

DEPARTMENT OF BOTANY

Part B

i. Important points/ recommendations of BoS that require consideration/ approval of academic council.

- BoS revised syllabus of Semester II, IV & VI presented in Annexure I.

The foregoing minutes of the meeting to be circulated out by the Chairman via e-mail and the same was unanimously approved by all the members present.

The Chairman thanked the members of the Board of Studies in Botany for their valuable contributions, suggestions and participation.

The meeting was concluded on 31st January 2020 at 02:00 PM.

The following members of Board of Studies in Botany were present for the meeting

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| 1. Mrs. Amisha Shirodker Pednekar | - Chairman |
| 2. Dr. S. Krishnan | - V.C. Nominee |
| 3. Dr. Ranjita Sawaiker | - Subject Expert |
| 4. Ms. Ravina Pai | - Alumnus |
| 5. Dr. Sangeeta Sankhalkar | - Member |
| 6. Dr. Uma Masur | - Member |
| 7. Ms. Divyarani Revankar | - Member Secretary |
| 8. Ms. Eldrika Freda D Costa | - Member |
| 9. Ms. Jocelyn Makasare | - Member |

Members Absent:

Ms. Luian Albuquerque, Industry representative was absent for the meeting.

Ms. Divyarani Revankar

Ms. Amisha Shirodker Pednekar

Member Secretary

Chairman

Board of Studies

Board of Studies

Date: 14th February 2020

Programme Outcome (PO) and Course Outcome (CO)

Name of the Department: **Botany**

Programme Outcomes (PO)	Short Title of the POs	Description of the Programme Outcomes Graduates will be able to :
PO-1	Problem Analysis and Solutions	Think critically, identify, analyze problems/ situations and further attempt to design/ develop solutions that meet the specified goals.
PO-2	Use of Technology	Apply appropriate IT tools efficiently in their daily activities of communication and academics.
PO-3	Environment and Sustainability	Analyze and attempt solutions to environmental issues and commit themselves to sustainable development in the local/ national and global context.
PO-4	Ethics	Recognize and understand professional ethics /human values and be responsible for the same.
PO-5	Individual and Team work	Function effectively at various levels, capacities and situations.
PO-6	Communication	Communicate proficiently (oral and written) as a responsible member of society.
PO-7	Research Aptitude	Understand general research methods and be able to analyse, interpret and derive rational conclusions.
PO-8	Life Skills	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of domain specific change.
<u>PROGRAMME SPECIFIC OUTCOMES (PSO)</u>		
PSO-1		Recognize all forms of lower plants (Algae, Fungi, Bryophytes, Pteridophytes), higher plants (Gymnosperm and Angiosperm) and interpret/ predict their Phylogenetic linkages. Illustrate distinct features.
PSO-2		Recognize cell organelles and bio molecules including enzymes, Predict and interpret their significances in cell metabolism/functioning and Pathways.
PSO-3		Apply physiological mechanism of plants to analyze synthesis of valuable plant products (Primary/ Secondary) with economic potential and health

	effects through the field of Horticulture.
PSO-4	Analyze the techniques and working principles of Instruments used in Botanical studies and apply the knowledge in Basic and applied Plant research (Microbiology, Plant Physiology, plant breeding, Fungi, Plant Tissue Culture, Plant Genetic Engineering, Ecology, plant drug technology. etc.) through bio statistical parameters.
PSO-5	Analyze applications of online biological database, data handling in plant drug discovery and interactions.
PSO-6	Appraise student's knowledge in Botany including fundamental basis of all living organisms (Plant and Microbes) and applying the same in sustainable usage of resources for the quality human survival on planet earth and protect environment.

Sr. No.	Course Code	Course Title	Course Outcomes
1.	BOT-I.C-1	Plant diversity	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Explain the evolutionary aspects of different plant groups of lower plants.</p> <p>CO2: define, describe, correlate and compare the lower plant groups.</p> <p>CO3: Position a given lower plant as per the classification studied.</p> <p>CO4: sketch the morphology and anatomy of selected lower plants.</p>
2.	BOT-I.C-2	Cell Biology & Biomolecules	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:Recognize, classify cell, explain cell theory, evolution and biogenesis</p> <p>CO2: Define, describe, classify and explain cytoskeleton, cell organelle, biomolecules</p> <p>CO3: Define, describe, compare, explain, illustrate cell wall and plasma membrane</p> <p>CO4: Predict and interpret the importance of cell organelles and biomolecules in cell functioning</p>

3.	BOT-II.C-3	Plant Anatomy and Embryology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Define, describe and explain the basic plant anatomical and embryological features</p> <p>CO2: Compare the interrelatedness of organ-systems and their functions</p> <p>CO3: Examine the features through histological techniques.</p> <p>CO4: Define, describe, explain, compare theories in organization of tissues</p>
4.	BOT-II. C-4	Microbiology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: appraise the student knowledge to fundamental basis of all living microbes and their interaction with the environment.</p> <p>CO2: Apply the knowledge of microbial world towards the sustainable usage of resources for the quality human survival on the planet Earth.</p>
5.	BOT-III.C-5	Physiology of Plants	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Analyse Physiological processes operational in plants.</p> <p>CO2: Formulate and design experiments to verify studies theoretical physiological concepts and interpret data.</p> <p>CO3: Learn to describe the processes through practicals and mini projects.</p> <p>CO4: Estimate and evaluate methods of quantitation of pigments, enzymes and metabolites.</p>
6.	BOT-IV.C-6	Cytogenetics	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: To restate, discuss, explain, interpret fundamentals of genetics</p> <p>CO2: To analyse and predict the applications of the laws of genetics.</p> <p>CO3: To identify different stages of cell division and to construct chromosome maps.</p> <p>CO4: To review the effects of mutagens on seed germination.</p>
7.	BOT-V.C-7	Plant Molecular Biology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Outline, memorize and express process of central dogma</p> <p>CO2: Estimate and evaluate methods of quantitation of macromolecules</p> <p>CO3: Understand molecular basis of life</p> <p>CO4: Learn and demonstrate basic molecular techniques</p>

			of nucleic acid isolation and separation through electrophoresis.
8.	BOT-VI.C-8	Plant Genetic Engineering	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Understand, associate and apply the basic knowledge of tools, genetic markers, techniques of gene sequencing in recombinant DNA technology towards research.</p> <p>CO2: To interpret, analyse, justify a research problem and design an experiment by themselves.</p> <p>CO3: Compare and assess the different DNA sequencing techniques</p> <p>CO4: To state the Biosafety regulations and assess its procedure and importance.</p>
9.	BOT- III.E-1	Ecology & Conservation	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: To discuss, explain and review the role and importance of biotic and abiotic environment factors in the sustenance of plant life</p> <p>CO2: To analyze and evaluate the pollution scenario of the area.</p> <p>CO3: To quantitatively estimate the oxygen and Carbon dioxide from different water samples.</p> <p>CO4: To evaluate and determine minimum area of sampling unit (using quadrat) for the study of local vegetation.</p> <p>CO5: To relate the theory in the natural environment and work towards conservation of the environment.</p>
10.	BOT-III.E-2	Systematics of Flowering plants and Phylogeny	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Identify, outline, arrange, describe and compare taxa/ families in Botany according to Bentham and Hooker classification with examples.</p> <p>CO2: To examine the characters and outline keys for identification of flowering plants with relevant examples..</p> <p>CO3: Analyse and interpret the phylogenetic trees, cladograms in phylogeny.</p> <p>CO4: To understand the importance of APG classification and biosystematics.</p>
11.	BOT-III.E-3	Enzymes and	Upon successful completion of the course, students

