Ipomoea*, *Ocimum, Hibiscus*, *Acacia auriculiformis* and Grass.	**2**
	TOTAL	**15**

REFERENCES: -

1. Bhojwani, S. S and Bhatnagar, S.P. (2009). *The Embryology of Angiosperms*, New Delhi: Vikas Publishing House Pvt. Ltd.,
2. Dwivedi. J.N. (1988). *Embryology of Angiosperms.* Meerut: Rastogi and Co.
3. Esau, K. (1977). *Plant Anatomy,* 2nd Edition. New Delhi: Wiley Eastern Private Limited.

4. Fahn, A. (1982). *Plant Anatomy* (3rd edition). Oxford: Pergoman Press.
5. Mauselth, J.D. (1988). *Plant Anatomy.* California, USA: The Benjamin Cummings Publishing Co. Inc.
6. Maheswari, P. (1971). *An Introduction to the Embryology of Angiosperms.* New Delhi: Tata McGrawhill.
7. Pandey, B.P. (1981). *A textbook of Botany Angiosperms*. New Delhi: S. Chand and Co.
8. Pandey, B.P. (1978). *Plant Anatomy.* New Delhi: S Chand and Co.,

Weblinks:

1. http://virtualplant.ru.ac.za/Main/ANATOMY/prac9.htm
2.http://www.biologydiscussion.com/plants/wood-anatomy-of-some-important-plants-biology/57016

COURSE TITLE: MICROBIOLOGY

(THEORY) COURSE CODE: BOT.II.C-4

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

The objective of this course is to familiarize the student with basic concepts that help in understanding of microbial world. The course is aimed to understand microbial survival and distribution, its relation and interaction with environment and human beings. The laboratory exercises are designed so that students acquire basic and bacteriological skills and are able to successfully use them.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:

CO1 : Appraise the students to the fundamental basis of all living organisms (Plant and Microbes)
CO2 : Relate interaction of microbes with plant and the environment.
CO3 : Describe, demonstrate and Assess methods of microbial preparation.
CO4 :Understand applications of the microbes in food, agriculture and industry with sustainable usage of resources for the benefit and human survival.

Sr.No.	TOPICS	Hours
Module I: Overview of microbial world & development		**15**
1.1	Developments of microbiology in the twentieth century Microbial taxonomy & phylogeny (archea, bacteria, fungi, algae, protozoa)	
1.2	Structure & General characteristics of viruses, viroids, Prions, Bacteriophages, TMV & mycoplasma, satellite viruses.	
1.3	Distribution of microbes in the environment (air, soil & water) Scope of microbiology and Microbial diseases	

Module 2: Isolation, characterization, growth of microorganisms & microbial genetics		**15**
2.1	**Control of microbial growth:** Biochemical characterization & nutritional types; Sterilization techniques,	
2.2	Preparation of pure cultures; growth factors & growth curve.	
2.3	Staining techniques	
2.4	Bacterial Reproduction: Conjugation, Transformation & transduction;	
2.5	Methods of viral replication (Lytic & Lysogenic mode)	
Module 3: Application Microbiology		**15**
3.1	**Applications in Environment**: Applications of microbes in environment sustenance (microbial degradation of cellulose, hemicelluloses, lignin, biodegradation of hydrocarbons),	
3.2	**Applications in Agriculture**: Association of plants with cyanobacteria, actinomycetes, fungus; Xenobiotics (biodegradation of pesticides, herbicides, metals) biofuels	
3.3	**Applications in Medicine**: Microbial antibiotics	
3.4	**Applications in Industry:** Microbes in Fermentation technology & dairy industry, bioreactors, UASB reactor and tricking filters for waste water treatment	
	TOTAL	**45**

COURSE TITLE: MICROBIOLOGY (PRACTICAL)

COURSE CODE: BOT-II.C-4

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr.No.	Topics	Practical Sessions
1	Preparation of culture media for bacteria, pure cultures and aseptic transfer of pure culture	3
2	Staining of microorganisms (Gram staining)	2
3	Measurement of bacterial growth, cell number in a culture (Turbidity, serial dilution & Haemocytometer	3
4.	Distribution of microorganisms in our environment (Skin, air, water and soil sample)	2
5	Mini Projects: i) Microbiological examination of water ii) Bacteriological testing of milk iii) Fermentation of carbohydrates and wine preparation	5
	TOTAL	**15**

REFERENCES:

1. Aneja, K. R. (2007). *Experiments in Microbiology Plant Pathology & Biotechnology*. 5th ed. New Age International Publishers.
2. Atlas, R. M. (1997). *Principles of Microbiology*. 2nd ed. McGraw-Hill
3. Dubey, R.C & Maheshwari, D.K. (2002). *Practical Microbiology*. New Delhi: S. Chand & Company Ltd.
4. Frazier, W.C. and Westhoff, D.C. (2008). *Food Microbiology*. 4th ed. McGraw Hill.
5. Pelczar, M. (2000). *Microbiology.* 5th ed. Tata-McGraw Hill.
6. Powar, C. B. & Daginawala, H.F. (1982). *General Microbiology*–Volume II. Mumbai: Himalaya publishing house.
7. Prescott, H. (2008). *Microbiology*. Boston: McGraw-Hill Higher Education.
8. Prescott, L. M. (2005). *Microbiology*. 6th ed. McGraw-Hill.

9. Salle, A. J. (1999). *Fundamental Principles of Bacteriology*. 7th ed. Tata- McGraw Hill.

10. Shivkumar, P. K., Joe, M. M. & Sukesh, K. (2010). *An Introduction to Industrial Microbiology*. 1st ed. New Delhi: S. Chand & Company Pvt. Ltd.

COURSE TITLE: PHYSIOLOGY OF PLANTS (THEORY) W.e.f. July 2022

COURSE CODE:

BOT.III.C-5

MARKS: 100 (75Theory +25 Practical)

CREDITS: 4 (3 Theory +1 Practical) COURSE

DURATION: 45 HOURS

PREREQUISITE COURSES: Biology at XIIth preferred.

COURSE OBJECTIVE:

Relate physiological mechanism of plants and their functioning.

Analyze biosynthesis of valuable plant metabolites (primary/ secondary) and their role.

COURSE OUTCOME:

Upon successful completion of the course, students will be able to:

CO1: Analyse Physiological processes operational in the plants.

CO2: Formulate and design experiments to explain physiological concepts and interpret data.

CO3: Estimate and evaluate methods of quantitation of pigments, enzymes and metabolites.

CO4: Describe and verify physiological processes through mini projects.

Sr. No	**UNITS, TOPICS AND SUB-TOPICS**	**Hours**
	MODULE -I: PLANT WATER RELATIONS AND SOLUTE TRANSPORT	**15**
1.1	Water and its significance to plants	
1.2	Osmotic & water potential of cell	
1.3	Transpiration, stomatal regulation & anti-transpirants	
1.4	Uptake, transport and translocation of water	
1.5	Essentiality of mineral nutrition and its uptake (active, passive and its role on membranes)	
1.6	Transport of organic solutes (source sink relationship)	
	MODULE II: PHOTOSYNTHESIS AND STRESS PHYSIOLOGY	**15**
2.1	Chloroplast and Light harvesting complexes	
2.2	Z scheme of photosynthesis & Mechanisms of electron transport	
2.3	CO2 fixation (C3, C4 and CAM pathways)	
2.4	Photoprotective mechanisms (photorespiration)	
2.5	Environmental change and its impact on photosynthesis	

	Responses of plants to abiotic (water, temperature and salt) stresses	
	MODULE III: PLANT GROWTH AND DEVELOPMENT AND SECONDARY METABOLITES	**15**
3.1 3.2 3.3 3.4 3.5	Role of phytochromes & cryptochromes and its functions Plant hormones, transport and physiological functions Photoperiodism & vernalization. Senescence, seed dormancy & germination Biosynthetic pathway of terpenes, phenols and alkaloids and their Functions	
	TOTAL	45

COURSE TITLE: PHYSIOLOGY OF PLANTS (PRACTICALS) COURSE CODE: BOT.III.C-5
MARKS: 25
CREDITS: 1
PRACTICAL SESSION: 15 (*Inclusive of 3 PA*)

Sr. No	**TOPICS**	**PRACTICAL SESSIONS**
1	Determination of osmotic potential of plant cell sap by plasmolytic method.	2
2	Determine water potential of given tissue by falling drop/ tissue weight method	2
3.	Chromatographic separation of plant pigments and plant sugars by paper chromatography	3
4	Quantitation of total free amino acids	2
5	Mini Project: 1. Mineral deficiency symptoms in plants 2. Secondary metabolites in plants. 3. Oxygen evolution during photosynthesis. 4. Role of Plant hormones in plant growth 5. Starch production during photosynthesis 6. Use of hydroponic technique for plant growth	6
		15

REFERENCES:

1. Harvey J.M. Hou, Najafpour, M. Mahdi., Moore, G. F., Allakhverdiev S. I. (2017) *Photosynthesis: Structures, Mechanisms, and Applications*. NY: Springer Publications.
2. Jordan Smith (2016) *Plant and Crop Physiology*. Syrawood Publishing House.
3. Taiz, Lincoln., Zeiger, Eduardo., Møller, I. Max and Murphy Angus (2018) *Fundamentals of Plant Physiology*.UK: Oxford University Press.
4. Taiz Lincoln and Zeiger, Eduardo (2015).Plant Physiology and Development. U.S: Sinauer Associates Inc.
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6. Taiz, L. and Zeiger, E. (2006). *Plant Physiology*, 4th edition, MA, USA: Sinauer Associates Inc . Salisbury F. B. and Ross C. W. (2002). Plant Physiology 3rd edition. CBS publishers and distributers.
7. Goodwin Y.W., and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition CBS Publishers and distributors.
8. Moore T.C. (1989). *Biochemistry and Physiology of Plant Hormones.* New York, USA: Springer –Verlag,
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10. Hopkins, W.G. and Huner, P.A. (2008) *Introduction to Plant Physiology.* John Wiley and Sons.
11. Nelson , D.I. and Cox M. M. (2000). *Lehninger. Principles of biochemistry*, 3rdedition, U.K: Macmillan.
12. Plummer D. T. (1985). *An introduction to Practical Biochemistry* 2nd edition. Tata Mcgraw Hill Publishing company Ltd.

CURRENT LITERATURE (JOURNAL ARTICLES):

Plant Physiology, The Plant Cell, Journal of Plant Physiology, Physiologia Plantarum, Plant Physiology and Biochemistry, Postharvest Biology and Technology, Journal of the American Society for Horticultural Science, Nature, Scientific American and Science reporter.

