।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २९ सप्टेंबर २०२० रोजी संपन्न झालेल्या ४९व्या मा. विद्या परिषद बैठकीतील विषय क्र.१०/४९–२०२०** च्या ठरावानुसार **प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

01. M.Sc.-I & II Year-Botany
02. M.Sc.-I & II Year-Microbiology
03. M.Sc.-I & II Year-Zoology
04. M.Sc.-I & II Year-Biotechnology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.

जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर(संकुल)–सीबीसीएस अभ्यासक्रम/२०२०–२१/**१४६५**

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : १२.११.२०२०.

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. संचालक, जैवतंत्रशास्त्र संकुल, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

SEMESTER PATTERN CURRICULUM UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)
for
Post Graduate Program
Faculty of Science and Technology

SUBJECT: BOTANY

Program Code: SLS-S-BOT-PG

M. Sc. First Year

With Effect from June 2020

Introduction:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in the curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

Swami Ramanand Teerth Marathwada University has several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in-keeping with Vision and Mission, process was already initiated towards introduction of semester system, grading system and credit system. University had implemented Choice Based Credit System (CBCS) pattern at PG level on Campus from the academic year 2014-2015 progressively. These regulations are called as Regulations on Swami Ramanand Teerth Marathwada University Choice Based Credit System 2014. Further, Revised Guidelines for implementation of CBCS in Campus and Sub Centre w. e. f. 2019-20 were also issued.

Revision and updating of the curriculum is the continuous process to provide an updated education to the students at large. In view of this priority and in-keeping with Vision and Mission, process of revision and updating the curriculum is initiated and implemented at PG level from the academic year 2020-2021 progressively. Presently there is wide diversity in the curriculum of different Indian Universities which inhibited mobility of students in other Schools of the Campus, Universities or States. To ensure uniform curriculum at PG level , curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, Forest Services and the UGC model curriculum are referred to serve as a base in updating the same.

The CBCS provides choice for students to select from the prescribed courses .The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our university has already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning.

Keeping in mind, BOS in Botany prepared the curriculum to ensure up-to-date level of understanding of plant sciences. Studying plant sciences prepares the students for their career working either in educational institutions or industries in which they can be directly involved in the research and development.

The addition of Discipline Specific Elective Courses which includes Skill Enhancement Courses aims to develop skills in plant sciences and practical experience in the students.

At the end of the curriculum, the students should have increased aptitude towards science and nature and also undertake the fundamental and applied research in plant science in the benefit of the human and nature.

The present syllabus was upgraded after taking opinions of experts, alumni, students and other stakeholders and was subsequently passed thorough the BOS, Faculty and the Academic Council of the University.

At last, comments or suggestions are welcome from all the teachers, students and other stakeholders for the upbringing the curriculum.

Salient Features:

The syllabus of M Sc Botany has been framed to meet the requirement of Choice Based Credit System. The courses offered here in will train and orient the students in the specific fields of Botany.

Apart from the Fundamental and applied Core Courses, the Discipline Specific Elective Courses deals with Pharmacognosy**,** Phytochemistry and Phytotherapy, Biodiversity and Conservation and Fungal Biotechnology. Skill Development Courses deals with Communication Skills in English and Foreign Language-French or Spanish.

Open Elective Courses provides an option to learn courses of their own choice across the Discipline from the Other Schools of the Campus or any other Institute. It also provides the option to learn online Courses of their choice like MOOC-NPTEL-SWAYAM.

The Discipline Specific Elective Courses which includes Skill Enhancement Courses like Technology of Fruit and Vegetable Processing and Technology of Biofertilizer Production offered during this program are designed with the aim of imparting specific skills to the students which will lead to the self employability through development of their own enterprises.

This would help students to lay a strong foundation in the field of Botany.

The courses which deal with the environment, sustainability and ethics are Biodiversity and Conservation, Taxonomy of Angiosperms and Systematics, Ecology, Plant Development and Reproduction and Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms. These courses create awareness about conservation of biodiversity and its relevance with the socio-economical and environmental aspects. It also aims to make the students aware of bioethics, legislations and acts prevalent to control the degradation of our environment.