		metabolic pathways	<p>will be able to:</p> <p>CO1:To identify the role of enzymes in various biological processes</p> <p>CO2:To classify the different enzymes based on its structure and function</p> <p>CO3:To understand and extrapolate the various mechanisms of enzyme action</p>
12.	BOT-III.E-4	Herbal Cosmetology	<p>Upon successful completion of the course, students will be able:</p> <p>CO 1: To explain the basics of herbal cosmetology, skin, skin types.</p> <p>CO 2: To outline the requirements for making herbal soaps, oils, shampoos, face packs, etc.</p> <p>CO 3: To inculcate the technique of preparation of herbal products.</p> <p>CO 4: To identify and describe the herbs used for cosmetic products.</p> <p>CO 5: To understand future prospects of Herbal cosmetic industry.</p>
13.	BOT-IV.E-5	Plant Breeding and Biostatistics	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:To recognize, discuss, explain and evaluate various techniques in plant breeding</p> <p>CO2:To categorize and compare different modes of plant breeding</p> <p>CO3:To employ manual emasculation procedure.</p> <p>CO4:To calculate mean, median, mode, standard deviation, std. error for provided material.</p>
14.	BOT-IV.E-6	Techniques and Instrumentation in Botany	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:To understand, define and explain the principle, instrumentation and working of techniques used in Botanical research.</p> <p>CO2:Analyze the research problem and formulate the methodology for carrying out research/experiment.</p> <p>CO3:To build a hypothetical methodology for analysis of biological samples.</p> <p>CO4:To compare and contrast the techniques used in Research fields.</p>
15.	BOT-IV.E-7	Plant pathology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:Identify various diseases and causal agents of economically important plants</p> <p>CO2:Find effective control measures</p>
16.	BOT- IV.E-8	Algal	

		Biotechnology	
17.	BOT-V.E-9	Bioinformatics	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:To introduce, explain the basics of Bioinformatics to students, biological databases</p> <p>CO2:Compare and contrast protein information resources and genome information resources, different biological databases and its role in molecular level sequencing</p> <p>CO3:Relate the theoretical knowledge with practical sessions.Enable data handling and analysis.</p> <p>CO4: To define the terminologies, types of biological databases and its applications</p> <p>CO5: Compare the homology between different biological species.</p> <p>CO6: To explore websites (online) and understand the need of Bioinformatics</p>
18.	BOT-V.E-10	Seed Technology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO 1: Review characteristics of good seeds and their role in germination.</p> <p>CO 2: Know methods of seed testing and understand seed viability.</p> <p>CO 3: Realize the role of seed banks, seed storage units and seed testing organizations.</p> <p>CO 4: Apply knowledge of seed types to the field.</p>
19.	BOT-V.E-11	Plant Drug Technology and Pharmacognosy	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:Explain, discuss and classify medicinal plants, plant drug and technologies of extraction</p> <p>CO2:Explain and illustrate, biosynthetic pathways, bioassays and working of instruments</p> <p>CO3:Discuss and compare methods of extraction and analysis of phytochemicals.</p>
20.	BOT-V.E-12	Organic Farming	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: 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.</p>

			<p>CO2:Assess the importance of organic foods in today's World.</p> <p>CO3: To analyse and interpret the given problem in components of Organic Farming.</p> <p>CO4:Apply the knowledge in becoming an entrepreneur in Organic Farming to create own business plan.</p>
21.	BOT-VI.E-13	Plant tissue culture	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: Explain and discuss the general theoretical backgrounds and practical techniques</p> <p>CO2:Describe, define, explain/ discuss, compare, concept of differentiation and culture types</p> <p>CO3:Define, describe, explain/ discuss, techniques in PTC in media preparation, sterilisation, callus culture and organogenesis</p> <p>CO4:Describe, explain, discuss applications in forestry, agriculture etc</p>
22.	BOT-VI.E-14	Horticulture, floriculture and landscaping	<p>Upon successful completion of the course, students will be able to:</p> <ul style="list-style-type: none"> • 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.
23.	BOT-VI.E-15	Economic Botany	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1:To identify plants based on their economic significance</p> <p>CO2:To extract valuable plant products of potential market and economic value.</p> <p>CO3:To extract essential oils from plant sources</p> <p>CO4:To evaluate, describe and create awareness of the uses of natural plant products as alternative to synthetic and chemical products</p>
24.	BOT-VI.E-16	Applied Mycology	<p>Upon successful completion of the course, students will be able to:</p> <p>CO1: To discuss and explain techniques involved in sampling, culturing and maintaining fungal cultures.</p> <p>CO2: To discuss and practice industrial and agricultural</p>

			applications of fungi.
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COURSE STRUCTURE – DEPARTMENT OF BOTANY
Three year B.Sc. Degree Course in BOTANY revised w.e.f. June 2020.

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. June 2020

COURSE CODE: BOT-I.C-1.

MARKS: 100(75 theory + 25 Practical)

CREDITS: 4 (3 theory + 1 Practical)

COURSE DURATION: 45 HOURS

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: Explain the 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 <i>Nostoc</i> and Charophyta: <i>Chara</i>	
UNIT II: FUNGI		
2.1	General characteristics, Classification, economic importance. Systematic position, life history of <i>Puccinia</i> and <i>Penicillium</i>	
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 <i>Riccia</i> , <i>Marchantia</i> , <i>Anthoceros</i> and <i>Funaria</i> .	
UNIT IV: PTERIDOPHYTES		
4.1	General characters, brief classification, stellar evolution, alternation of generation.	
4.2	Structure, reproduction, life history and systematic position of <i>Psilotum</i> , <i>Lycopodium</i> and <i>Marsilea</i> .	
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 <i>Pinus</i> and <i>Gnetum</i>	
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: <i>Oscillatoria/Nostoc, Chara, Sargassum, Polysiphonia</i>	03
2.	Morphological study of fungal forms: <i>Puccinia, Penicillium, Albugo</i> and <i>Rhizopus</i>	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 <i>Riccia</i> or <i>Anthoceros</i>) ii. Pteridophyte (preferably <i>Selaginella</i>) iii. Gymnosperm (preferably <i>Cycas</i>)	05
6.	Mini project: Collection and field study of locally available Algae, Bryophytes, Pteridophyte, Gymnosperms and Lichens	02
	Total	15

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1. Alexopoulos, Constantine J.; Mims, Charles W. (1983). Introductory Mycology; 3rd edition; New Delhi: Wiley Eastern Limited.
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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

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8. Sharma, O. P. (2017). *Diversity of Microbes and Cryptogams- Pteridophyta*. McGraw Hill Education.
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13. Vasishtha B.R. And Sinha A. K. (2005). *Botany for degree students Part 1 Algae*; 1st Edition S. Chand &CompanyLtd.