Weblinks:

1. http://www.nrce.niepa.ac.in › ... › Life Science
2. http://exa.unne.edu.ar › biologia › fisiologia.vegetal
3. https://www.springer.com › journa
4. https://www.ncbi.nlm.nih.gov › pmc › journals
5. https://www.biologydiscussion.com/plant-physiology-2/notes-plant-physiology/34597

COURSE TITLE: ECOLOGY AND CONSERVATION (THEORY) W.e.f. July 2022
COURSE CODE: BOT- III.E-1
MARKS: 100 (75 Theory+ 25 Practical)
CREDITS: 4 (3 Theory+ 1 Practical)
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.

COURSE OBJECTIVES:

Objective of this paper is to provide introductory knowledge on biotic and abiotic environmental factors, pollution and phytogeography with regards to Government regulations towards environmental management with respect to agriculture and food security.

COURSE OUTCOMES:

Upon successful completion of the course, students will be to:

CO1: Discuss, explain and review the concept of ecosystem, phytogeography and population ecology.

CO2: Analyze and evaluate the pollution scenario of the area and relate the theory in the natural environment and work towards conservation of the environment and its legalities.

CO3: Quantitatively estimate the oxygen and Carbon dioxide from different water samples.

CO4: Evaluate and determine minimum area of sampling unit (using quadrant) for the study of local vegetation.

Sr.No.	UNITS, TOPICS AND SUB-TOPICS	HOURS
Module 1: CONCEPT OF ECOSYSTEM, PHYTOGEOGRAPHY AND POPULATION ECOLOGY		**15**
1.1	Concept of Ecosystem, Ecological adaptations of plants belonging to following ecological groups: Hydrophytes, Xerophytes and Halophytes. Shelford's law of tolerance; Introduction to Species diversity indices (Simpson's & Shannon-Weiner) of herbaceous vegetation.	
1.2	Phytogeography- plant distribution, theories on plant distribution Endemism, Biomes of the world, and phytogeographical regions ofIndia, biosphere reserves, Forest training institutes, Land bridge theory	
1.3	Population Ecology: Survivorship curves- Type I, Type II, Type III. Population growth: Population growth curves – Carrying capacity K, Exponential growth (J shaped curve) and Logistic growth (S shaped curve).	
MODULE II: ECOLOGICAL FACTORSAND COMMUNITY RELATIONSHIPS		**15**
2.1	Light - quality, duration, absorption, intensity & effects on plants	

	Temperature-variation due to altitude effects on plants, thermal constant and stratification	
2.2	Water- precipitation, moisture & measurement of rainfall Wind - speed,	
2.3	advantages and damage caused to plants	
2.4	Soil- Soil profile, texture, classification and organic matter	
	Community relationships:Biotic interactions, Gaia Hypothesis, Introduction to Optimal foraging theory	
MODULE III: POLLUTION,LAWS AND ORGANISATIONS		**15**
3.1	Air pollution- polluting gases; ozone depletion, greenhouse effect, global warming, acid rain and smog	
3.2	Water pollution-eutrophication, sewage, industrial waste, heavy metal pollution	
3.3	Soil pollution – chemical pollutants	
3.4	Bioremediation	
3.5	Forest conservation act, Indian forest act, Biodiversity act, western Ghat protection act, Kasthurirangan Act, Gadgil committee report, Mining committee reports, wild life act (recent acts to be studied).	
3.6	Organizations (National & International) working for conservation (NEERI, TERI, MSSRF, IUCN, TRAFFIC)	
	TOTAL	**45**

COURSE TITLE: ECOLOGY AND CONSERVATION (PRACTICAL) COURSE CODE: BOT- III.E-1
MARKS: 25
CREDITS: 1
PRACTICAL SESSIONS: 15

Sr. No	**Module IV- Topics**	**Practical Sessions**
1.	Study of ecological instruments i.e. lux meter, rain guage, hygrometer, wet and dry bulb thermometer, maximum and minimum thermometer	02
2.	To study the physical and chemical characters (moisture, texture and pH) of Sand, Loam and Clay.	02
3.	Analysis of different water samples for oxygen and carbon-dioxide content	03
4.	Estimation of total carbonates from soil sample	01
5.	Visual interpretation of remotely sensed image for vegetation types (Land use land cover, NDVI)	01
6.	Anatomical study of Hydrophytes (leaf - *Eichhornia*), Xerophytes (succulents - *Opuntia*), and Halophytes (leaf - *Avicennia*)	01
7.	Mini project: To determine minimum area of sampling unit (quadrat) for the study of local community and to determine species diversity index (Simpson's & Shannon-Weiner) of herbaceous vegetation	05
Total		15

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2. World Wide Fund – India :https://www.wwfindia.org/
3. NEERI: https://www.neeri.res.in/
4. TRAFFIC:https://www.worldwildlife.org/initiatives/traffic-the-wildlife-trade-monitoring- network
5. International Union for conservation of nature: https://www.iucn.org/
6. MSSRF- https://www.mssrf.org/
7. TERI-https://www.teriin.org/

COURSE TITLE: SYSTEMATICS OF FLOWERING PLANTS AND PHYLOGENY W.e.f. July 2022

COURSE CODE: BOT- III.E-2

MARKS: 100 (75 Theory + 25 Practical)

CREDITS: 4 (3 Theory +1 Practical

DURATION: 45 HOURS

PREREQUISITE COURSES: Biology at XIIth preferred.

COURSE OBJECTIVES:

To study the morphology, systematics and phylogeny of flowering plants.

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1: Understand the process of Plant Classification, documentation and nomenclature in Plant Systematics. .

CO2: Explain, examine the concept of taxonomic evidences and phylogeny of angiosperms..

CO3: Understand, explain, analyze and interpret the systems of classification, features of families in Systematics of flowering plants. .

CO4: Identify plants with help of Floras, taxonomic keys, prepare Herbarium and construct Cladograms.

	TOPICS	**Hours**
Module 1: Introduction to Plant classification, Nomenclature		
1.1	Plant classification, nomenclature & biosystematics	**15**
1.2	Field inventory; Functions of Herbarium; Important herbaria and botanical gardens (India & world), virtual herbarium; e-flora	
1.3	Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access	
1.4	Principles and rules (ICBN); Ranks and names; Typification, author citation, valid publication	
1.5	Rejection of names, principle of priority and its limitations; Names of hybrids	
Module 2: Concept, Taxonomic evidences and Phylogeny of Angiosperms		**15**

2.1 2.2 2.3	Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; species concept (taxonomic, biological, evolutionary). Evidence from palynology, cytology, phytochemistry and molecular data. Origin & evolution of angiosperms, Co-evolution of angiosperms. Characters; Variations; OTUs, cluster analysis, Phenograms, cladograms (definitions and differences)	15 hours
Module 3: Systems of classification; position and diagnostic features of Families		**15**
3.1 **3.2** **3.3**	Concepts of evolution and phylogeny Major contributions by Linnaeus, Bentham and Hooker, Engler and Prantl; Brief reference of Angiosperm Phylogeny group (APG III) Classification. Annonaceae, Capparaceae, Brassicaceae, Grewiaceae, Rutaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Apocyanaceae - Asclepiadaceae (sub-family), Solanaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Orchidaceae, Araceae, Asteraceae, Zingiberaceae, Commelinaceae, Poaceae.	
	Total:	**45**

COURSE TITLE: SYSTEMATICS OF FLOWERING PLANTS AND PHYLOGENY COURSE CODE: BOT-III.E-2
MARKS: 25

CREDITS: 3

Sr.no	Module 4: Topics	Practical
1	Plant identification using flora book and database	**01**
2	Identification of 15 families mentioned in unit IV (Bentham & Hooker's system) studied in theory from locally available specimens (with floral diagram).	**10**
3	Use of taxonomic keys and construction of dichotomous keys	**01**
5	Taxonomic interpretation using pollen of related species	**01**
6	Construction of Phenogram and Cladogram	**01**
	Mini project: Preparation of herbarium	**01**
	Total	**15**

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3. Pandey, B. P. (1969). *Taxonomy of Angiosperms*. New Delhi: S. Chand and company Ltd, India, pp.102-105.
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COURSE TITLE: ENZYMES AND THEIR METABOLIC PATHWAYS (THEORY) W.e.f. July 2022

COURSE CODE: BOT-III. E-3

MARKS: 100 (75 Theory+ 25 Practicals)
CREDITS: 4 (3 Theory+ 1 Practical) COURSE
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:

The objective of this course is to understand the importance and mechanisms of enzyme action. The course also discusses enzymatic regulation & metabolic control of biochemical reactions.

COURSE OUTCOMES:
Upon successful completion, the students will be able to:
CO1: Identify the role of enzymes in various biological processes
CO2: Classify the different enzymes based on its structure and function
CO3: Understand and extrapolate the various mechanisms of enzyme action
CO4: Study application of enzymes in industry

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
	MODULE I: BASIC CONCEPT AND CATALYSIS OF ENZYMES	**15**
1.1	Classifications & nomenclature (IUB system).	
1.2	Biological role of enzymes; Concept of holoenzymes, apoenzymes, prosthetic group, iso-enzymes, allosteric enzymes and Active sites.	
1.3	Chemical nature of enzymes, Enzyme activity. Characteristics of enzymes **(**Physico-chemical and biological properties).	
1.4	Role of co-factors (NAD, NADP+, FMN/FAD, Co-enzyme A, Pyridoxyl phosphate and metal ions).	
	MODULE II: ENZYME KINETICS	**15**
2.1	Factors affecting enzyme activity (concentration, substrate, pH, temperature, inhibitors).	
2.2	Michaelis-Menten equation and its significance.	
2.3	Fisher's lock and key model and Koschland (induced fit theory), Arrhenius plot.	