Overall after completion of this course, students will also acquire fundamental knowledge in Plant Science and also understand that Botany is an integral part of the human life and developments.

Program Educational Objectives:

The Objectives of this program are:

PEO1: To expose themselves to the diversity amongst life forms.

PEO2: To make aware of natural resources and environment and the importance of conserving the same.

PEO3: To update curriculum by introducing recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

PEO4: To train and orient the students so as to develop human resource for the educational institutes, industries and other organizations.

PEO5: To develop specific skills amongst students for self employability through the development of their own enterprises.

PEO6: To develop ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

Program Outcomes:

The Outcomes of this program are:

PO1: This program will expose the students to the diversity amongst different life forms.

PO2: This program shall also make aware the students about natural resources and environment and the importance of conserving the same.

PO3: This will provide updated curriculum with recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

PO4: This program shall train and orient the students so as to develop human resource for the educational institutes, industries and other organizations.

PO5: This will also develop specific skills amongst students for self employability through the development of their own enterprises.

PO6: This shall develop ability in the students for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

Program Specific Outcomes:

PSO1: This program will train and orient the students for job opportunities in Plant Biotechnology

PSO 2: This program will also generate human resource for Phytochemical laboratories

Prerequisite:

The optional courses are offered to the students registered for post-graduate programs. Such students should have the basic knowledge of Plant Science and willing to gain additional knowledge in the field of Botany.

Admissions to this program are given as per the University rules.

Dr B S Surwase

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Swami Ramanand Teerth Marathwada University, Nanded- 431 606, Maharashtra, India.

SCHOOL OF LIFE SCIENCES

Name of program: M Sc Botany

Program Structure/Syllabus - 2020-2021 Onwards (CBCS Pattern)

CLASS: M. Sc. FIRST AND SECOND YEAR
An Outline:

Semester	Course Code	Title of the Course	No. of Instructional hrs / week	Type of Course	Total Credits	Marks		Total Marks
						MSA	ESA	
Semester I		**THEORY**						
	BOT-C101	Biochemistry	04	CC	04	50	50	100
	BOT-C102	Cell Biology	04	CC	04	50	50	100
	BOT-C103	Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms	04	CC	04	50	50	100
	*BOT-E101 **OR** E102	Technology of Fruit and Vegetable Processing **OR** Technology of Biofertilizer Production	04	**DSE**	04	50	50	100
		PRACTICAL						
	BOL-C101	Lab Course in Biochemistry	04	CC	02	25	25	50
	BOL-C102	Lab Course in Cell Biology	04	CC	02	25	25	50
	BOL-C103	Lab Course in Biology and Diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms	04	CC	02	25	25	50
	*BOL-E101 **OR** E102	Lab Course in Technology of Fruit and Vegetable Processing **OR** Lab Course in Technology of Biofertilizer Production	04	**DSE**	02	25	25	50
		Total	**32**	**3-CC; 1-DSE**	**24**	**300**	**300**	**600**
Semester II	BOT-C201	Genetics and Molecular Biology	04	CC	04	50	50	100
	BOT-C202	Ecology, Plant Development and Reproduction	04	CC	04	50	50	100
	BOT-C203	Bioinstrumentation	04	CC	04	50	50	100
	*BOT-E201 **OR** E202	Pharmacognosy **OR** Biodiversity and Conservation	04	**DSE**	04	50	50	100
		****Open Elective**	02	**OE**	02	25	25	50
		PRACTICAL						
	BOL-C201	Lab Course in Genetics and Molecular Biology	04	CC	02	25	25	50
	BOL-	Lab Course in Ecology, Plant	04	CC	02	25	25	50