Web References:

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

COURSE TITLE: CELL BIOLOGY AND BIOMOLECULES (THEORY) w.e.f June 2020

COURSE CODE: BOT-I.C-2

MARKS: 100 (75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

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	
1.2	Prokaryotic and Eukaryotic cell; Cell theory	
1.3	Cell evolution and biogenesis	
1.4	Structure and functions of cytoskeleton;	
1.5	Structure and function of Microtubule, Intermediate filaments, Microfilaments	
1.6	Structure and function of cell wall; Chemical composition of cell wall; 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	Semiautonomy and gene control;	
2.2	Structure & functions of peroxisome, glyoxysome& lysosomes	
2.3	Nucleus and its Organization; Nuclear envelope, nuclear pore complex Nuclear matrix, Chromosomes and chromatin structure	
2.4	Structure and function of ribosome	
2.5	Endomembrane systems- Endoplasmic reticulum and Golgi complex	
Module III: BIOCHEMISTRY OF CARBOHYDRATES, LIPIDS AMINO ACIDS AND PROTEINS		15
3.1	Definition & importance of biomolecules; types of bonds in biomolecules; pH and buffers ; Water as a biological solvent	
3.2	Classification and biological functions of carbohydrates and lipids	
3.3	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	PRACTICAL SESSIONS
1.	Study of cell structure in <i>Hydrilla</i> and <i>Tradescantia</i> 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
	I. Cytochemical staining of Nucleus- Acetocarmine II. Cytochemical staining of polysaccharides- Periodic Acid Schiff's (PAS) III. Cytochemical staining of Mitochondria – Jannis Green IV. Cytochemical staining of Total proteins –Bromophenol blue V. 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

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3. Gupta, P.K. (1999). A Text-book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
4. Robert A. Horton. (2006).Principles of Biochemistry.4th ed. Pearson Prentice Hall.
5. Jeremy M. Berg, John L. Tymoczko and LubertStryer.(2002). Biochemistry5th edition, W.H.Freeman & Company, New York
6. Karp, G. (1999). Cell and molecular Biology, Concepts and experiments (John Wiley and Sons Inc) 2nd

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10. Randall J. WeselakeEmail authorStacy D. SingerGuanqun Chen. (2018, July 19). *Introduction to Plant Biomolecules and Cellular Metabolism*. Retrieved Februaury 13, 2020, from Springer:
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<https://nptel.ac.in/courses/102103012/>
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COURSE TITLE: PHYSIOLOGY OF PLANTS (THEORY)
COURSE CODE: BOT.III.C-5
MARKS: 100 (75Theory +25 Practical)
CREDITS: 4 (3 Theory +1 Practical)
COURSE DURATION: 45 HOURS

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:

- CO 1: Analyse Physiological processes in plants.
- CO 2: Formulate, design experiments and interpret data.
- CO 3: Learn to demonstrate and describe the physiological process through practical's and mini projects.
- CO 4: Estimate and evaluate methods of quantitation of pigments, enzymes and metabolites.

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	CO ₂ fixation (C ₃ , C ₄ 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	Role of phytochromes & cryptochromes and its functions	
3.2	Plant hormones, transport and physiological functions	
3.3	Photoperiodism and & vernalization	
3.4	Senescence, seed dormancy & germination	
3.5	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 consumption during respiration 4. Role of Plant hormones in plant growth 5. Starch production during photosynthesis 6. Use of hydroponic technique for plant growth	6
		15

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12. Nelson , D.I. and Cox M. M. (2000). Lehninger. Principles of biochemistry, 3rd edition, Macmillan U.K.
11. 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.

COURSE TITLE: ECOLOGY & CONSERVATION (THEORY) w.e.f June 2020

COURSE CODE: BOT-III.E-1

MARKS: 100 (75 Theory+ 25 Practical)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

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 able:

CO 1: To discuss, explain and review the role and importance of biotic and abiotic environment factors in the sustenance of plant life

CO 2: To analyze and evaluate the pollution scenario of the area.

CO 3: To quantitatively estimate the oxygen and Carbon dioxide from different water samples.

CO 4: To evaluate and determine minimum area of sampling unit (using quadrat) for the study of local vegetation.

CO 5: To relate the theory in the natural environment and work towards conservation of the environment.

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 of India, 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 FACTORS AND 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 Water- precipitation, moisture & measurement of rainfall	
2.2	Wind - speed, advantages and damage caused to plants	
2.3	Soil- Soil profile, texture, classification and organic matter	
2.4	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 & 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), Xerophytes (succulents) and Halophytes (leaf)	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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1. Ambasht, R.S. (1988), A Text Book of Plant Ecology. Students Friends Co., Varanasi.
2. P. D. Sharma (2004), Ecology and environment, 7th edition, Rastogi publications, Meerut.
3. Jogdand, SN, (1995), Environmental Biotechnology, Himalaya Publishing House, Mumbai.
4. Sharma B. K., (2001), Environmental chemistry ,Sixth revised edition , Goel publication house, Meerut
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6. Santra S.C., (2017), Environmental Science, New Central Agency, NewDelhi.
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12. Sangodkar U.M.X and MasurPatil Uma (2018), Fundamentals in Environmental Biotechnology, 1st Edition,CinnamonTeal Publishers.
13. Science Direct:<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/carrying-capacity>.
14. World Wide Fund – India :<https://www.wwfindia.org/>
15. NEERI: <https://www.neeri.res.in/>
16. TRAFFIC:<https://www.worldwildlife.org/initiatives/traffic-the-wildlife-trade-monitoring-network>
17. International Union for conservation of nature: <https://www.iucn.org/>
18. MSSRF- <https://www.mssrf.org/>
19. TERI-<https://www.teriin.org/>

COURSE TITLE: TECHNIQUES & INSTRUMENTATION IN BOTANY (THEORY)

w.e.f. June 2020

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 techniques used in Botanical research.

CO 2: Analyze the research problem and formulate the methodology for carrying out research/experiment.

CO 3: To build a hypothetical methodology for analysis of biological samples.

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)	
1.2	Fluorescence microscopy	
1.3	Transmission and Scanning electron microscopy (sample preparation for electron microscopy, cryofixation,)	
1.4	Microscopic measurements (Micrometry & cytometry) and photography (micro and macro)	
1.5	Radioactivity and its measurements (Geiger Muller and Scintillation counter and autoradiography)	

MODULE II : CENTRIFUGATION AND SPECTROPHOTOMETRY: PRINCIPLE, METHODOLOGY AND APPLICATIONS		15
2.1	Centrifugation: Low speed, high speed, cooling centrifuges and ultracentrifugation Analytical, preparatory and gradient centrifugation	
2.2	UV visual spectrophotometry	
2.3	Fluorescence spectrophotometry	
2.4	Flame (Atomic absorption) spectrophotometry	
2.5	Mass spectrophotometry	
MODULE III: CHROMATOGRAPHY, ELECTROPHORESIS & MOLECULAR TECHNIQUES: PRINCIPLE, METHODOLOGY AND APPLICATIONS		15
3.1	Adsorption and partition chromatography	
3.2	Column chromatography (isocratic and gradient)	
3.3	High Performance Liquid Chromatography & Gas Chromatography	
3.4	Electrophoresis: Agarose Gel Electrophoresis, Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis , Iso-Electric Focussing and 2-Dimensional Electrophoresis	
3.5	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: 1. Comparison of data of ultra and gradient Centrifugation 2. Microscopy: Analysis of different photo micrographs 3. Photography: To submit a report of macro and micro photography 4. Preparation of column for column chromatography.	4
	Total	15

Suggested Reference Books:

1. Karp, G. (1999). Cell and molecular Biology, Concepts and experiments (John Wiley and Sons Inc) 2nd edition. USA.
2. Bajpai P. K. (2006). Biological instrumentation and methodology (S. Chand and Company. Ltd. Mumbai.
3. Plummer D.T. (2009). An Introduction to Practical Biochemistry. 3rd edition. Tata Mc Graw Hill Education Private Ltd. New Delhi.
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6. vlab.amrita.edu,. (2011). Polyacrylamide Gel Electrophoresis. Retrieved 12 February 2020, from vlab.amrita.edu/?sub=3&brch=186&sim=319&cnt=1
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COURSE TITLE: ENZYMES AND THEIR METABOLIC PATHWAYS (THEORY) w.e.f June 2020.