2.4	Enzyme action (competitive, noncompetitive and reversible)	
MODULE III: METABOLIC CONCEPTS OF ENZYMES		**15**
3.1	Glycolysis, Fate of pyruvate (Lactic acid & alcohol fermentation).	
3.2	Citric acid cycle, Respiratory substrate, Mitochondrial Electron transport, Cytochrome, Alternate oxidase pathway, Glycogen cycle.	
3.3	Biosynthesis and degradation of triglycerides.	
3.4	Pathway for amino acid catabolism (Nitrogenase enzyme complex**,** NIF and Nod genes).	
	TOTAL	**45**

COURSE TITLE: ENZYMES AND METABOLIC PATHWAYS (PRACTICALS) COURSE CODE: BOT- III.E-3
MARKS: 25 MARKS
CREDITS: 1
COURSE DURATION: 15 SESSIONS

Sr. No	**TOPICS**	**PRACTICAL SESSIONS**
1	Qualitative and quantitative determination for amylase enzyme in the given plant samples.	3
2	Effect of enzyme concentration, temperature, substrate, inhibitors and pH on the activity of α-amylases	5
3	To extract and determine the activity of catalase , lipase and peroxidase enzymes	3
4	a. Mini project on role of Nitrogen in plants b. Application of enzymes in industries (dairy/ pharmaceuticals/ sugar/ waste management/ food/ wine) c. Anaerobic respiration in germinating seeds.	4
	TOTAL	**15**

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15. Satyanarayana, U. & Chakrapani, U. (2020). Biochemistry (5 ed.). Chennai: Elsevier.
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4.https://www.biologydiscussion.com/enzymes/enzymes-meaning-mechanism-classification-factors-and-importance/17003

5. https://nptel.ac.in/courses/102102033

COURSE TITLE: HERBAL COSMETOLOGY (THEORY) W.e.f. July 2022
COURSE CODE: BOT-III.E-4
MARKS: 100 (75 Theory +25 Practical)
CREDITS: 4 (3 Theory +1 Practical)
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:
To impart knowledge about the different plants that play a very important role in enriching inner health and skin quality.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able:
CO 1: Explain the basics of herbal cosmetology, skin, skin types.
CO 2: Outline the requirements for making herbal soaps, oils, shampoos, face packs, etc.
CO 3: Inculcate the technique of preparation of herbal products.
CO 4: Identify and describe the herbs used for cosmetic products and understand the future prospects of Herbal cosmetic industry.

	TOPICS	Hours
Module I: Introduction to Herbal cosmetology		**15**
1.1 1.2 1.3 1.4 1.5 1.6	Definition, Collection and processing of herbal material, Natural and artificial drying of herbal material Herbal remedies for holistic health Current status of Herbal Cosmetic Industry in India Introduction Herbal edible churnas beneficial for skin and hair Herbs used in weight loss and weight gain: ● Herbs for weight gain ● Herbs for weight loss (For e.g. Ginseng, Cinnamon, Black Pepper, Dandelion, Yashtimadhu, Ashwagandha) Herbs that help in depression and anxiety Future prospects of herbal cosmetic Industry	

Module 2: Identification (botanical name and family), description and utilization of following plants with Cosmetic benefits & their cosmetic uses		**15**
2.1	*i) Curcuma longa* *ii) Aloe vera* *iii)Azadirachta indica* *iv) Ocimum sp.* *v) Moringa sp.* *vi) Cymbopogon flexuosus* *vii) Murrayakoenigii* *viii) Citrus limon* *ix) Mentha sp.* *x) Tagetes sp.* *xi) Musa paradisica* *xii) Rosa sp.* *xiii) Manjistha*	
Module 3: Standardization of raw material and commonly used herbs in the herbal cosmetics		**15**
3.1 3.2 3.3 3.4	Importance of standardization Physical and chemical methods of standardization Quantitative and qualitative estimation of phyto-constitutes Herbs used in the following cosmetic product: ● Herbal Shampoo(s) and soap(s) ● Herbal Conditioner ● Herbal Hair Dye/ Herbal Hair Oil/Hair Cream/Hair Gel, ● Herbal Face Mask ● Herbal Bath Oil. Study of protocol for preparation of : ● Different types of Herbal face masks- for dry skin, oily skin, ● pigmented skin & wrinkled skin ● Special Herbal masks for sensitive skin ● Herbal Shampoo(s) and soap(s)	
	Total	**45**

COURSE TITLE: HERBAL COSMETOLOGY (PRACTICAL) COURSE CODE: BOT- III.E-4
MARKS: 25
CREDITS: 1

Sr. No.	Module 4- Topics	Practical
1.	Herbal face masks for dry skin, oily skin, pigmented skin, wrinkled skin.	02
2.	Preparation of Herbal Shampoo(s) and soap(s)	02
3.	Preparation of herbal hair oils	01
4.	Comparison of Herbal products to non-herbal products	01
5.	Visit to an Ayurvedic institute / local ayurvedic clinic.	02
6.	Extraction of plant pigments- *Lawsonia inermis* (mehndi) and *Curcuma longa* (turmeric),	02
7.	Mini project : • Study of herbal products for weight loss and weight gain • Study of various skin and hair care herbal products available in the market. • Study of locally available herbal Churnas. • Local Survey to know about awareness about home remedies for cosmetic purpose.	05
	Total	15

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4. Sachs, M. (2014). Ayurvedic Beauty Care: Ageless Techniques to Invoke Natural Beauty. ISBN: 9788120818804
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2. www.santulan.in
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4. https://wjpr.s3.ap-south-1.amazonaws.com/article_issue/1522478937.pdf
5. https://www.planetayurveda.com/stholyantak-churna/

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

This course will enable the students to understand fundamentals of genetics and evolution.

COURSE OUTCOMES: Students will be able to:

CO1: Restate, apply, analyze and access the fundamentals of genetics

CO 2: To discuss, explain and interpret extra nuclear inheritance, Sex linked inheritance and chromosomal aberrations.

CO 3: Identify different stages of cell division, to construct chromosome maps.

CO 4: Review the effects of mutagens on seed germination.

Sr.No.	TOPICS	HOURS
Module 1: Mendelian Genetics and Linkage		**15**
Mendelian genetics and principles of inheritance and Multiple allelism		
1.1	Cell cycle- mitosis, meiosis and its significance, Mendel's Laws, backcross and test cross.	
1.2	Allelic and non-allelic interactions, Epistatic interactions	
1.3	Multiple alleles in Drosophila (eye colour), man (blood groups) and plants (self-incompatibility).	
Linkage, Mutations and Molecular basis of mutations		
1.4	Linkage- Coupling and Repulsion Hypothesis Chromosome maps.	
1.5	Mutations and its types. Types of mutagens.	
1.6	Transitions and transversions; frame shift mutations. DNA repair mechanisms, Applications of mutations	

Module 2: Extranuclear inheritance and Sex linked inheritance		**15**
Extranuclear inheritance and Maternal influence		
2.1	Extranuclear inheritance and maternal influence: Kappa particles in *Paramecium;* CO_2 sensitivity in *Drosophila*; cytoplasmic inheritance in mitochondria and plastids; Shell coiling in snails; eye colour in flour moth.	
Sex Determination and Sex Linkage		
2.2 2.3	Sex Chromosomes, Mechanisms of sex determination; Genic balance mechanism. Sex-linked inheritance- X linked and Y linked inheritance.	
Module 3: Genetic variation due to chromosome structure and number		**15**
Genetic variation due to chromosome structure and number		
3.1 3.2	Chromosomal aberrations – duplications, deletions, inversions and translocation Variations in chromosome number; auto-and allo-polyploidy - types and effects; artificial induction of polyploidy. Auto and allo-polyploid crop species Aneuploid segregations in plants- tetrasomics and nullisomics; triploid and tetraploid plants. Applications of polyploidy	
	TOTAL	**45 HOURS**

COURSE TITLE: CYTOGENETICS (PRACTICAL)

COURSE CODE:BOT-IV.C-6

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr. No	MODULE 4: TOPICS	Practical
1.	Study of Mitosis and meiosis using suitable plant material	**03**
2.	Karyotype analysis and preparation of ideogram	**02**
3.	Detection of anomalies in cell division using suitable plant material.	**02**
4.	Study of multiple allelism in blood groups of human beings.	**01**
5.	Effect of physical and chemical mutagen on seed germination	**03**
6.	Preparation of chromosome maps from 3-point test cross data and calculation of Interference and coincidence	**01**
7.	Induction of polyploidy using Colchicine treatment.	**02**
8.	Study of sex linked inheritance	**01**
	TOTAL	**15 P**

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1. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (1991). *Principles of Genetics* (8th edition). India: John Wiley & sons.
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COURSE CODE:BOT-IV.E-5

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

To enable the students to learn various techniques in plant breeding with regards to crop productivity**.**

COURSE OUTCOMES: Students will be able to:

CO 1: Identify and assess the role of various institutions and certification programmes in plant breeding.

CO 2: Describe and compare various techniques in plant breeding

CO 3: Employ manual emasculation procedure.

CO 4: Calculate mean, median, mode, standard deviation, std. error for provided material.

Sr.No.	TOPICS	HOURS
Module 1: Introduction to Plant breeding, Organisations and Certifications		**15**
Introduction to Plant breeding and Organizations		
1.1	Introduction, history, objectives, achievements and prospects. Centres of origin of crop plants.	
1.2	Organizations & their mandate–CCARI- ICAR, ICRISAT, IRRI (Indian& International)	
1.3	Plant breeders' & Farmers' Rights Phytosanitary and Seed Certifications	

Module 2: Hybridisation, Heterosis, Inbreeding Depression and Mutation breeding		**15**
Hybridisation, Heterosis and Inbreeding Depression		
2.1 **2.2** **2.3**	Pure line and mass selection Types and Techniques in hybridization Introduction, domestication and acclimatization. Heterosis and inbreeding depression.	
Mutation Breeding; Breeding for stresses.		
2.4 **2.5**	Varieties developed in India through mutation breeding; Limitations of mutation breeding	
Module 3: Biostatistical methods and Genetics of Pathogenicity		**15**
Biostatistical methods and Genetics of Pathogenicity		
3.1 **3.2** **3.3** **3.4**	Introduction to biostatistics: Terms used in biostatistics, types of data, Sampling theories- random sample, sample size determination, precision, data collection, processing and presentation of data: qualitative and quantitative Measures of central tendency: Mean, Median, Mode. Measures of variation: standard deviation, standard error Concept of correlation between two variables and regression line Chi square Physiological races and types. Genetics of pathogenicity; vertical and horizontal resistance & breeding for various biotic stresses in rice/wheat.	
	TOTAL	**45 HOURS**

COURSE TITLE: PLANT BREEDING AND BIOSTATISTICS (PRACTICAL) COURSE CODE: BOT-IV.E-5

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr. No	MODULE 4: TOPICS	Practical sessions
1.	Emasculation and bagging of flowers using suitable plant material and Estimation of fruit and seed set in emasculated flowers	**03**
2.	Correlation of floral structure with pollination system	**01**
3.	Estimation of pollen fertility (pollen viability) in (any two) locally grown crop species.	**02**
4.	Study of centres of origin of some important crop plants.	**01**
5.	Study of soil pH using different soil types & relate it to crops	**01**
6.	Analysis of data for mean, median & mode, Standard deviation and standard error using suitable plant samples	**03**
7.	Determination of correlation and regression, Chi square analysis	**03**
8.	Visit to CCARI- ICAR	**01**
	TOTAL	**15 P**

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2. Mahajan, B.K.; (1997) *Methods in biostatistics* (6th edition). New Delhi: Jaypee Brothers.
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COURSE TITLE: TECHNIQUES & INSTRUMENTATION IN BOTANY (THEORY)
COURSE CODE: BOT-IV.E-6
MARKS: 100 (75 Theory+ 25 Practical)
CREDITS: 4 (3 Theory+ 1 Practical)
COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:
Objective of the course is to impart knowledge of principle, methodology and application of various techniques & instrumentation.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able:
CO 1: To understand, define and explain the principle, instrumentation and working of microscopy and radiobiology techniques used in Botanical research.
CO2: To understand the principle, working and applications of centrifugation and spectrophotometry in Botanical research.
CO 3: To understand, define the principle, working and applications of chromatography, electrophoresis and molecular techniques.
CO 4: To compare and contrast the techniques used in Research fields.