	C202	Development and Reproduction						
	BOL-C203	Lab Course in Bioinstrumentation	04	CC	02	25	25	50
	*BOL-E201 **OR** E202	Lab Course in Pharmacognosy **OR** Lab Course in Biodiversity and Conservation	04	**DSE**	02	25	25	50
		Total	**34**	**3-CC; 1-DSE; 1-OE**	**26**	**325**	**325**	**650**
Semester III	BOT-C301	r-DNA Technology	04	CC	04	50	50	100
	BOT-C302	Plant Physiology and Metabolism	04	CC	04	50	50	100
	BOT-C303	Taxonomy of Angiosperms and Systematics	04	CC	04	50	50	100
	***BOT E301 **OR** E302 **OR** E303	Communication Skills in English **OR** Foreign Language-French **OR** Foreign Language-Spanish	02	**SDC**	02	25	25	50
		****Open Elective**	04 **OR** 2+2	**OE**	04 **OR** 2+2	50 **OR** 25+25	50 **OR** 25+25	100
		PRACTICAL						
	BOL-C301	Lab Course in r-DNA Technology	04	CC	02	25	25	50
	BOL-C302	Lab Course in Plant Physiology and Metabolism	04	CC	02	25	25	50
	BOL-C303	Lab Course in Taxonomy of Angiosperms and Systematics	04	CC	02	25	25	50
		Total	**30**	**3-CC; 1(2)-OE ; 1-SDC**	**24**	**300**	**300**	**600**
Semester IV	BOT-C401	Plant Biotechnology	04	CC	04	50	50	100
	BOT-C402	Biostatistics and Bioinformatics	04	CC	04	50	50	100
	BOT-C403	Mycology and Plant Pathology	04	CC	04	50	50	100
	*BOT-E401 **OR** E402	Phytochemistry and Phytotherapy **OR** Fungal Biotechnology	04	**DSE**	04	50	50	100
		****Open Elective**	02	**OE**	02	25	25	50
		PRACTICAL						
	BOL-C401	Lab Course in Plant Biotechnology	04	CC	02	25	25	50
	BOL-C402	Lab Course in Biostatistics and Bioinformatics and Mycology and Plant Pathology	04	CC	02	25	25	50
	BOL-C403	**Project / Research Review**	04	CC	04	--	100	100
		Total	**30**	**3-CC; 1-DSE ; 1-OE**	**26**	**275**	**375**	**650**

CC: Core Course, OE: Open Elective Course, DSE: Discipline Specific Elective Course, SDC- Skill Development Course, MSA: Mid Semester Assessment, ESA: End Semester Assessment, Credits of four semesters = 100.

*Discipline Specific Elective	**Open Elective / *** Skill Development Elective Course
* indicates an Elective Course. Botany student, in a particular sem, can opt for either of these Courses **OR** a Course offered by Other Programs of the School.	** indicates an Open Elective Course. Botany student must opt for any Open Elective Course OR Skill Development Course offered by Other Schools of the Campus **OR** MOOC-SWAYAM-NPTEL Course. *** indicates Skill Development Elective Course

Total Credits / year = 50; Total Credits of All Four Semesters = 100 ,Total Marks of All Four Semesters = 2500; MSA: Two Internal Exams of 15 Marks each (based on MCQs) , Home assignment of 10 Marks, Seminar of 10 Marks for each Course.

LIST OF OPEN ELECTIVES IN BOTANY FOR OTHER SCHOOLS

School of Life Sciences- Subject: Botany						
Sr No	**Course Code**	**Title of Open Elective Course**	**No of credits**	**Semester in which it is offered**	**Prerequisite of the student (Eligibility)**	**Course Instructor**
1.	BOT OE 101	Fundamentals of Plant Tissue Culture	02	I / III	Any graduate	Dr B S Surwase
2.	BOT OE 201	Basics of Plant Identification	02	II / IV	Any graduate	Dr B S Surwase
3.	BOT OE 301	Biofertilizers	02	I / III	Any graduate	Dr B S Surwase
4.	BOT OE 401	Herbal Botany	02	II / IV	Any graduate	Dr B S Surwase

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606
SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM), SEMESTER -I SYLLABUS (W.E. F. 2020)

BOT- C101 BIOCHEMISTRY

Max Mark: 100 **Periods: 60**

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Course Objectives: The Students will know how the collection of thousands of inanimate molecules that constitute living organisms interact each other to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the non-living things.