COURSE CODE: BOT-III. E-3

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

COURSE OUTCOMES:

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

CO 1: To identify the role of enzymes in various biological processes.

CO 2: To relate the various mechanisms of enzyme action.

CO 3: To specify enzyme characteristics and their metabolism.

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	Michalis Menten equation and its significance.	
2.3	Fisher's lock and key model and Koshland (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

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	<ul style="list-style-type: none"> 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

REFERENCES:

1. Bennett, T. P. and Frieden E. (1969). *Modern Topics in Biochemistry*. pg. 43-45, Macmillan, London
2. Breaker, Ronald R. (2000). Making Catalytic DNAs. *Science* 290: 2095–2096.
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4. Deeth, R. J. (1997). Chemical Choreography. *New Scientist* 155: 24–27.
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6. Holum, J. (1968). *Elements of General and Biological Chemistry*, 2nd ed., 377, NY: Wiley.
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13. Voet, D., & Voet, J. (2010). *Biochemistry* (4 ed.). New Jersey: John Wiley & Sons, Inc.

COURSE TITLE: HERBAL COSMETOLOGY (THEORY) w.e.f June 2020

COURSE CODE: BOT-III.E-4

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3 Theory +1 Practical)

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: To explain the basics of herbal cosmetology, skin, skin types.
- CO 2: To outline the requirements for making herbal soaps, oils, shampoos, face packs, etc.
- CO 3: To inculcate the technique of preparation of herbal products.
- CO 4: To identify and describe the herbs used for cosmetic products.
- CO 5: To understand future prospects of Herbal cosmetic industry.

	TOPICS	Hours
Module I: Introduction to Herbal cosmetology		
1.1	Definition, Collection and processing of herbal material, Natural and artificial drying of herbal material	15 hours
1.2	Herbal remedies for holistic health	
1.3	Current status of Herbal Cosmetic Industry in India	
1.4	Introduction Herbal edible churnas beneficial for skin and hair	
1.5	Herbs used in weight loss and weight gain: <ul style="list-style-type: none">• Herbs for weight gain• Herbs for weight loss (For e.g. Ginseng, Cinnamon, Black Pepper, Dandelion, Yashtimadhu, Ashwagandha)	
1.6	Herbs that help in depression and anxiety Future prospects of herbal cosmetic industry	

Module II: Identification (botanical name and family), description and utilization of following plants with Cosmetic benefits & their cosmetic uses		15 hours
2.1	i) <i>Curcuma longa</i> ii) <i>Aloe vera</i> iii) <i>Azadirachta indica</i> iv) <i>Ocimum sp.</i> v) <i>Moringa sp.</i> vi) <i>Cymbopogon flexuosus</i> vii) <i>Murrayakoenigii</i> viii) <i>Citrus limon</i> ix) <i>Mentha sp.</i> x) <i>Tagetes sp.</i> xi) <i>Musa paradisiaca</i> xii) <i>Rosa sp.</i> xiii) <i>Manjistha</i>	
Module 3: Standardization of raw material and commonly used herbs in the herbal cosmetics		15
3.1	Importance of standardization	
3.2	Physical and chemical methods of standardization	
3.3	Quantitative and qualitative estimation of phyto-constitutes Herbs used in the following cosmetic product:	
3.4	<ul style="list-style-type: none"> ○ Herbal Shampoo ○ Herbal Conditioner ○ Herbal Hair Dye/ Herbal Hair Oil/Hair Cream/Hair Gel, ○ Herbal Face Mask ○ Herbal Bath Oil. Study of protocol for preparation of : <ul style="list-style-type: none"> ○ Different types of Herbal face masks- for dry skin, oily skin, pigmented skin & wrinkled skin ○ Special Herbal masks for sensitive skin 	

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	02
3.	Demostration of Churna preparation	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- <i>Lawsonia inermis</i> (mehndi) and <i>Curcuma longa</i> (turmeric),	02
7.	Mini project : <ul style="list-style-type: none">• 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

REFERENCES:

1. Fuller, K.W. and Gallon, J.A. (1985) Plant Products and New Technology. Clarendon Press, Oxford, New York.
2. Kocchar, S.L. (1998) Economic Botany in Tropics, 'i.'d edition. Macmillan India Ltd., New Delhi..
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4. Sachs, M. (2014) Ayurvedic Beauty Care: Ageless Techniques to Invoke Natural Beauty. ISBN: 9788120818804

5. Sharma, O.P. (1998) Hill's Economic Botany. Tata McGraw Hill Publishing Company Ltd., New
6. www.santulan.in
7. www.pvayurveda.com

COURSE TITLE: PLANT MOLECULAR BIOLOGY (THEORY)**COURSE: BOT-V.C-7****MARKS: 100 (75 Theory+25 Practicals)****CREDITS: 4 (3 Theory +1 Practical)****COURSE DURATION: 45 HOURS****COURSE OBJECTIVE**

At the end of the course student will 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:

CO 1: Outline, memorize and express process of central dogma.

CO 2: Estimate and evaluate methods of quantitation of macromolecules.

CO 3: Understand molecular basis of life.

CO 4: Learn and demonstrate basic molecular technique of DNA isolation and separation through electrophoresis.

Sr. No	UNITS, TOPICS AND SUB-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.	

Module II: DNA DAMAGE AND TRANSCRIPTION		15
2.1	Types of DNA damages and repair (direct reversal of damage, excision repair)	
2.2	Structure and functions of mRNA, tRNA and rRNA	
2.2	Transcription of mRNA in prokaryotes & eukaryotes	
2.3	Post transcriptional event; eukaryotes splicing & processing	
MODULE III: GENE REGULATION, EXPRESSION & TRANSLATION (PROTEIN SYNTHESIS)		15
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) & eukaryotes (tryptophan) ; Inducible and repressible mechanism.	
3.3	Secondary structure of mRNA and its functions	
3.4	Mechanism & factors of Translation; RNA polymerases	
3.5	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. 4th edition. Garland Publishing, Inc., New York.
3. Buchanan B., Gruissem Wilhelm and Jones Russell L.(2015) Biochemistry and molecular biology of plants. Wiley Blackwell pub Ltd.
4. Pal, J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology. Oxford.
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 (Second Edition). Happer Collins College Publishers, New York.
7. Lehninger (2008). Principles of Biochemistry by David L. Nelson and Michael M.
8. Dube, R.C. (2008). A Text Book of Biotechnology S. Chand pub.
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- 12 David Freifelder(1983) Jones & Bartlett publishers. 2ed Molecular biology. Reprint 1993. Narosa Publishing House.