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
MODULE I: MICROSCOPY AND RADIOBIOLOGY (PRINCIPLE, METHODOLOGY AND APPLICATIONS)		**15**
1.1	Light microscopy (compound microscopy and Phase contrast microscopy) Fluorescence microscopy	
1.2	Transmission and Scanning electron microscopy (sample preparation for electron microscopy, cryofixation,)	
1.3	Microscopic measurements (Micrometry & cytometry) and photography (micro and macro)	
1.4	Radioactivity and its measurements (Geiger Muller and Scintillation counter	
1.5	and autoradiography)	

MODULE II : CENTRIFUGATION AND SPECTROPHOTOMETRY: PRINCIPLE, METHODOLOGY AND APPLICATIONS		**15**
2.1 2.2 2.3 2.4 2.5	Centrifugation: Low speed, high speed, cooling centrifuges and ultracentrifugation Analytical, preparatory and gradient centrifugation UV visual spectrophotometry Fluorescence spectrophotometry Flame (Atomic absorption) spectrophotometry Mass spectrophotometry	
MODULE III: CHROMATOGRAPHY, ELECTROPHORESIS & MOLECULAR TECHNIQUES: PRINCIPLE, METHODOLOGY AND APPLICATIONS		**15**
3.1 3.2 3.3 3.4 3.5	Adsorption and partition chromatography Column chromatography (isocratic and gradient) High Performance Liquid Chromatography& Gas Chromatography Electrophoresis: Agarose Gel Electrophoresis,Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis , Iso-Electric Focussing and 2-Dimensional Electrophoresis Polymerase Chain Reaction, Real Time PCR	
	TOTAL	**45**

COURSE TITLE: TECHNIQUES & INSTRUMENTATION IN BOTANY (PRACTICAL)
COURSE CODE: BOT-IV.E-6
MARKS: 25
CREDITS: 1

SR.NO	Module 4- TOPICS	PRACTICAL
1	Preparation of Molar, Normal and ppm solutions	1
2	Determination of Lambda (λ) max of a given solution Verification of Beer's Law	2
3	Micrometric dimensions (cytometry and micrometry)	2
4	Demonstration of SDS- PAGE/ Agarose gel Electrophoresis	2
5	Preparation of TLC plate and Separation of biomolecules	2
6	Visit to Instrumentation Lab (NIO/College/ Goa University)	1
7.	Demonstration of Flame photometry	1
8	Mini project: Comparison of data of ultra and gradient Centrifugation Microscopy: Analysis of different photo micrographs Photography: To submit a report of macro and micro photography Preparation of column for column chromatography.	4
	Total	15

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2. Bajpai P. K. (2006). *Biological instrumentation and methodology* . Mumbai: S. Chand and Company. Ltd.
3. Plummer D.T. (2009). *An Introduction to Practical Biochemistry*. 3rd edition. New Delhi: Tata Mc Graw Hill Education Private Ltd.
4. Ghatak K.L (2011). *Techniques and methods in Biology*. NY: Prentice Hall India Learning Private Limited.

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COURSE TITLE: PLANT PATHOLOGY (THEORY)

COURSE CODE: BOT-IV.E-7

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

To make the students aware of various plant pathogens and their control.

COURSE OUTCOME:

Upon successful completion of the course, students will be able to:
CO1: Identify various diseases and its causal agents of economically important plants.
CO2: Explain plant pathogen interaction.
CO3: Find effective control measures to deal with pathogen.
CO4: Isolate, observe and culture plant disease causing pathogens.

Sr. No	TOPICS	Hours
MODULE I: AN INTRODUCTION AND EPIDEMOLOGY OF PLANTS DISEASES		**15**
1.1	History, Definitions and Importance of plant pathology	
1.2	Concepts and types of diseases in plants	
1.3	Biotic causes of plant diseases.	
1.4	Infectious agents (nematodes, protozoans, bacteria, fungi & viruses) rowth, reproduction, survival and dispersal of important plant pathogens	
1.5	Disease triangle	
MODULE II: PLANT DISEASE DEVELOPMENT (PATHOGENESIS) AND MANAGEMENT		**15**

2.1 **2.2** **2.3** **2.4** **2.5** **2.6**	Parasitism and pathogenicity Symptomatology Host parasite interaction Recognition concept and infection, Role of enzymes, toxins & growth regulators in pathogenesis uantitative resistance (Physical, Biological & cultural methods) Biochemical defences (oxidative burst; Phenolics, Phytoalexins, PR proteins, antimicrobial substances and plantibodies), Quarantine measures	
ODULE III: GENETICS OF PLANT DISEASE AND STUDY OF PLANT DISEASES IN INDIA		**15**
3.1 **3.2** **3.3** **3.4**	Altered plant metabolism due to pathogens attack Genetics of resistance ('R' & avr genes, elicitors responses) Signalling and programmed cell death **Study of Diseases** (Name of disease, pathogen, symptoms and control measures need to be studied) Important diseases (Any 2 of each) of Paddy, Arecanut, Wheat, Banana, Coconut, Sugarcane, Mango and Amaranth/ Raddish	
	TOTAL	**45**

COURSE TITLE: PLANT PATHOLOGY (PRACTICAL)

COURSE CODE: BOT-IV.E-7

Sr. No	Topics	Practical Sessions
1	Isolation and culture of fungal and bacterial pathogens.	02
2.	Demonstration of Koch's postulates	01
3.	Assay for cellulase /pectinase enzyme from diseased plant	02
4.	Study of plant diseases with reference to pathogen & symptomology (Viral, Bacterial & Fungal) (any 10 as per theory)	05
5	Anatomical observations of fungal infected plants (rust, blight, rots)	3
6	Study of antagonistic behaviour of bacterial pathogens	1
7.	Visit to Plant Pathology Laboratory (CCARI)	1
	Total	**15**

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

REFERENCES

1. Agrios, G.N. (2005). *Plant Pathology* (5th ed.). London: Academic Press.
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5. Singh, R. S. (2019). Introduction to Principles of Plant Pathology. USA: Medtech
6. Gunasekaran, P. (2005). *Laboratory manual in Microbiology*. New Delhi: New Age International (P) Limited.

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9. Mehrotra, R.S. (1980). *Plant Pathology*. New Delhi: TMH
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11. Rangaswami, G. (1999). *Disease of Crop plants of India*. New Delhi: Prentice Hall of India Pvt. Ltd.

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COURSE TITLE: ALGAL BIOTECHNOLOGY (THEORY)

COURSE CODE: BOT-IV.E-8

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

This course provides knowledge on diversity of algal types in Goa and understands the potential significance of algal resources as food, fodder, fuel and environment sustenance

COURSE OUTCOMES: Students will be able to

CO1: Apprise the students to the methods of algal culture techniques.
CO2: Assess, compare and manage algal in water bodies
CO3: Explore algal bioresources and understand their commercial applications.
CO4: Understand opportunitities for start-ups through eco-friendly biofertilizer production using algae.

Sr. No	TOPICS	Hours
MODULE I: METHODS OF ALGAL ISOLATION AND CULTURE		**15**
1.1	Methods of algal isolation	
1.2	Types of algal cultures (synchronous, continuous, mass and "in vitro" culture)	
1.3	Maintenance and growth of algal culture (freshwater and marine algae)	
1.4	Multiplication of economically important algae (Rhodophyta, Phaeophyta, Chlorophyta, Cyanophyta)	

MODULE-II: PHYCOREMEDIATION AND ALGAL POLLUTION		15
2.1 2.2 2.3 2.4 2.5 2.6 2.7	Phycoremediation Sewage disposal and waste treatment, textile and effluent sugar industry Single cell algal protein and phycocolloids Algae as indicator of pollution, aquatic pollution by algae: causes and consequences Eutrophication and its impact on water quality Algae in environmental health, sewage treatment , Algal Blooms and their control	

Module III: COMMERCIAL APPLICATIONS OF ALGAL TECHNOLOGY		15
3.1 3.2 3.3 3.4 3.5 3.6	Application of algae in carbon sequestration Application of algae as food and fodder Application of algae in pharmaceutical industries Algae in biofuels Algae as Biofertilzers, application of cyanobacteria in bioplastics Algae as secondary metabolites Applications of algae in entrepreneurship development	
	TOTAL	**45**

COURSE TITLE: ALGAL BIOTECHNOLOGY (PRACTICALS)
PAPER CODE: BOT-IV.E-8
MARKS: 25
CREDITS:1
COURSE DURATION: 15 SESSIONS

Sr. No	TOPICS	PRACTICALS
1	Survey of market products of algal material	2
2	Visit to NIO and submission of report	2
3	Chromatographic separation of algal pigments (β-carotene containing algal	2
4	Documentation of various types of algae found in fresh and marine ecosystems of Goa	2
	Mini Projects Isolation and estimation of algal proteins and lipids Culture of algae (Fresh & marine water, one each) Preparation of algal biofertilizer.	7
	Total	**15**

REFERENCES

1 .Becker, S. W. (1994). *Micro Algae Biotechnology and Microbiology*. Cambridge University Press.

2. Ignacimuthu, S. (1996). *Basic Biotechnology*. New Delhi: Tata McGraw Hill Publishing Limited.

4. Tridevi, P. C. (2001). *Algal Biotechnology*. Jaipur: Point Publisher.

5. Venkatraman, G. S. (1972). *Algal Biofertilizers and rice cultivation*. New Delhi: Today and Tomorrows Printers and Publishers.

6. Zajic, J. E. (1970). *Properties and Products of Algae*. New York: Plenum Press.

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- Aziz M.A. and Ng W.G. (1993). Industrial wastewater treatment using an activated algae-reactor. *Water Sci. Technol.* ***28: 71–76.***

- Thomas D.G., Minj N., Mohan N. and Rao P.H. (2016.) Cultivation of microalgae in domestic wastewater for biofuel applications – An upstream approach. *J. Algal Biomass Utln.* ***7(1): 62-70***

- Power, M., Van der Meer, J., Tchelat, R. (1998). Molecular based methods can contribute to assessments of toxological risks and bioremediation strategies. *J. Microbiol*. Methods, **32: 107 –119**.