Learning Outcomes: Students will be able to

1. Know the chemical constituents of cells, the basic units of living organisms.
2. Explain various types of weak interactions between the biomolecules.
3. Know how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids and nucleic acids.
4. Correlate the structure-function relationship in various biomolecules
5. Know the role of biomolecules for orderly structures of the cells/tissues.

UNIT I

Chemical Foundations of living systems: Molecular basis of life, Biological chemistry – Biomolecules, Bioenergetics- Entropy, Biochemical equilibria, Dissociation and association constants, pH and buffers. Interactions in biological systems: Intra and intermolecular forces, Electrostatic and hydrogen bonds, Disulfide bridges, Hydrophobic and hydrophilic molecules and forces, Water and weak interactions

UNIT II

Amino acids and Proteins: Amino acids as building blocks of proteins, their structure, classification and chemical properties; non- protein organic amino acids; Structure of peptide bond, organizational levels of protein structure; alpha- helix, beta pleated sheet, Ramachandran Plot.

UNIT III

Nucleic Acids and Porphyrins: Structure and properties of nucleic acid bases, nucleosides and nucleotides, biologically important nucleotides, Physical and chemical properties of RNA/DNA. Hydrolysis of nucleic acids. Structure, properties and classification of porphyrins.

UNIT IV

Carbohydrates: Classification, monosaccharide – structures and function; reactions of monosaccharides- mutarotation, glycoside formation, reduction and oxidation, epimerization and Esterification , important monosaccharides and disaccharide; Polysaccharides –overview,

structure; important polysaccharide; plant polysaccharide; Glycosaminoglycans and Glycoproteins.

Lipids: Fatty acids as building blocks of most lipids, their structure and properties, classification of lipids, General structure and function of major lipid subclasses: Acylglycerols, Phosphoglyceride, Sphingolipids , glycosphingolipids, terpenes, steroids, Prostaglandins

References:

1. Nelson, D.L., Cox, M. M. and Lehninger (2008) Principles of Biochemistry, 5th ed. WH Freeman
2. David, E. M. (2003) Biochemistry, The Chemical reactions of Living Cells Vol. 1. 2nd Edition, Elsevier Academic Press.
3. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2005) Biochemistry, 5th Edition, WH Freeman and Company.
4. Koolman, J. and Roehm, K. H. (2005) Color Atlas of Biochemistry, 2nd Edition, Georg Thieme Verlag, Publishers.
5. Jain, J. L., Jain, S. and Jain, N. (2005) Fundamentals of Biochemistry, S. Chand and Company Ltd.
6. Plummer, D. T. (1988) An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Limited.

BOL C101 Laboratory course in Biochemistry

1. Calibration of instruments and verification of Lambert-Beer's Law
2. Preparation of buffer solutions
3. Determination of pK values of amino acids
4. Estimation of reducing sugars
5. Estimation of total carbohydrates, amino acids and proteins
6. Estimation of amino acids
7. Estimation of proteins
8. Qualitative tests of carbohydrates
9. Quantitative analysis of lipids
10. Quantitative analysis of nucleic acids
11. Iodine number of given oil
12. Isolation of proteins from seeds
13. Determination of Achromatic point

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606
SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER- I SYLLABUS (W.E. F. 2020)

BOT-C102 CELL BIOLOGY

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To provide understanding of the different microscopic techniques used to study the biology of cell.
2. To understand the structure and role of various cell organelles**.**
3. Acquire in-depth knowledge of the cellular components underlying mitotic and meiotic cell division and regulation of cell cycle.
4. To have a concrete knowledge about transport and cell to cell communication in animals as well as plants.
5. To provide wider perspective of cancer and its control**.**

Learning Outcomes: On completion of this course, the students shall:

1. Understand the structure and function of cell and its organelles. Also. acquire knowledge on cell cycle and its regulation
2. Acquire the knowledge about transport and cell to cell communication in animals as well as plants.
3. Acquire knowledge about causes of cancer, tumour suppressor genes and control of cancer.

UNIT-I

Investigating the Cell: Cell theory, Microscope and its modifications: light, phase contrast, fluorescence, scanning and transmission electron microscopy.