COURSE TITLE: BIOINFORMATICS (THEORY) w.e.f June 2020

COURSECODE: BOT-V.E-9

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3Theory +1 Practical)

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:

CO 1: Introduce, explain the basics of Bioinformatics and biological databases.

CO 2: Compare and contrast protein information resources and genome information resources, different biological databases and its role in molecular level sequencing

CO 3: Relate the theoretical knowledge with practical sessions. Enable data handling and analysis.

CO 4: To define the terminologies, types of biological databases and its applications

CO 5: Compare the homology between different biological species.

CO 6: To explore websites (online) and understand the need of Bioinformatics

	TOPICS	Hours
MODULE 1: INTRODUCTION TO BIOINFORMATICS AND INFORMATION NETWORKS		
1.1	Introduction to bio-informatics, The biological sequence / structure deficit.	15 hours
1.2	Genome projects, Pattern recognition and prediction, Levels of protein structure, Ramachandran Plot	
1.3	Role of Chaperons, Sequence analysis.	
1.4	Fields Related to Bioinformatics: Computational Biology, Genomics, Proteomics, Pharmacogenomics, Cheminformatics, Medical Informatics, Importance of Bioinformatics.	
1.5	Internet and the facilities available on it, computational biology, What is World Wide Web, Web browsers and Web Addresses. The National Centre for Biotechnology Information- NCBI, MMDB The European Molecular Biology Network- EMBnet Bioinformatics programme in India- BTISNet, BPI-2004, BOLD (Bar code of life database)	

MODULE II: INTRODUCTION TO BIOLOGICAL DATABASES AND SEQUENCE ALIGNMENT METHODS.		15
2.1	Introduction To Biological Database : GenBank, EMBL, SwissProt, PROSITE, EC-ENZYME, PDB, GDB, OMIM,PIR-PSD.	15 hours
2.2	Introduction and comparison of Homology, Analogy, Orthology And Paralogy. Alignment based methods and Hybrid method. Comparison of Computer Prediction Algorithms	
2.3	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.	
2.4	BLAST; Databases of Multiple Alignments, Clustal Omega	
MODULE 3: PROTEIN AND GENOME INFORMATION RESOURCES		15
3.1	Introduction to Protein information resources, Primary Sequence Databases, Composite protein sequence databases, Secondary databases, Composite protein pattern databases; Structure classification databases.	
3.2	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
1.	Biological databases and exploring various websites- NCBI, PUBMED and GenBank databases	3
2.	To explore EBI server and searching EMBL	2
3.	Exploring and querying UniProt KB	1
4.	Pairwise global alignment of protein and DNA using Needleman- Wunsch algorithm.	2
5.	Obtaining sequences for Pairwise alignment and to interpret the results to study the homology between the sequences.	2
6.	Database searching using different versions of BLAST and FASTA and Derivation of relationships of query sequences.	2
7.	Use of Clustal Omega for multiple sequence alignment	1
8.	MINI PROJECTS 1. Drug designing 2. 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 Publishing House
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.

Web Resources

1. <http://genes.mit.edu/GENSCAN.html>
2. <http://vmoc.museophile.org> ComputerHistory
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
14. 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)**COURSE CODE: BOT-V. E-10****MARKS: 100 (75+25)****CREDITS: 4 (3+1)****DURATION: 75 HRS****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. 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: PLANT BREEDING IN RELATION TO SEED TECHNOLOGY		15
2.1	Maintenance of breeders seed methods in self and cross fertilized crops. Development trial and release of seed variety	
2.2	Germplasm and its conservation, seed banks and types of seed collections; Use of heterosis in crop improvement	
Module III: SEED PROTECTION, PROCESSING AND STORAGE		15
3.1	Importance of epidemic and seed borne diseases; Factors affecting seed infection	
3.2	Control of Seed borne pathogens; Pest problems and their treatment during storage	
3.3	Methods of seed drying and their advantages; Chemicals and equipments for seed treatments; Concept of seed marketing; Forecasting of seed.	
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 seed	3
2	Structure of dicot and monocot seeds from various plant species	3
3	To test seed viability (2,3,5-triphenyl tetrazolium chloride test)	2
4	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
5	Visit to ICRISAT/ seed tech plant and report submission	1
	Total	15

REFERENCES:

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

COURSE TITLE: PLANT DRUG TECHNOLOGY AND PHARMACOGNOSY (THEORY)(w.e.f. June 2020)

COURSE CODE: BOT-V.E-11

MARKS: 100(75 Theory+ 25 Practicals)

CREDITS: 4 (3 Theory+ 1 Practical)

COURSE DURATION: 45 HOURS

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.

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

	TOTAL	45
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**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, Dragendorff's reagent	01
3.	Disc diffusion for antimicrobial assay	02
4.	MIC evaluation for antimicrobial assay	02
5.	Anatomical study of <i>Nux vomica</i> seeds, Ginger, Citronella leaf, Senna leaf & its medicinal properties	04
6.	Histochemical tests for Oils And Fats – Castor seed/ <i>Eucalyptus</i> Citrus	01
7.	Microchemical test of Arum / <i>Colocasia</i> leaves for observation of Calcium oxalate crystals.	01
8.	Mini project Adulteration of crude drugs	02
	TOTAL	15

REFERENCES:

1. Gokhale, S.B.&Kokate, C.K. (2009). *Pharmacognosy*. Maharashtra: NiraliPrakashan.
2. Khandelwal, K. R. (2008). *Practical Pharmacognosy*. Maharashtra: NiraliPrakashan.
3. Kokate, C. K. (2008). *Pharmacognosy*. Maharashtra: NiraliPrakashan.
4. Qadry, J.S. (2014). *A Textbook of Pharmacognosy, Theory and Practicals*. New Delhi: CBS Publishers & Distributors.
5. Trease, G.E. & Evans, W.C., (2002). *Pharmacognosy*. USA: Elsevier Science Publishers.
6. Wallis, T. E. (2005). *Textbook of Pharmacognosy*. New Delhi: CBS Publishers & Distributors.
7. Leland, J. C. (2006). *Natural Products from Plants*. New York: Taylor and Francis.
8. Harborne, J. B. (2010). *Phytochemical Methods*. New Delhi: Springer International edition.