COURSE TITLE: PLANT MOLECULAR BIOLOGY (THEORY) W.e.f. July 2022
COURSE: BOT-V.C-7
MARKS: 100 (75 Theory+25 Practicals)
CREDITS: 4 (3 Theory +1 Practical) COURSE
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVE:
At the end of the course students will be able to explain life processes at the sub-cellular and molecular (gene) level and know general principles of gene organization and functions.

COURSE OUTCOMES
Upon successful completion of the course, students will be able to:
CO1: Outline, memorize and express process of central dogma
CO2: Understand molecular basis of life
CO3: Estimate and evaluate methods of quantitation of macromolecules
CO4: Learn and demonstrate basic molecular techniques of nucleic acid isolation and separation by electrophoresis.

Sr. No	TOPICS	Hours
MODULE-I: NATURE OF GENETIC MATERIAL AND DNA REPLICATION		**15**
1.1	Characteristics of genetic material, evidences to prove DNA & RNA as as genetic material, Watson and Crick's model of DNA; Polymorphism of DNA.	
1.2	Central dogma of molecular biology, Model organism for studying molecular biology; C-value paradox; Chargoff's Law, Franklin's and Wilkin's work	
1.3	General feature of DNA replication (replication eye, replication forks); Types of DNA replication, mechanism of DNA replication in Prokaryotes & in Eukaryotes (Dispersive, Conservative and Semi- conservative); enzymes of replication –DNA Primase; DNA polymerases.	
1.4	Recombination/Holiday model	

Module II: DNA DAMAGE AND TRANSCRIPTION		**15**
2.1 2.2	Types of DNA damages and repair (direct reversal of damage, excision repair) Structure and functions of mRNA, tRNA and rRNA, RNA polymerases	**15**
2.3	Secondary structure of mRNA and its functions	
2.4	Transcription of mRNA in prokaryotes & eukaryotes	
2.5	Post transcriptional event; eukaryotes splicing & processing.	
MODULE III: GENE REGULATION, EXPRESSION & TRANSLATION (PROTEIN SYNTHESIS)		
3.1	Units of gene (Cistron, recon, muton, enhancers, split genes, overlapping genes; transposons and its role in gene structure, promoters & terminators.	
3.2	Gene regulation in prokaryotes (Lac operon concept/tryptophan) & eukaryotes; Inducible and repressible mechanism.	
3.3	Mechanism & factors of Translation.	
3.4	Post translational modifications; Protein targeting	
	Total	**45**

COURSE TITLE: PLANT MOLECULAR BIOLOGY (PRACTICALS) COURSE CODE: BOT-V. C-7
MARKS 25

CREDIT 1

COURSE DURATION: 15 SESSIONS (*inclusive of 3 PA*)

Sr. No	**TOPICS**	**Practical sessions**
1	Isolation of plant genomic-DNA	3
2	Quantification of DNA by DPA method.	2
3	Isolation and estimation of RNA from plant tissue(orcinol method).	2
4	Preparation of Agarose gel and running of DNA	3
5	Demonstration of DNA amplification by PCR	3
6	Mini Project 1. Spooling of DNA from different plant samples	2
	Total	**15**

REFERENCES:

1. Gupta P.K. (2018) *Molecular Biology*. Rastogi Publications.
2. Alberts Bruce, Johnson A. Lewis Julian., Raff Martin., Roberts Keith., and Walter Paul (2002). *Molecular Biology of the Cell*. 4thedition. New York: Garland Publishing, Inc.
3. Buchanan B., Gruissem Wilhelm and Jones Russell L. (2015) *Biochemistry and molecular biology of plants*. Wiley Blackwell pub Ltd.
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5. James D. Watson (2007). *Molecular Biology of the Gene* (6th Edition) by, Tania A. Baker, Stephen P. Bell, and Alexander Gann.
6. Kleinsmith L.J and Kish V.M (1995). *Principles of Cell and Molecular Biology* (2nd Edition). New York: Happer Collins College Publishers.
7. Lehninger (2008). *Principles of Biochemistry* by David L. Nelson and Michael M.
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11. Johnson Charlotte (2009) *Plant molecular biology*. Oxford Book company.
12. David Freifelder (1983) Jones & Bartlett publishers. *Molecular biology*. 2nd Ed. Reprint 1993. Narosa Publishing House.

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3. https://www.cell.com › molecular-plan
4. https://www.freebookcentre.net › The-Molecular-Biolo…
5. https://nptel.ac.in/courses/102106025

COURSE TITLE: BIOINFORMATICS (THEORY) W.e.f. July 2022

COURSE CODE: BOT-V.E-9
MARKS: 100 (75 Theory +25 Practical)
CREDITS: 4 (3Theory +1 Practical)
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:

The course will help the students to understand the fundamentals of bioinformatics and tools available.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
CO1: Introduce, explain and explore biological databases through websites (online) and the need of Bioinformatics.
CO2: Compare and contrast protein information resources and genome information resources, different biological databases and its role in molecular level sequencing
CO3: Relate the theoretical knowledge with practical sessions. Enable data handling and analysis.
CO4: Define the terminologies, types of biological databases, its applications and compare the homology between different biological species.

	TOPICS	**Hours**
MODULE 1: INTRODUCTION TO BIOINFORMATICS AND INFORMATION NETWORKS		
1.1	Introduction to bio-informatics, The biological sequence / structure deficit.	**15**
1.2	Genome projects, Pattern recognition and prediction, Levels of protein structure, Ramachandran Plot	
	Role of Chaperons, Sequence analysis.	
1.5	Internet and the facilities available on it, computational biology, What is World Wide Web, Web browsers and Web Addresses.	
	The National Center for Biotechnology Information- NCBI, MMDb The European Molecular Biology Network- EMBnet Bioinformatics programme in India- BTISNet, BPI-2004,	

MODULE 2: INTRODUCTION TO BIOLOGICAL DATABASES AND SEQUENCE ALIGNMENT METHODS.		**15**
2.1 2.2 2.3 2.4	Introduction To Biological Database : GenBank, EMBL, SwissProt, PROSITE, EC-ENZYME, PDB, GDB, OMIM,PIR-PSD. Introduction and comparison of Homology, Analogy, Orthology And Paralogy. Alignment based methods and Hybrid method. Comparison of Computer Prediction Algorithms Introduction to pairwise and multiple sequence alignment; Comparison of sequences; Global alignment: The Needleman and Wunsch algorithm; Database interrogation, Alphabet and complexity; Pairwise database searching. BLAST; Databases of Multiple Alignments, Clustal Omega	15
MODULE 3: PROTEIN AND GENOME INFORMATION RESOURCES		15
3.1 3.2	Introduction to Protein information resources, Primary Sequence Databases, Composite protein sequence databases, Secondary databases, Composite protein pattern databases Structure classification databases. Introduction to genome information resources, DNA sequence databases, Specialised genomic resources, ORF (Open Reading Frame Finder), TIGR Genome Resources ,Genome comparison, Genome Annotation, Microarray image analysis	
	Total	45

COURSE TITLE: BIOINFORMATICS
COURSE CODE: BOT-V.E-9
MARKS: 25

CREDITS: 1

SR. NO	Module 4- TOPICS	PRACTICAL
	Biological databases and exploring various websites- NCBI, PUBMED and GenBank databases	3
	To explore EBI server and searching EMBL	2
	Exploring and querying UniProt KB	1

	Pairwise global alignment of protein and DNA using Needleman- Wunsh algorithm.	2
	Obtaining sequences for Pairwise alignment and to interpret the results to study the homology between the sequences.	2
	Database searching using different versions of BLAST and FASTA and Derivation of relationships of query sequences.	2
	Use of Clustal Omega for multiple sequence alignment	1
	MINI PROJECTS Drug designing Construction of phylogenetic trees/cladogram (comparison between different organisms)	2
	TOTAL	15

REFERENCES:

1. Attwood, D. J., Parry Smith D.J. and Phukan, S. (2011). *Introduction to Bioinformatics.* Pearson education.
2. Ignacimuthu, S. (2005). *Basic Bioinformatics*. Narosa PublishingHouse
3. Khan, I. A. and Khanum, A. (2003). *Fundamentals of Bioinformatics* –Ukaaz publications.
4. Mani, K. and Vijayaraj, K.A. (2002). *Bioinformatics for Beginners*. Aparnaa Publication.
5. Murthy, C. S. V. (2004). *Bioinformatics*. Himalaya Publishing House.

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3. http://www.clcbio.com/index
4. http://www.genome.jp
5. http://www.genome.jp/dbget/LinkDB
6. http://www.ncbi.nlm.nih.gov/Structure/CN3D/cn3d.shtml
7. http://www.softberry.com/berry
8. http://www.studentworkzone.com/
9. www.ebi.ac.uk
10. www.fgcu.edu/support/office2000
11. www.learnthenet.com WebPrimer
12. www.clustawomega.org
13. www.embl.org

Research article:

1. Antre R.V *et al.*, Computer aided Drug Design: An Innovative Tool for Modeling, Open Journal of Medicinal Chemistry, 2012,2,pp139-148.
2. Surabhi et al, Computer aided drug designs: An overview, Journal of Drug Delivery and Therapeutics, 2018; 8(5);pp504-509. Available at http://jddtonline.info

Drug Design Softwares:

1. ArgusLab- https://www.arguslab.com
2. Schrodinger- https://www.schrodinger.com/
3. VlifeMDSTM- https://vlifesciences.com/
4. Accelrys
5. SYBYL
6. AutoDock- https://autodock.scripps.edu/
7. FlexX- https://www.biosolveit.de/FlexX
8. Vakser Lab
9. Ligplot: https://www.ebi.ac.uk/thornton-srv.software/LIGPLOT/
10. LiganScout- https:/www.intelligand.com

COURSE TITLE: SEED TECHNOLOGY (THEORY) W.e.f. July 2022
COURSE CODE:BOT-V. E-10
MARKS: 100 (75 Theory+ 25 Practical)
CREDITS: 4 (3 Theory+ 1 Practical) COURSE
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVE:
Characterize seeds based on their viability, know and apply the theoretical knowledge to conserve the germplasm.
COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
CO 1: Review characteristics of good seeds and their role in germination. CO 2: Know methods of seed testing and understand seed viability.
CO 3: Realize the role of seed banks, seed storage units and seed testing organizations. CO 4: Apply knowledge of seed types to the field.