Cell Organelles: Cell wall: Structure and functions; Plasma membrane: Molecular organization and functions; Vacuole: Tonoplast membrane, transporters, storage organelle; Glyoxysomes and peroxisomes: Structure, enzymes and functions: Golgi complex: Organization, role in storage and secretion; Cytoskeleton: Composition and organization of microtubules and microfilaments, role in cell division and mobility, intracellular motility; Lysozymes: Enzymes and role, Nucleus: structure, organization and regulation of nuclear pure complex, Role of Sarcoplasmic Reticulum in muscle contraction; Melanosomes, E/R etc.

UNIT-II

Transport across membrane: Cell and transport processes, simple diffusion, facilitated diffusion, Active transport, Sodium- potassium pump, proton pump, transport into prokaryotic cells, endocytosis and exocytose.

Cell Interactions: Extracellular matrix of animal cells, cell-cell recognition and adhesion, cell junctions.

Energy transaction: Role of mitochondria and chloroplast in energy transaction.

UNIT-III

Cell division and cell cycle: Mitosis, meiosis, their regulation, steps in cell cycle and control of cell cycle.

Cell Signalling: Hormones and their receptors, Cell surface receptors, Signalling through G-protein coupled and protein kinase associated receptors, Signal transduction pathways, Second messenger, Bacterial and plant two component signalling systems, Bacterial chemotaxis and quorum sensing, Signal transduction induced by auxins and GA in plants.

UNIT-IV

Cancer: Normal cells and cancer cells, Causes, Genetic arrangements in progenitor cells, Oncogenes, Tumour suppressor genes, Cancer and cell cycle, virus induced cancer, Metastasis, interaction of cancer cells with normal cells, Therapeutic interventions of uncontrolled cell growth.

Apoptosis: Role of different genes, Cell organelles during apoptosis, Genetic control of apoptosis. Flower induction, development and its regulation in *Arabidopsis*. Brief introduction to Life Cycle and Molecular Biology of some important pathogens: AIDS, Malaria, Hepatitis, Filaria and Kala-azar.

References:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. (1994) Molecular Biology of Cell, Garland Publishing Company, New York and London.
2. Darnell, J., Lodish, H. and Baltimore, D. (1990) Molecular Cell Biology by Scientific American Books, New York.
3. Backer, W. M., Kleinsmith, L. J. and Hardin, J. (2004) The World of the Cell by Pearson Education, Menlo Park, CA: Benjamin/Cummings.
4. Gerald Karp (1996) Cell and Molecular Biology by McGraw Hill Publishing Company, New York.
5. David, E. and Sadava (1992) Cell Biology – Organelle Structure and Function by Bostan and Bartlett publisher.
6. Loewy, A. G., Siekevitz, P., Manniger, J. R. and Gallant, J. (1991) Cell Structure and Function (An integrated Approach), Saunders college Publishing house.
7. Kleinsmith, L. J. (1995) Principles of Cell and Molecular Biology, New York.
8. Philip, S. and Donald, B. Cell and Molecular Biology by John Wiley and Sons.
9. Harrmann, R. G. and Wien (1992) Cell Organells by Springer Verlag.

BOL -C102 Lab Course in Cell Biology

1. Microscopy
2. Demonstration of phenomenon of osmosis through a cell membrane.
3. Isolation of chloroplasts from spinach leaves.
4. Demonstration of Hill reaction to measure intactness of chloroplasts.
5. Isolation of mitochondria and mitochondrial swelling.
6. Isolation of mitochondria and activity of its marker enzyme, succinate dehydrogenase (SDH).
7. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.
8. Study of mitosis.
9. Study of meiosis.
10. Induction of polyploidy using colchicine treatment.
11. Isolation of lysosomal fraction and estimation of acid phosphatase activity.
12. Study of Karyotyping and ideogram.
13. Orcein and feulgen staining of salivary gland chromosomes of chironomas and Drosophila.
14. WBC count.
15. Sub-cellular fractionation and marker enzymes.
16. Visit to National Level institutes undertaking studies in cell and molecular biology.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606
SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER -I SYLLABUS (W.E. F. 2020)

BOT-C103 BIOLOGY AND DIVERSITY OF ALGAE, BRYOPHYTES, PETRIDOPHYTES AND GYMNOSPERMS

Max Mark: 100 **Periods: 60**

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Objectives

1. To understand diverse groups of organisms such as Algae, Bryophytes, Pteridophytes and Gymnosperms.
2. To impart detailed knowledge of diverse groups of organisms in the form of their habits and habitats, characters, classification and Economic/ Ecological importance.