9. Mammen, D. (1991). *Methods in Plant Chemistry and Economic Botany*. New Delhi: Kalyani publishers.
10. Kumar, G. S., & Jayaveera, K. N. (2014). *A Textbook of Pharmacognosy and Phytochemistry*. New Delhi: S. Chand & Company Pvt. Ltd.
11. McCreath, S. B., & Delgoda, R. (2017). *Pharmacognosy: Fundamentals, Applications and Strategies*. Amsterdam: Mica Haley.
12. Shah, B., & Seth, A. (2010). *Textbook of Pharmacognosy and Phytochemistry*. New Delhi: Elsevier Health Sciences.
13. *What is Pharmacognosy*. (2020, February 12). Retrieved from www.pharmacognosy.com:
<https://pharmacognosy.com/pharmacognosy-consulting-firm/>
14. *Pharmacognosy*. (2020, February 12). Retrieved from www.phytojournal.com:
<http://www.phytojournal.com/pharmacognosy>
15. *Pharmacognosy Journal*. (2020, February 12). Retrieved from www.scimagojr.com:
<https://www.scimagojr.com/journalsearch.php?q=19700175096&tip=sid>
16. (2020, February 12). Retrieved from www.medicinalplants-pharmacognosy.com:
<https://www.medicinalplants-pharmacognosy.com/>

COURSE TITLE: ORGANIC FARMING (THEORY)w.e.f June 2020

COURSE CODE:BOT-V.E-12

MARKS: 100 (75 Theory +25 Practical)

CREDITS: 4 (3Theory +1 Practical)

COURSE DURATION: 45 HOURS

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	Soil types and Soil tillage	
2.2	Factors affecting soil fertility and productivity	
2.3	Land preparation	
2.4	Water management for good soil, Commercial fertilizers, composition	
2.5	Residual effects and fertilizer use efficiency	
2.6	Foliar application and its concept	
MODULEIII: Organic plant protection, Seed Certification and Entrepreneurship Development		15
3.1	Plant protection- cultural and mechanical	
3.2	Plant protection- bio pesticide and bio control agents. Allelopathic methods of weed control.	
3.3	Certification of organically produces seeds.	
3.4	Entrepreneurship – Concept, characteristics, approaches, need for entrepreneurship in Organic farming	
3.5	Popularization of organic farming.	
3.6	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
8.	Comparative analysis of pH, EC, organic C, total N, available N, P, K and S from organic and inorganic data (obtained data).	01
9.	Survey of weeds in crop fields (Organic v/s inorganic farming)	01
10.	Study of soil types.	01
11.	Observation of Mycorrhizae	01
12.	Study of bio pesticide (Neem cake)	01
13.	Study of Mulching	01
14.	Study of nitrogen fixing bacteria in leguminous plants	01
15.	Visit to an organic farm	02
16.	Mini project: Preparation of Compost/ vermi-compost Effect of various manures on plant growth. Study of recycling of farm waste.	06
Total		15

REFERENCES:

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, AgrobiosPublishers (India).
3. Gehlot, D. (2010). Organic Farming: Components and Management, Agrobios Publishers (India).
4. Gupta, O.P. (2010). Modern weed management. AgrobiosPublishers .
5. Israelsen, O.W. and Hansen, V.E. (2015). Irrigation Principles and Practices. John Wiley & Sons Inc.

6. Kanwar, J.S. (1978). Soil Fertility, Theory and Practice. Indian Council of Agricultural Research Publication.
7. Palaniappan, S.P. and Annadurai, K.A. (2010). Organic Farming: Theory and Practice. Indian Council of Agricultural Research, Scientific Publishers Journals Dept.
8. Rao, V.S. (2000). Principles of Weed science. Taylor & Francis Publishers.
9. Reddy, T.Y. and SankarReddi, G. H. (2015). Principles of Agronomy. Kalyani Publishers.
10. Sadhu, A.N. and Singh, A. (2014). Fundamentals of Agricultural Economics. Himalaya Publishing House.
11. Saraswat, V.N., Bhan, V. M. and Yaduraju, N.T. (2003). Weed management - (ICAR), Indian Council of Agricultural Research Publication.
12. Sharma, A.K. (2002). A hand book of Organic Farming. Agrobios Publishers.
13. Singh, B. D. (2006). Plant Breeding Principles and Methods. Kalyani Publishers.
14. Tisdale, S.L., Nelson, W.L., Beaton, J.D. and Havlin, J. L. (2013). Soil fertility and fertilizers. Pearson Publishers.
15. Yawalkar, K. S., Agrawal, J.P. and Bokde, S. (1962). Manures and Fertilizers. Agri-Horticulture Publishing House.
16. *Introduction to Organic Farming*. (n.d.). Retrieved February 13, 2020, from <http://agritech.tnau.ac.in/>: <http://agritech.tnau.ac.in/>
17. Reddy, J. (2017, February 19). *Organic Agriculture Information Guide*. Retrieved February 13, 2020, from AgriFarming: <https://www.agrifarming.in/organic-agriculture>.

**COURSE TITLE: HORTICULTURE, FLORICULTURE AND LANDSCAPING
(THEORY) w.e.f June 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-VI.E-14****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.
4. Nayak, K.C. South Indian fruits and their culture P.L. Varadaraj & Co.,& Lingichetti Street, Madras.
5. Edment Senn Andrews 1994 Fundamentals of Horticulture – Tata McGraw Hill Publishing Co., Ltd.,Delhi.
6. Richard B, ‘Pruning, Training & Topiary’, Lorenz Books.
7. Sara Oldfield, Botanic Garden, New Holland Publishers UK Ltd.
8. Alan Titchmarshs gardening guides (1984), Lawns, Hamlyn.

9. Alan Titchmarshs gardening guides(1984), Bush Roses, Hamlyn.
10. Alan Titchmarshs gardening guides(1984), Climbing Plants, Hamlyn.

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

Module II: Propagation Methods		15
2.1	<p>Theory sessions:</p> <p>Introduction to sexual methods (seed propagation) – Definition, Merits and Demerits, Criteria for selection of seeds.</p> <p>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.</p> <p>Use of plant growth regulators in horticulture</p>	
2.2	<p>Practice sessions:</p> <p>i) Field work in cutting, grafting, budding, layering</p> <p>ii) To design experiments for induction of rooting, flowering, fruit set, fruit development and control of fruit crops</p> <p>iii) To study the cultivation practices of local commercial flowers</p> <p>iv) Field work in Nursery management; Cut flowers; to improve shelf life of cut flowers.</p> <p>v) Visit to a local florist for learning different forms of flower-arrangement and live tutorials in classroom on various examples of flower arrangement all around the world</p>	
Module III: Landscaping		15

<p>3.1</p> <p>3.2</p>	<p>Theory sessions:</p> <p>Types of garden: Formal, informal and kitchen garden</p> <p>Locations in the garden- edges, hedges, fence, lawn, flower beds, Avenue, water garden (with two examples of each). Focal point.</p> <p>Auto CAD in garden designing. Bonsai techniques</p> <p>Practice session:</p> <p>i) Visit to local gardens and giving comparative account of types of garden</p> <p>ii) Listing of plants used for edges, fence, lawn, flower beds, water gardens, etc.</p> <p>iii) Visit to a botanical gardens/ water garden</p> <p>iv) To learn different styles of Bonsai techniques</p> <p>v) Lawn making: type of lawn grasses and maintenance. Plants suitable for hedges.</p> <p>Aftercare: Weeding, top dressing methods of pruning and topiary</p> <p>vi) Garden designing using (preferably Auto CAD) software</p>	
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Module 4: Applications of Horticulture, Floriculture and Landscaping		15
4.1	Theory sessions: Entrepreneurship skills, Invited lecture by Guests (Spice Farm owner, Ecotourism sector, Organic farmer/ Organic products outlet owner, Nursery manager/ Landscaper, Krishivigyan Kendra, Agriculture dept, Forest Dept, etc) Latest schemes in horticulture, floriculture, agriculture in Goa.	
4.2	Practice sessions: Preparation of garden design (area of the campus) Innovative ideas for beautification of the campus and preparation of the same. Establishment of vegetable garden using organic compost &vermi-compost Or Internship at any firm related to Horticulture.	
	Total	60

REFERENCES:

11. Swarup V. (1997). Ornamental horticulture. MacMillan India Limited, New Delhi.
12. Randhava, G.S, (1973) – Ornamental horticultural in India Today and Tomorrow Printers and Publishers, NewDelhi.
13. Trivedi TP (2007). Ornamental horticultural in India. Indian Council of Agricultural Research NewDelhi.
14. Nayak, K.C. South Indian fruits and their culture P.L. Varadaraj & Co. ,& Lingichetti Street, Madras.
15. Edment Senn Andrews (1994) Fundamentals of Horticulture – Tata McGraw Hill Publishing Co., Ltd., Delhi.