Sr. No	UNITS, TOPICS AND SUB-TOPICS	Hours
Module-I: PRINCIPLES OF SEED TECHNOLOGY AND SEED TESTING ORGANIZATIONS		**15**
1.1	Concepts and role of seed technology; Seed definition; types of seed (breeders seed, foundation seed, and certified seed); characteristics of good seeds, Field inspection, Seed certification, National seed corporation.	
1.2	International seed testing association ; central and state seed testing laboratory; Role of ICRISAT AND ICAR; Procedure, Equipments for seed testing; and importance of seed testing.	
Module II: PROCESSING AND PLANT BREEDING IN RELATION TO SEED TECHNOLOGY		**15**
2.1	Methods of seed drying and their advantages; Seed cleaning, Seed processing, seed treatments.	
2.2	Seed viability, seed dormancy – methods of breaking dormancy (any two methods), seed germination, Maintenance of breeders seed methods in self and cross fertilized crops.Development trial and release of seed variety. Use of heterosis in crop improvement.	

Module	**III: SEED PROTECTION AND STORAGE**	**15**
3.1	Importance of epidemic and seed borne diseases; Factors affecting seed infection	
3.2	Seed storage: Control of Seed borne pathogens; Pest problems and their treatment during storage.	
3.3	Germplasm and its conservation , seed banks and types of seed collection,Concept of seed marketing , forecasting of seeds.	
	Total	45

COURSE TITLE: SEED TECHNOLOGY
(PRACTICALS) COURSE CODE: BOT-V.E-10
MARKS: 25
CREDITS: 1
DURATION: 15 SESSIONS (*inclusive of 3 PA*)

Sr. No	TOPICS	Practical sessions
1	Physical and chemical properties of seeds	2
2	Structure of dicot and monocot seeds from various plant species	2
3	To test seed viability (2,3,5-triphenyl tetrazolium chloride test)	2
4	Breaking of seed dormancy using physical methods.	2
5	Mini Projects 1. Breaking of seed dormancy methods (chemical, hormone & temperature) 2. Seeds and diseases 3. Seed moisture and germination 4. Preparation of seed balls	6
6	Visit to ICRISAT/ seed tech plant and report submission	1
	Total	15

REFERENCES:

1. Agrawal (2005). *Seed Technology*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
2. Pandey (2010). *A text book of Botany*. New Delhi: S. Chand and Company Ltd.
3. Reddy (2008). *Principles of crop production*. New Delhi: Kalyani Publishers.
4. Santra and Chatterjee (2007). *College Botany*. Kolkata: New Central Book Agency (P) Ltd..
5. Umaraniet. A.L. (2006). *Experimental Seed Science and Technology*. Jodhpur: Agrobios.
6. Dutta (1983). *A Class book of Botany*. Calcutta: Oxford University Press.

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2. http://www.jnkvv.org/PDF/30032020194456Principles_of_Seed_Technology_Dr_Rudrasen_Singh.pdf
3. http://sgvu.bestbookbuddies.com/cgi-bin/koha/opac-detail.pl?biblionumber=69584
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COURSE TITLE: PLANT DRUG TECHNOLOGY AND PHARMACOGNOSY (THEORY) W.e.f. July 2022
COURSE CODE: BOT-V.E-11
MARKS: 100(75 Theory+ 25 Practicals)
CREDITS: 4 (3 Theory+ 1 Practical)
DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred.
COURSE OBJECTIVES:

To enable the students to learn and understand the fundamental knowledge, techniques & skills in plant drug industry, drug discovery and development.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
CO 1: Explain, discuss and classify medicinal plants, plant drug and technology
CO 2: Explain and illustrate, biosynthetic pathways, bioassays and working of instruments
CO 3: Discuss and compare methods of extraction and analysis of phytochemicals.
CO4: Apply fundamental knowledge, techniques and skills in plant drug industry, drug discovery and development.

SR. NO.	TOPICS	HOURS
	MODULE I: INTRODUCTION	**15**
1.1 1.2 1.3 1.4	Introduction to plant drug technology and Pharmacognosy Classification of drugs: morphological, chemical and pharmacological. Identification of marker compounds in the formulations. Bioassays, Fingerprint and identification of plant drugs. Biosynthesis of alkaloids. Metabolic pathways of selected plants (from *Ocimum sanctum* and *Rauwolfia*).	
	MODULE II: CULTIVATION, COLLECTION AND CONSTITUENTS	**15**
2.1 2.2 2.3 2.4 2.5	ROOTS/ RHIZOME: *Rauwolfia* and *Curcuma* LEAVES: *Adathoda* and *Ocimum* SEEDS: Fenugreek and Nutmeg FRUITS: Coriander and Senna pod FLOWERS: Clove and Rose	
	MODULE III: PHYTOCHEMICALS (EXTRACTION AND ANALYSIS)	**15**
3.1 3.2 3.3	Extraction methods and principles. Traditional and modern techniques Methods of Characterization: NMR,MS,UV-Vis, GC-MS, LC- MS Analysis of Pigments, Phenolics, Flavonoids and Alkaloids.	

	TOTAL	45

COURSE TITLE: PLANT DRUG TECHNOLOGY AND PHARMACOGNOSY (PRACTICAL)
COURSE CODE: BOT-V.E-11
MARKS: 25 CREDITS: 1
PRACTICAL SESSIONS: 15

Sr. No.	MODULE IV: TOPICS	Practical
1.	Isolation of alkaloids and Phenolics	02
2.	Test for alkaloids: Mayer's, Wagner's, Dragendorffs' reagent	01
3.	Disc diffusion for antimicrobial assay	02
4.	MIC evaluation for antimicrobial assay	02
5.	Anatomical study of *Nux vomica* seeds, Ginger, Citronella leaf, Senna leaf & its medicinal properties	04
6.	Histochemical tests for Oils and Fats – Castor seed/ *Eucalyptus*Citrus	01
7.	Microchemical test of Arum / *Colocasia* leaves for observation of Calcium oxalate crystals.	01
8.	Mini project Adulteration of crude drugs	02
	TOTAL	15

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2. www.pharmacyguideline.com
3. https://www.springer.com
4. https://www.biologydiscussion.com
5. amrita.edu/course/herbal-drug-technology-theory
6. pharmacyinfoline.com/herbal-drug-technology

COURSE TITLE: ORGANIC FARMING (THEORY) W.e.f. July 2022
COURSE CODE:BOT-V.E-12
MARKS: 100 (75 Theory +25 Practical)
CREDITS: 4 (3Theory +1 Practical)
COURSE DURATION: 45 HOURS
PREREQUISITE COURSES: Biology at XIIth preferred
COURSE OBJECTIVES:

The course provides knowledge of principles and practices of organic agriculture and its role in sustainable crop production.

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
CO 1: To understand the need and basics of Organic Farming, create awareness of the social, economic and environmental context for current and future organic agricultural production and management.
CO 2: Assess the importance of organic foods in today's World.
CO 3: Analyse and interpret the given problem in components of Organic Farming.
CO 4: Apply the knowledge in becoming an entrepreneur in Organic Farming to create own business plan.

Sr.No.	UNITS, TOPICS AND SUB-TOPICS	HOURS
MODULE 1: Concept of Organic farming, compost, manures and its application.		**15**
1.1	Introduction: Farming, organic farming, concept and development of organic farming. Principles of organic farming, Types of organic farming. Needs and benefits of organic farming. Agencies and institutions related to organic agriculture. Farm components for an organic farm	

1.2	Manure application: Composted vs. uncomposted manure Composting- principles, stages, types and factors Composting methods, Vermicomposting Bio-fertilizers, M.I., F.I.M., Neem cake, Mulching, Elley farming, Bioinoculation	
MODULE II: Soils, Soil Fertility Management and fertilizers		**15**
2.1 2.2 2.3 2.4 2.5 2.6	Soil types and Soil tillage Factors affecting soil fertility and productivity Land preparation Water management for good soil, Commercial fertilizers, composition Residual effects and fertilizer use efficiency Foliar application and its concept	
MODULEIII: Organic plant protection, Seed Certification and Entrepreneurship Development		**15**
3.1 3.2 3.3 3.4 3.5 3.6	Plant protection- cultural and mechanical Plant protection- bio pesticide and bio control agents. Allelopathic methods of weed control. Certification of organically produces seeds. Entrepreneurship – Concept, characteristics, approaches, need for entrepreneurship in Organic farming Popularization of organic farming. Marketing of organic produce. National and international scenario of organic farming	
	TOTAL	45

COURSE TITLE: ORGANIC FARMING
(PRACTICAL) COURSE CODE: BOT-V.E-12
MARKS: 25
CREDITS: 1
PRACTICAL SESSIONS: 15

Sr. No	**Module IV- Topics**	**Practical sessions**
1.	Comparative analysis of pH, EC, organic C, total N, available N, P, K and S from organic and inorganic data (obtained data).	01
2.	Survey of weeds in crop fields (Organic v/s inorganic farming)	01
3.	Study of soil types.	01
4.	Study of bio pesticide (Neem cake)	01
5.	Study of Mulching	01
6.	Study of nitrogen fixing bacteria in leguminous plants	01
7.	Visit to an organic farm	02
8.	Mini project: i) Preparation of Compost/ vermicompost ii) Effect of various manures on plant growth. iii) Study of recycling of farm waste. iv) Effect of AM inoculant on plant growth.	07
Total		15

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1. Chakraverty, A. (1991). Post-*harvest technology of cereal, pulses and oil seeds*. Oxford: IBH Publishing Co. Pvt Ltd.
2. Deshmukh, S.N. (2012). Organic Farming: Principles, Prospects and Problems, India: Agrobios Publishers.
3. Gehlot, D. (2010). *Organic Farming: Components and Management*, India: Agrobios Publishers.
4. Gupta, O.P. (2010). *Modern weed management*. Agrobios Publishers.
5. Israelsen, O.W. and Hansen, V.E. (2015). *Irrigation Principles and Practices*. John Wiley & Sons Inc.
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8. Rao, V.S. (2000). *Principles of Weed science*. Taylor & Francis Publishers.
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13. Singh, B. D. (2006). *Plant Breeding Principles and Methods*. Kalyani Publishers.
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15. Yawalkar, K. S., Agrawal, J.P. and Bokde, S. (1962). *Manures and Fertilizers*. Agri-Horticulture Publishing House.
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1. http://agritech.tnau.ac.in
2. https://www.agrifarming.in
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4. https://www.biologydiscussion.com
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COURSE TITLE: PLANT GENETIC ENGINEERING

COURSE CODE: BOT- VI.C-8

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3Theory +1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES: This course is to develop fundamental knowledge and skills in various aspects of Genetic engineering.

COURSE OUTCOME: Upon successful completion of the course, students will be able to:

CO1: Understand, associate and apply the basic knowledge of tools in plant genetic engineering.
CO2: Interpret, analyze and understand the techniques in plant genetic engineering.
CO3: Apply the knowledge of plant genetic engineering in various fields.
CO4: State the Biosafety regulations and assess its procedure and importance.