Outcomes:

This paper introduces several key markers to identify the Algae, Bryophytes, Pteridophytes and Gymnosperms.

UNIT I ALGAE

Algae in diversified habitats (Terrestrial, freshwater, marine), thallus organization, Cell structure, reproduction (Vegetative, asexual, sexual), pigments, reserve food, flagella, classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Pheophyta and Rhodophyta, Algal blooms, Economic importance of algae-Algal biofertilizers, algae as food, feed and uses in industry.

UNIT II BRYOPHYTES

Distribution, morphology, structure, reproduction, life cycle, classification, Phylogeny, economic and ecological importance of Bryophytes, General account of Marchantials, Junger-manials, Anthocerotales, Sphagnales, Funariales and Polytrichales.

UNIT III PTERIDOPHYTES

Morphology, anatomy, reproduction, classification; evolution of Stele, heterospory and origin of seed habit, general account of fossil pteridophytes, introduction of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT IV GYMNOSPERMS

General characters, distribution, classification, Brief account of Pterdospermales, general account of cycadeoidales and corditales. Structure, reproduction and phylogeny in Cycadales, Ginkgoales, Coniferales, Ephedrales and Gnetales, Affinities with angiosperms, Applied aspects of Gymnosperms.

References:

1. Kumar, H. D. (1988) Introduction phycology, Affiliated East West press Ltd., New Delhi.
2. Morris, I. (1986) An Introduction to the algae, Cambridge University Press, U. K.
3. Parihar, N. S. (1991) Bryophyta, Central Book Depot, Allahabad.
4. Puri, P. (1980) Bryophytes, Atmaram and Sons, Delhi.
5. Round, F. E. (1986) The biology of algae, Cambridge University Press, Cambridge.
6. Sporne, K. K. (1991) The Morphology of pteridophytes, B. I. Publishing Pvt. Ltd. Bombay.
7. Stewart, W. N. and Rathwell, G. W. (1993) Paleobotany and evolution of Plants, Cambridge university press, Cambridge.
8. Bhatnagar, S. P. and Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.

BOL-C103 Lab Course in Biology and diversity of Algae, Bryophytes, Pteridophytes & Gymnosperms

1. **Microscopic and macroscopic observations with labelled sketches of the following types.**
   a) Algae:-i) Cholorophyta:- *Volvox, Chlorella, Oedogonium, Spirogyra, Zygnema* etc. ii) Charophyta*:*- *Chara, Nitella* etc. iii) Cyanophyta:- *Nostoc, Anabaen*a etc. iv) Pheophyta*:*- *Ectocarpus* v) Xanthophyta:- *Voucheria* vi) Rhodophyta:- *Batrachospermum, Polysiphonia* etc.
   b) Bryophyta:- *Riccia, Marchantia, Anthoceros* etc.
   c) Pteridophyta:- *Psilotum, Lycopodium, Equisetum, Selaginella* etc.
   d) Gymnosperm:- *Cycus ,Pinus, Gnetum*, *Araucaria , Ephedra* etc.
2. Study of fossil specimens:-Compression, Impressions, Petrification.
3. Separation of algal Pigments by chromatography.
4. Microscopic measurement of the algae.
5. Camera lucida drawings of some microscopic plants.
6. Collection, Preservation and Submission of material along with excursion/ field report.

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SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER -I SYLLABUS (W.E. F. 2020)

BOT-E101 TECHNOLOGY OF FRUIT AND VEGETABLE PROCESSING (Elective)

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To impart knowledge of basic principles in fruit and vegetable processing.
2. To impart knowledge of different methods of fruits and vegetable processing.
3. To impart the knowledge about Food safety regulations like National Food Law (FSSA) and Other Food Laws.