Weblink

1. http://agritech.tnau.ac.in/horticulture/horti_index.html

**Parvatibai Chowgule College of Arts & Science
(Autonomous)
Margao –Goa
Department of Botany**

Certificate course in Herbal Cosmetology

SYLLABUS

Sr.no	Topics	Time (hour)
1	Introduction to herbal cosmetology.	1
2	Concept of Skin, skin types and metabolism.	2
3	Ayurvedic guidelines about diet and nutrition for healthy skin and hair.	2
4	Hair and its types,	1
5	Hair growth and metabolism in body.	2
6	Ayurvedic management of hairfall, dandruff and premature greying.	2
7	Benefits of tulsii, neem, <i>Aloevera</i> , fenugreek seeds, ragi etc in herbal Cosmetology.	2
8	Scope of herbal cosmetology	1
9	Assignment	3
10	Written exam	2
11	Practical exam	2
	Total	20

Sr.no	Practicals	Sessions
1	Preparation of herbal soaps and lipbalms.	2
2	Preparation of herbal oil, shampoos etc	2
3	Preparation of facepacks, body massage powder etc	2
4	Practice sessions- skin products	2
5	Practice sessions- hair products	2
	Total	10

ANNEXURE A

(Summary of changes incorporated in the syllabus)

Semester	Course Title	Existing (Indicate only the unit where the change is proposed)	Changes Proposed	Specify the reason for the change
Sem I	BOT-I.C-1 Plant Diversity	Module 2: 4.1	Added Stelar Evolution	Questions based on the said topic are common at entrance exams
	BOT-I.C-2 Cell Biology and Biomolecules	No changes made	The course syllabus is modified into 4 module system (3 theory and one practical)	As it was proposed
Sem III	BOT-III.C-5 Plant Physiology	Practical component	<ul style="list-style-type: none"> ➤ Practical no. 3 was specified as paper chromatography No change in title ➤ Addition of Hydroponics and plant growth as Mini project. Latest book references are along with existing ones.	The course syllbabus was modified into 4 modules (3 theory and 1 practical) as per college requirement . Earlier units were merged to make to 3 modules even though they are independent units and had no connection to each other.
	BOT-III.E-1 Ecology and	Module 1 1.1	The course syllabus is modified into 4 module	The BoS members felt the need of

	Conservation	<p>1.2</p> <p>Module II 2.3</p> <p>Module III</p> <p>3.5</p> <p>Module IV- Practical 1.</p> <p>3..</p>	<p>system (3 theory and one practical) Addition of Shelford's law of tolerance; Introduction to Species diversity indices (Simpson's & Shannon-Weiner) of herbaceous vegetation. 1.2 Land bridge theory is incorporated</p> <p>Title of the module is renamed to Ecological factors and community relationships Community relationships: Addition of Biotic interactions, Gaia Hypothesis, Optimal foraging theory</p> <p>POLLUTION, LAWS AND ORGANISATION S. Addition of Organizations (National & International) working for conservation (NERI, TERI, MSSRF, IUCN, TRAFFIC)</p> <p>To study the physical and chemical characters (moisture, texture and pH) of Sand, Loam and Clay. Visual interpretation of remotely sensed image for vegetation types (Land use land cover, NDVI)</p> <p>Anatomical study of Hydrophytes (leaf), Xerophytes (succulents) and Halophytes (leaf).</p> <p>New references added.</p>	<p>removing Food chain, food web, ecological pyramids as they study the same under environmental studies. The addition of topics are done according to NET /SET Life Science syllabus.</p> <p>The soil types should be mentioned.</p> <p>BoS member suggested the inclusion of study and calculation of vegetation</p>
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				cover, Land use Land Cover and NDVI was added.
	BOT-III.E-2 Systematics of Flowering plants and Phylogeny	The course is interchanged with Techniques and Instrumentation in Botany	The semester in which it will be offered and course code is changed.	The BoS members felt the need of floating this paper earlier than applied courses. Availability of plants is the best in the Monsoon season.
	BOT-III.E-3 ENZYMES AND THEIR METABOLIC PATHWAYS	All Modules Module 1 1.2 1.3 1.4 Module 2	Matter rearranged into 4 sub units Renamed as “Basic concept and catalysis of enzymes” 1.2 and 1.3 combined together Added Active sites 1.4 and 1.5 combined together. Renamed as “Chemical nature of enzymes, Enzyme activity. Characteristics of enzymes (Physico-chemical and biological properties).” Added new & Renamed as: Role of co-factors (NAD, NADP+, FMN/FAD, Co-enzyme A, Pyridoxyl phosphate and metal ions). Renamed as “Enzyme Kinetics” Entire module rearranged	To bring about uniformity To suit the contents Important aspect of enzymes To suit the contents

			and modified	
		2.1	Added new & Renamed as: Factors affecting enzyme activity (concentration, substrate, pH, temperature, inhibitors).	
		2.2	Renamed as: Michalis Menten equation and its significance.	Important for NET-SET examinations
		2.3	Renamed as: Fisher's lock and key model and Koshland (induced fit theory), Arrhenius plot. Added new: Arrhenius plot.	Important for NET-SET examinations
		2.4	Renamed as: Enzyme action (competitive, non-competitive and reversible)	Basic concepts of enzyme action
		Module 3	Renamed as "Metabolic concepts of enzymes" Entire module rearranged and modified	To suit the contents
		3.1	Renamed as: Glycolysis, Fate of pyruvate (Lactic acid & alcohol fermentation) Renamed as: Citric acid cycle, Respiratory	

		<p>3.2</p> <p>substrate, Mitochondrial Electron transport, Cytochrome, Alternate oxidase pathway, Glycogen cycle. Added new: Cytochrome, Alternate oxidase pathway</p> <p>3.3</p> <p>Added new & Renamed as: Biosynthesis and degradation of triglycerides.</p> <p>3.4</p> <p>3.4 and 3.5 combined together: Pathway for amino acid catabolism (Nitrogenase enzyme complex, NIF and Nod genes).</p> <p>Practicals</p> <p>Sr. No. 3</p> <p>To demonstrate anaerobic respiration in germinating seeds- Removed as an experiment and added in the mini project list. Renamed as: Anaerobic respiration in germinating seeds. New references added.</p>	Important pathways	
	BOT-III.E-4 Herbal Cosmetology	Module	This course is revised into four module system. New references added.	Revised according to the guidelines by the Dean into for module system.
Sem V	BOT-V.C-7 Plant Molecular Biology	Module I	Comparison of DNA and RNA was eliminated as per BOS suggestion. The concept will be covered under	The course syllabus was modified into 4 modules (3 theory and 1