Sr. No	TOPICS	HOURS
	Module 1: Tools in Recombinant DNA technology	**15**
1.1	Introduction to Recombinant DNA technology, DNA cloning- cell based and cell free.	
1.2	Enzymes- Importance in plant genetic engineering, Nucleases: Exo and endonucleases; Types I, II, III and Nomenclature. DNA ligases. DNA modifying enzymes, Factors affecting enzyme activation.	
1.3	DNA ligation, transformation, selection of transformed bacteria- antibiotic selection.	
1.4	Vectors- Key features, advantages and disadvantages. Prokaryotic vectors - plasmids, cosmids, Lambda phage. Eukaryotic vectors- Bacterial Artificial Chromosome, Yeast Artificial Chromosome.	
1.5	DNA Isolation and sequencing (Sanger & Coulson, Maxam & Gilbert).	

Module 2 : Techniques in Recombinant DNA technology		15
2.1 2.2 2.3 2.4 2.5	Methods of Gene transfer: Indirect and Direct methods of gene transfer. Indirect method: Agrobacterium mediated gene transfer- T-DNA, Ti plasmid and Ri plasmid derived vector systems. T-DNA transfer. Direct methods of gene transfer: Physical and Chemical. Selection of transformants; selectable marker (Antibiotic resistant markers, herbicide resistant markers) and reporter genes (Luciferase, GUS, GFP). Gene Cloning: Construction of genomic and cDNA libraries, screening of DNA libraries; complementation, colony hybridization; Southern, Northern and Western blotting; ELISA, CRISPR-Cas9. Polymerase Chain Reaction, Techniques of DNA fingerprinting (RFLP, RAPD, AFLP)	

	Module 3: Applications of Genetic Engineering	15
3.1	Applications in Agriculture: Transgenic crops with improved quality traits: FLAVR SAVR Tomato, Golden rice, Bt cotton, herbicide resistant plants.	
3.2	Applications in Environment: Role of transgenics in bioremediation Mycoremediation, Phytoremediation, and Waste management(UASB reactor), Remediation of Xenobiotic compounds Molecular techniques in Phytoremediation .	
3.3	Applications in Industries: Edible vaccines; Industrial enzymes (Protease, Lipase); Genetically Engineered Products – Human Growth Hormone; Humulin; Superweeds	
3.4	Bioethics and Biosafety: Intellectual Property Rights, Genetic engineering and Public issues. Biosafety regulations	
	Total	**45**

COURSE TITLE: PLANT GENETIC ENGINEERING (PRACTICAL)

COURSE CODE: BOT- VI.C-8

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr. No	Topics	Practical Sessions
1	DNA isolation by CTAB/(any other) method	02
2.	Estimation of DNA	02
3.	Agarose Gel Electrophoresis	02
4.	Restriction digestion of DNA	02
5.	Sequence reading – Sanger method/Maxam Gilbert method – problem	02
6.	*Agrobacterium tumefaciens*-mediated plant transformation. (Virtual Library)	01
7.	Small scale plasmid preparation from *E. coli*	03
8.	Visit to a leading biotechnology institute/ Guest Lecture by Biotechnologist/ Goa university/ College and Report making.	01
	Total	**15**

REFERENCES:

1. Brown, T. A., (2006). *Gene cloning and DNA analysis An Introduction*. UK: Blackwell scientific publishers.
2. Chawla, H.S. (2000). *Introduction to Plant Biotechnology*. New Delhi: CRC Press.
3. Dovstekel (2005). *Microarray Bioinformatics*. UK: Cambridge University press.
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7. Sobti, R.C & Pachauri, S.S. (2009). *Essentials of Biotechnology*. New Delhi: Ane Books.
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J.E. (2005). *Biotechnology*. UK: Cambridge University press.

11. Wilson, K. & Walker, J. (2008). *Principles and Techniques of Biochemistry and Molecular Biology*. UK: Cambridge University Press.

Weblinks and Article References:

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COURSE TITLE: PLANT TISSUE CULTURE

COURSE CODE: BOT-VI.E-13

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3Theory +1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES: To develop the plant tissue culture skills.

COURSE OUTCOME: **Upon successful completion, the students will be able to:**

CO 1: Explain and discuss the general theoretical backgrounds and practical techniques

CO 2: Describe, define, explain/ discuss, compare, concept of differentiation and culture types.

CO 3: Define, describe, explain/ discuss, techniques in PTC in media preparation, sterilisation, callus culture and organogenesis

CO 4: Describe, explain, discuss applications in forestry, agriculture etc.

Sr.No	TOPICS	Hours
	MODULE – I: INTRODUCTION AND DIFFERENTIATION CONCEPT	**15**
1.1	Scope and history of plant tissue culture, Laboratory organization.	
1.2	Culture techniques – Sterilization methods of glasswares, explant preparation, sterilization, media composition and preparation.	
1.3	Cellular differentiation and totipotency; effect of growth regulators on differentiation.	
	MODULE – II: CULTURE TYPES AND TECHNIQUES IN TISSUE CULTURE	**15**
2.1	Cell culture types- callus, single cell and suspension culture Organogenesis and embryogenesis; Somaclonal variation; meristem culture, anther and	
2.2	Micropropagation, Germplasm conservation; Isolation and regeneration of protoplasm; Somatic hybridization, Synthetic seeds, Cryopreservation, secondary metabolite production.	
	MODULE- III: APPLICATION OF PLANT TISSUE CULTURE	**15**
3.1	Horticulture	
3.2	Agriculture	
3.3	Forestry	

TOTAL	**45**

COURSE TITLE: PLANT TISSUE CULTURE (Practical)

COURSE CODE: BOT-VI.E-13

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr. No	MODULE 4: Topics	Practical sessions
1	Preparation of MS Medium; Sterilization techniques	**03**
2	Embryo culture of maize	**02**
3	Callus induction and its morphological studies	**04**
4	Sub-culturing callus for rooting and shooting	**03**
5	Enzymatic Isolation of plant protoplast	**01**
6	Synthetic seed production	**01**
7	Visit to Plant tissue culture unit	**01**
	TOTAL	**15**

REFERENCES:

1. Bhojwani, S.S. (1990). *Plant Tissue Culture: Applications and Limitations*. USA: Elsevier Science Publishers.
2. Kumar, U. (1999). *Methods in Plant Tissue Culture.* Jodhpur: Agrobios.
3. Razdan, M. K. (2002). *Introduction to Plant Tissue Culture.* New Delhi: Oxford &IBH Publishing Co. Pvt. Ltd.
4. Satyanarayana U. (2013). *Biotechnology.* New Delhi: Books and allied (P) Ltd.
5. Vasil, I.K. and Thorpe, T.A. 1994. *Plant Cell and Tissue Culture*. Netherlands: Kluwer Academic Publishers.

COURSE TITLE: HORTICULTURE, FLORICULTURE AND LANDSCAPING (THEORY) w.e.fJune 2020

COURSE CODE: BOT-VI.E-14

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3 Theory +1 Practical

COURSE OBJECTIVES:

To provide entrepreneur opportunities.

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

- To explain the basics of Horticulture, floriculture and landscaping.
- To outline the requirements for building up nurseries, garden, etc.
- To inculcate the technique of vegetative propagation of plants.
- To identify and relate the scope of these fields in building up career.

	TOPICS	Hours
Module I: Introduction to Horticulture		
1.1	Definition and importance; scope of PomocultureOlericulture, Floriculture	**15 hours**
1.2	Fertilizers: inorganic, Organic – biofertilizers: vermin composting, green manure, algal culture, FYM.	
1.3	Pots & potting:– Earthen, Fibre, Polythene bags, Potting mixture, Potting, Re-potting, Top dressing.	
1.4	Irrigation:- Surface, Sprinkle, Drip and Gravity irrigation	
1.5	Use of plant growth regulators in horticulture: Induction of rooting, flowering, fruit set, fruit development and control of fruit crops.	

Module II: Introduction to Floriculture and Propagation methods		**15 hours**
2.1	Knowledge of annual, biennials and perennials with reference to ornamental flowers.	
2.2	Cultivation of commercial flowers – Rose, Jasmine, Chrysanthemum., Crossandra& Orchid	
2.3	Nursery maintenance; Cut flowers ; flower arrangements (including ikebana); improving shelf life of cut flowers. Green house, Poly house, Moist chamber, Net frame	
2.4	Sexual methods (seed propagation) – Definition, Merits and Demerits, Criteria for selection of seeds.	
2.5	Asexual (Vegetative) propagation – Definition, and types- Cutting (root, stem, leaf), Layering (simple, air), Grafting (Whip, Approach) and Budding (T, patch), Stock –scion relationship in important horticultural crops.	
Module III: Introduction to Landscaping		**15**
3.1	Types of garden: Formal, informal and kitchen garden.	
3.2	Locations in the garden- edges, hedges, fence, lawn, flower beds, Avenue, water garden (with two examples of each). Focal point. Auto CAD in garden designing	
3.3	National parks, Botanical gardens, water garden, rockery plants, Bonsai techniques, Hydroponics.	
3.4	Lawn making: type of lawn grasses and maintenance. Plants suitable for hedges. Aftercare: Weeding, top dressing methods of pruning and topiary	
	Total	**45 hours**

COURSE TITLE: HORTICULTURE, FLORICULTURE AND LANDSCAPING

COURSE CODE: BOT-IV.E-4

MARKS: 25

CREDITS: 1

Sr. No.	Module 4- Topics	Practical
1.	Preparation of nursery bed and polybag filling	01
2.	Preparation of potting mixture – Potting, repotting.	02
3.	Field work in cutting, grafting, budding, layering	02
4.	Garden designing using Auto CAD software/any app	01
5.	Familiarizing gardening tools and implements	01
6.	Preparation of organic compost&vermicompost	02
7.	Establishment of vegetable garden using organic compost &vermi-compost	03
8.	Flower arrangement	01
9.	Visit to nurseries, gardens and Report.	01
10	Improving the shelf life of cut flowers using chemicals	01
	Total	**15**

REFERENCES:

1. Swarup V. (1997). Ornamental horticulture. MaMillan India Limited, NewDelhi.
2. Randhava, G.S, 1973 – Ornamental horticultural in India Today and Tomorrow Printers and Publishers, NewDelhi.