Learning Outcomes: On completion of this course-

Students shall acquire training in processing technology of fruit and vegetable based products. Students shall also acquire knowledge about Food Safety Regulations. Over all, they will get opportunities in Food Technological Industries as well as they shall be able to start their own enterprises for self employment.

UNIT I INTRODUCTION

Importance of fruits and vegetables, Production and processing scenario of Fruits and vegetables in India and world, Scope of fruit and vegetable processing industry in India-present status, constraints and prospective. Principles and Methods of Preservation: Low temperature, High Temperature, Use of chemical preservatives, Irradiation, Drying/Dehydration, Removal of air etc

UNIT II FRUITS BEVERAGES, JAMS, JELLIES MARMALADES, CANDIES, TOFEE AND BARS

FRUITS BEVERAGES: Introduction, Processing of fruit juices (selection, juice extraction, deaeration, straining, filtration and clarification), preservation of fruit juices (pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation), processing of squashes, cordials, nectars, concentrates and powder.

JAMS, JELLIES, MARMALADES, CANDIES, TOFFEE AND BARS

Introduction**,** Jam: Constituents, selection of fruits, processing & technology**,** Jelly: Essential Constituents (Role of pectin, ratio), Theory of jelly formation, Processing & technology, defects in jelly**,** Marmalade: Types, processing & technology, defects. Candy: Processing and Technology. Fruit Toffee and Bars: Processing & technology.

UNIT III PICKLES, CHUTNEYS AND SAUCES AND DEHYDRATUIN

PICKLES: Processing, Types, Causes of spoilage in pickling**.**

TOMATO PRODUCTS

Selection of tomatoes, pulping & processing of tomato juice, tomato puree, paste, ketchup, sauce and soup.

DEHYDRATION OF FOODS AND VEGETABLES

Sun drying & mechanical dehydration, process variation for fruits and vegetables, packing and Storage.

UNIT IV: FOOD SAFETY REGULATIONS

- National food law (FSSA), standards and regulations
  - Global Scenario
  - Other laws and standards related to food
- Food additives and contaminants
- Hygiene and sanitation
- HACCP

References:

1. Girdharilal, Siddappaa, G. S. and Tandon, G.L. (1998) Preservation of fruits & Vegetables, ICAR, New Delhi.
2. Crusess, W. B. (2004) Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India.
3. Manay, S. and Shadaksharaswami, M. (2004) Foods: Facts and Principles, New Age Publishers.
4. Ranganna, S. (1986) Handbook of analysis and quality control for fruits and vegetable products, NTS.
5. Srivastava, R. P. and Kumar, S. (2005) Fruit and Vegetable Preservation Principles and Practices International Book Distributing Company, New Delhi.
6. Khader (2000) Preservation of Fruits and Vegetables. Indus Publishing.
7. Lal, G. S., Siddappa, G. S. and Tandan, G. L. (1996) Preservation of Fruits and Vegetable, ICAR Publication, New Delhi.
8. Sinha, N. and Hui, Y. H. (2010) Handbook of Fruit and Vegetable Processing, John Wiley and Sons,
9. M.G. Danthy .Fruit and Vegetable Processing .FAO, Rome
10. Singh, I. S. Post harvest Handling and Processing of Fruit and Vegetable.
11. Salunkhe, D. K. and Kadam, S. S. (1995) Handbook of Fruit Science &Technology: Production, Composition and Processing, Marcel Dekker.

BOL-E101 Lab Course in Technology of Fruit and Vegetable Processing

1. Preparation of RTS beverage e.g. Amala, Mango and Pineapple etc
2. Preparation of jam/ jelly from selected fruit
3. Preparation of squash
4. Preparation of fruit candy
5. Preparation of fruit leather
6. Preparation of fruit toffee
7. Preparation of pickle
8. Preparation of banana and potato wafers
9. Estimation of total soluble solids (TSS).
10. Estimation of pH and acidity of products.
11. Estimation of Brix: acidity ratio
12. Estimation of ascorbic acid and effect of heat treatment on it.
13. Dehydration of fruits and vegetables.
14. Visit to fruit and vegetable processing units

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M. Sc.-I BOTANY (CREDIT SYSTEM), SEMESTER- I SYLLABUS (W.E. F. 2020)

BOT-E102 TECHNOLOGY OF BIOFERTILIZER PRODUCTION (Elective)

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To impart knowledge about basic principles of Biofertilizer production.
2. To acquaint the students with knowledge on various methods of Biofertilizer application.