		Module III	<p>polymorphism of DNA & RNA</p> <ul style="list-style-type: none"> ➤ Sr. No 1.3 word replication enzymes is replaced with Enzymes of replication ➤ Module III Sr. 3.2, Gene regulation in eukaryotes: Tryptophan e.g is incorporated. <p>Practicals:</p> <ul style="list-style-type: none"> ➤ 2nd practical on Spooling of DNA changed to Mini project as Spooling of DNA from different plant samples ➤ 4th Practical on RNA estimation, method specified by Orcinol reagent ➤ 5th practical word demonstration is removed <p>Latest book references are added along with existing ones</p>	practical) as per college requirement . Earlier units were merged to make to 3 modules even though they had no connection to each other
BOT-V.E-9 Bioinformatics	Module 1 1.2	1.5	Inclusion of Ramachandran Plot.	BoS members felt the need to understand ramachandra n plot wrt understanding protein structures.
	Module II	2.4	Addition of MMDB The European Molecular Biology Network- EMBnet INTRODUCTION TO BIOLOGICAL DATABASES AND SEQUENCE ALIGNMENT METHODS BLAST; Databases of Multiple Alignments, Clustal Omega	
	Module 4 9		Addition of mini projects 1. Drug designing	

			2. Construction of phylogenetic trees/cladogram (comparison between different organisms). New references added.	
	BOT-V.E-10	Practical Module	Mini projects: ➤ Preparation of seed balls is added as mini project. Latest book references are added along with existing ones	The course syllabus was modified into 4 modules (3 theory and 1 practical) as per college requirement . Earlier units were merged to make to 3 modules even though they had no connection to each other
	BOT-V.E-11 Plant Drug Technology and Pharmacognosy	1.1	Renamed as Introduction to Plant Drug Technology and Pharmacognosy.	To simplify the unit name.
Module II		Renamed as Cultivation, Collection and Constituents	To simplify the module name.	
Module IV- Practicals		Experiments 1 & 2 are interchanged.	To have a sequential flow	
Expt. No. 6.		Addition of Eucalyptus	As a source of oils	
	BOT-V.E-12 Organic farming	Module: III 3.6	Renamed as National and international scenario of organic farming. New references added.	The suggestion was given by BoS members
Sem IV	BOT-IV.E-6 Techniques and instrumentation in Botany	This course is interchanged with BOT-III.E-2 of semester III to semester IV Module I	The semester in which it will be offered and course code is changed Title changed to Microscopy and Radiobiology (Principle, Methodology and	The BoS members felt the need of floating this paper earlier than applied courses. Availability of plants is

		1.4 2.1 2.2 3.3 3.4	applications) Addition of micro and macro photography. 2.1, 2.2 merged to form 2.1 Ultraviolet –Visual Spectrophotometry High Performance Liquid Chromatography and Gas Chromatography Agarose Gel Electrophoresis(AGE) Sodium Dodecyl Polyacrylamide gel electrophoresis(SDS-PAGE), Isoelectric focusing(IEF), Two dimensional electrophoresis (2D-Electrophoresis)	the best in the Monsoon season. Full forms of techniques is mandatory.
		Module 4 1 5 7 8	Changed to Preparation of Molar, Normal and ppm solutions Preparation of Thin Layer Chromatographic plate and separation of biomolecules Demonstration of Flame photometry 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. New references added.	
SEM VI	BOT-VI.E-14 Horticulture, Floriculture and Landscaping	Module 1 1.5	The course is restructured back to elective in semester VI for the Third year in B.Sc. Botany. This course is in four module system. 1.5 is shifted to Module 1 from unit II of earlier	Change was proposed to the BoS members and it was accepted.



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			syllabus. New references added.	
SEM IV	Skill Enhancement course Basics in Horticulture	Four module course	The title of the SEC course is changed from 'Horticulture, Floriculture and Landscaping' to 'Basics in Horticulture'.	To differentiate between the Elective and the SEC course.

ANNEXURE II

DEPARTMENT OF BOTANY

List of SWAYAM / NPTEL courses identified by the Botany department:

Sr.No.	Title of the SWAYAM course	Duration
1	Post Harvest Management of Fruits and Vegetables	12 weeks
2	Food Microbiology and Food Safety	15 weeks
3	Applied Environmental Microbiology	12 weeks

List of SWAYAM / NPTEL courses identified by the Botany department:

1. Post Harvest Management of Fruits And Vegetables

Course Status :	Upcoming
Course Type :	Core
Duration :	12 weeks
Start Date :	20 Jan 2020
End Date :	20 Apr 2020
Exam Date :	09 May 2020
Enrollment Ends :	28 Feb 2020
Category :	Agricultural and Food Engineering
Level :	Undergraduate

Description:

Post-harvest technologies constitute an inter-disciplinary science and techniques applied to agricultural commodities after harvest for the purpose of preservation, conservation, quality control, processing, packaging, storage, distribution, marketing and utilization to meet the food and nutritional requirements of consumers in relation to their needs. Fruits and vegetables are highly perishable commodities and the ambient high temperatures in tropical countries make them more susceptible for rapid development of senescence, decay and rotting. Both respiratory and transpiratory rates are proportional to temperature increases and the produce quickly dries, wilts and spoils unless properly preserved.

In this course, the various changes that take place in the fruit or vegetable after harvesting as

well as the maturity indices for harvesting a particular crop will be discussed. The students will learn about post harvest handling of the crops so as to enhance the shelf life of the crops. The course will also discuss on the various principles involved in preservation of fruits and vegetables along with the various techniques used in the preservation of fruits and vegetables. Dr.NongalleiPebam, Food Safety Administration, Department Of Health, Government of Manipur is the course coordinator.

2. Food Microbiology and Food Safety

Course Status :	Upcoming
Course Type :	Core
Duration :	15 weeks
Start Date :	06 Jan 2020
End Date :	30 Apr 2020
Exam Date :	09 May 2020
Enrollment Ends :	28 Feb 2020
Category :	Agricultural and Food Engineering
Level :	Postgraduate

Food microbiology is about the understanding of microorganisms that grow or multiply in or contaminate the food which we consume. Food microorganisms could be either beneficial or harmful. The key aspect of food microbiology is food safety which focuses on the disease-causing microorganism and their toxins which may contaminate the food. That is why it becomes essential to recognise the possible role of microorganisms to ensure the public safety. The major learning objectives of this course will be to study: the scope of food microbiology and food safety; to obtain the knowledge about important genera of microorganisms associated with food and their characteristics; to learn various techniques for enumeration and control of microorganisms in food; to gain the essential knowledge and applications of various techniques (traditional to advanced) for preserving food; to understand the role of different microorganisms in food spoilage, food fermentation and food-borne diseases; to comprehend the microbiological quality control and food-borne

illnesses investigation procedures for ensuring food safety and hygiene; to understand current national and international food safety rules and regulations; to know the requirements and components of food safety management system (FSMS) and use of microbiological risk assessment (MRA) tools for assessing microbiological risks in food sector.

Course coordinator: Dr.TejpgalDhewa | Central University of Haryana

3. Applied Environmental Microbiology

Course Status :	Upcoming
Course Type :	Elective
Duration :	12 weeks
Start Date :	27 Jan 2020
End Date :	17 Apr 2020
Exam Date :	25 Apr 2020
Enrollment Ends :	03 Feb 2020
Category :	Civil Engineering
Level :	Postgraduate