3. Trivedi TP (2007). Ornamental horticultural in India. Indian Council of Agricultural Research NewDelhi.
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9. Alan Titchmarshs gardening guides(1984), Bush Roses, Hamlyn.
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Web links:

1. http://agritech.tnau.ac.in/horticulture/horti_index.html
2. http://agritech.tnau.ac.in/horticulture/horti_flower%20crops.html
3. http://agritech.tnau.ac.in/horticulture/horti_nursery%20techniques.html

COURSE TITLE: ECONOMIC BOTANY (THEORY)

COURSE CODE: BOT-VI. E-15

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

COURSE OBJECTIVES:

This course provides knowledge on the value of plants with scientific information and critical thinking to enhance economic botany.

COURSE OUTCOMES: Students will be able to

CO1: Identify and classify economically important plants/plant parts.

CO2 : Extract valuable plant products of potential market and economic value.

CO3 : Describe and create awareness of the uses of natural plant products

CO4 : Understand and use plants as an alternative to synthetic and chemical products

Sr. No	TOPICS	Hours
Module 1: Origin of Cultivated Plants (Centres of Origin, Cereals & legumes)		**15**
1. 1	**Centres of origin**: Concept, Vavilov's work, examples of major plant introductions; evolution of new crops/ varieties; crop domestication, NRRI, CFTRI, SBRI	
1.2	Genetic diversity and its loss, Importance of germplasm	
1.3	**Cereals:** Wheat, Rice (local varieties) and Millets (any one)	
1.4	**Legumes**: Chick pea, Cow pea and one fodder legumes	
Module 2: Sources of sugars & Starch, Oils & Fats, Drugs & Natural Rubber		**15**
2.1	**Sugar & Starch sources**: Sugarcane ; Potato & Dioscorea	
2.2	**Fat and Oil sources**: Groundnut, Coconut, Soybean and; extraction and applications of essential oils, Eucalyptus and mustard oils	

2.3	**Therapeutic and habit-forming drugs**: C*inchona, Cannabis*; Tobacco (Morphology, processing, uses and health hazards)	
2.4	**Tapping, processing and uses of** *Hevea brasiliensis*	
Module 3: Classification, general description and uses of Spices, & beverages, Fruit and Nuts, Fibers and Timber Plants		**15**
3.1	**Spices & condiments:** Clove, Black pepper, cinnamon, turmeric	
3.2	**Beverages**: Tea & Coffee	
3.3	**Fruits:** Mango, Cashew & Jackfruit	
3.4	**Fibers**: Coconut, cotton & Jute.	
3.5	**General account of Timber Plants**: Teak and Matti	
		45

COURSE TITLE: ECONOMIC BOTANY (PRACTICAL)

COURSE CODE: BOT-VI.E-15

MARKS: 25

CREDITS: 1

COURSE DURATION: 15 SESSIONS

Sr. No	TOPICS	Practical Sessions
1	Morphological and Microscopic study of cereal and legumes seeds (rice and groundnut)	04
2	Study of essential oil yielding plants (Coconut, Eucalyptus, Citrus)	02
3.	Mini Projects: i. Essential oil from plant sources ii. Analysis of starch content from plant sources(fruits, rhizome, tubers) iii. Analysis of plants for drugs, alkaloids and dyes iv. Fibers from plants v. Study of local fruits and spices	07
4	Visit to a Spice Farm/ Rubber Plantation/ economically important plant farm	02
	Total	**15**

REFERENCES:

1. Kochhar, S.L. (2012). *Economic Botany in Tropics*. New Delhi: MacMillan & Co.
2. Wickens, G.E. (2001). *Economic Botany: Principles & Practices*. Netherlands: Kluwer Academic Publishers.
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COURSE TITLE: APPLIED MYCOLOGY (THEORY)

COURSE CODE: BOT-IV.E-16

MARKS: 75

CREDITS: 3

COURSE OBJECTIVES:

This paper provides knowledge on culture techniques and the applicative aspects of fungi.

COURSE OUTCOMES: The students be able to:

- To explain techniques involved in sampling, culturing and maintaining fungal cultures.
- To discuss industrial and agricultural applications of fungi.

Sr.No.	TOPICS	Hours
Module 1: Introduction and Fungal Culture studies		**15**
INTRODUCTION		
1.1	General account of fungi. Microscopic structure, Chemical composition and understanding of fungal cell wall	
1.2	Environmental factors influencing fungal growth	
STUDIES OF FUNGAL CULTURE		
1.3	Introduction to culture collections, Culture Media formulations and types of media used in mycology. Culture databases.	
1.4	Various techniques for pure culture isolation and maximum recovery from different habitats (Soil, Litter, Water, Dung) Baiting, moist-chamber and particle-plating techniques	
1.5	Isolation of pure cultures and maintenance.	
1.6	Study of colony characters and growth patterns	
1.7	Fungal gene banks- Culture Collection Centres.	
Module 2: Industrial Mycology		
INDUSTRIAL MYCOLOGY		**15**
2.1	Role of fungi in biotechnology	
2.2	Applications of fungi in food industry • Flavour and texture • Fermentation and baking	

	• Organic acids (Preferably Citric acid) • Enzymes (Preferably Cellulases and Pectinases) Mycoproteins– SCP (Yeast)	
2.3	Endophytic fungi and its industrial applications.	
Module 3: Fungi in Agriculture, medicine and recent mycological advances.		**15**
FUNGI IN AGRICULTURE		
3.1	Fungi as biofertilizers (Preferably *Trichoderma*) Fungi as biocontrol agents- Mycofungicides, Mycoherbicides, Mycoinsecticides	
3.2	Mycorrhizae and its role	
3.3	Medical mycology - Secondary metabolites- Pharmaceutical preparations from fungi, antibiotics from fungi. (Preferably *Penicillium* and *Ganoderma*)	
MUSHROOM CULTIVATION & RECENT ADVANCES IN MYCOTECHNOLOGY		
3.4	Mushroom cultivation techniques: Oyster and Button mushrooms.	
3.5	Applications of PCR and other molecular techniques in mycology, Mycoinformatics, Mycoremediation	
		TOTAL: 45 Hours

COURSE TITLE: APPLIED MYCOLOGY (PRACTICAL)

COURSE CODE: BOT-IV.E-8

MARKS: 25

CREDITS: 1

Sr. No.	MODULE 4: TOPICS	Practicals
1.	Isolation and preparation of pure culture from a mixed culture plate on solid medium.	02
2.	Preparation of moist chamber and incubation of fungi	01
3.	Particle dilution plating for fungi	01
4.	Isolation of endophytic fungi from plant leaves	01
5.	Study of effect of incubation temperatures and pH on fungal growth	02
6.	Colorimetric estimation of cellulase and amylase produced by fungi	02
7.	Production of Citric acid (using *Aspergillus*) in broth and testing for its presence.	02
8.	Mushroom cultivation- Oyster mushrooms and its protein estimation	03
9.	Understanding structures of fungal enzymes using Bioinformatics tools.	01
	TOTAL	15

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2. Bhat, D. J. (2010) Fascinating Microfungi (Hyphomycetes) of Western Ghats – India. First edition.,Broadway Book Centre, Goa.

3. Powar, C.B. and Daginawala, H.F.(1982) General Microbiology–Volume II. Himalaya Publishing house: Bombay.

4. Prescott, L. M. (2005) Microbiology. 6th ed., Mc Graw-Hill.

5. Shivkumar, P.K., Joe, M.M. &Sukesh K.(2010) An Introduction to Industrial Microbiology. 1st ed., S.Chand& Company Pvt. Ltd.

6. Trivedi, P.S. and Pandey, S.N. (2009) A Textbook of Botany. Volume I. Vikas Publishing House Pvt Limited, New Delhi.

COURSE TITLE: BIORESOURCE MANAGEMENT W.e.f. July 2022

COURSE CODE: BOT-III.SEC-1
MARKS: 100
CREDITS: 4
DURATION: 60 HOURS
COURSE OBJECTIVES:

Objective of this paper is to provide introductory and practical knowledge on wine preparation, mushroom cultivation and spices and condiments and to develop professional skills in the given areas.

COURSE OUTCOMES:

Upon successful completion of the course, students will be able:
CO1: Learn about the varieties of fruits used for the wine preparation.
CO2: Understand the basic elements of wine fermentation, responsible organisms and process of wine production.
CO3:The course aims at developing skills and making the students become self-reliable and employable.
CO4: They are able to work in a mushroom farm / industry and research laboratory.
CO5: Identify and classify important plants/plant parts.
CO6 : Extract valuable plant products of potential market and economic value.

	UNITS, TOPICS AND SUB-TOPICS	HOURS
	Module 1: INTRODUCTION TO BIORESOURCES	**15**
1.1	Definition, types, importance and scope of bioresources, sustainable uses, value added products in the market	
1.2	**Basics of wine making**: History and culture of wine, Classification of wine: Generic classification, varietal classification, Grape variety as criteria for quality wine production	
1.3	Organic wines: Organic viticulture and wine-making practices	
1.4	Traditional and commercial wine-making: A comparison of traditional and new wine-making practices.	

1.5	Barrel aging, clarification, fining, settling, cold stabilization, filtering, blending, bottling, closure systems	
1.6	Economic importance of winemaking	
1.7	Wine marketing	
	MODULE II: PRODUCTION OF WINE	**15**
2.1	Wine preparation: fermentation, microorganisms, raking, tasting	
2.2	Preparation of wine using various fruits like apple, chickoo, ginger, guava, grapes, mango, pineapple, pomegranate, carrot, orange, dates, rose, watermelon, jamun, garcinia etc.	
	MODULE III – Mushroom Cultivation	**15**
3.1	Introduction, history and scope, Edible and non-edible mushrooms (Poisonous). Mushroom classification based on occurrence, habitat, color, morphology, fruit bodies.	
3.2	Biology and Life cycles of specific mushrooms (any one). Nutritional value and medicinal importance of mushroom, value added products of mushroom.	
3.3	Cultivation Technology: Mushroom laboratory; infrastructure- facilities and materials; Substrates (locally available - paddy straw, sugarcane trash, maize straw, banana leaves), Mushroom bed preparation (Composting technology, platform, equipment & facilities); pasteurization room & growing rooms. Mushroom spore isolation & spore culture; Culture media (PDA medium, Malt extract agar medium); Preparation of spawn-substrate, sterilization, multiplication & storage.	
3.4	Visit/demo/virtual study of button mushroom cultivation.	
	MODULE IV: MANAGEMENT OF OTHER BIORESOURCES	**15**
4.1	General description, processing, post-harvest practices and uses of Spices & condiments: chillies, clove, black pepper, cinnamon, turmeric, nutmeg.	
4.2	General description, processing, post-harvest practices and uses of vanilla and coconut and cashew.	
4.3	Visit to farms/processing units.	

	TOTAL	**60**

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4. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K., & Jayarajan, R. (1991). Oyster Mushrooms. Coimbatore, TN: Department of Plant Pathology, Tamil Nadu Agricultural University.

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