Learning Outcomes: On completion of this course, the students shall acquire knowledge in Biofertilizer production. They shall develop scientific skills in the field of Biofertilizers. Over all, they will get opportunities in Biofertilizer Industries as well as they shall be able to start their own enterprises for self employment.

UNIT I

Biofertilizer Types: Introduction, Commercial history, types: *Rhizobium, Azotobacter*, *Azospirillum,* Cyanobacteria, *Azolla,* PSM, AM fungi, Silicate solubilizing bacteria (SSB), Plant Growth Promoting Rhizobacteria (PGPR) and mass production. Constraints in Biofertilizer technology, Cost and availability of Biofertilizers, Benefits and Characteristics of Liquid biofertilizers.

UNIT II

Maintenance and Preparation of Biofertilizer: Culturing of microbes, preparation of inoculums, processing and preparation of carrier material, mass production, packaging and storage, Concept & its need in organic farming , treatment.

Rhizobium Biofertilizer : Characteristics, Host-*Rhizobium* interactions, N_2-fixation in root-nodules, Production , Methods of application.

Azotobacter Biofertilizer : Characteristics, N_2-fixation process, Production, Methods of application ,

Azospirillum Biofertilizer: Characteristics, Association with plants, Production, Methods of application.

UNIT III

Azolla & BGA Bio fertilizers: *Azolla:* Characteristics , Production , Methods of application

BGA: Characteristics, N_2-fixation process, Production , Methods of application

AM Biofertilizer: Characteristics & types of association, Production , Methods of application

UNIT IV

PSB Biofertilizer (Phosphate solubilising Bacteria) : Mechanism of phosphate solubilisation, Production , Methods of application

Quality control of Biofertilizers as per FCO (Fertilizer Control Order) : Introduction of FCO specifications for bio fertilizers , Sampling procedure , Methods of analysis, Standards of biofertilizers , Biostability of Biofertilizers.

References:

1. Subbarao -Soil Microbiology
2. Rangaswamy-Agriculture Microbiology
3. Rangaswamy-Bio fertilizers (Ekta Publication).
4. Arun Sharma -Bio fertilizers.
5. Fertilizer Control Order–1985 amended up to June, 2011

BOL-E102 Lab Course in Technology of Biofertilizer Production

1. Isolation & preparation of bacterial fertilizer
   a) *Azotobacter*
   b) *Azospirillum*
2. Isolation and preparation of symbiotic biofertilizer: *Rhizobium*
3. Isolation of Phosphate solubilizing bacteria from soil.
4. Isolation and identification of AM fungi from soil and preparation of biofertilizer.
5. Determination of heterocyst frequency of blue-green bacteria.
6. Quality control of microbial inoculants
7. Estimation of total nitrogen by Kjeldahl digestion method/ Determination of N concentration by indophenol method.
8. Determination of total nutrient content by spectrophotometric method
9. Evaluation of the P-solubilising capability of microorganism
10. Estimation of Nitrogenase activity by acetylene reduction assay
11. Colorimetric estimation of amino-N and nitrate-N.
12. Preparation of biofertilizer carrier materials a. Preparation of materials, b. Irradiation (sterilization), c. Confirmation of sterilization effect, d. Inoculation of microorganisms to carrier.
13. Collection and preservation of root nodules in field trips

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SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM), SEMESTER -II SYLLABUS (W.E. F. 2020)

BOT-C201 GENETICS AND MOLECULAR BIOLOGY

Max Mark: 100 **Periods : 60**

Learning Objectives:

1. Understanding Concept of Mendelian and post Mendelian of genetics.
2. Understanding Genome organization, Genome duplication and genome function in viruses, prokaryotes and Eukaryotes.

Learning Outcomes: Students must know the

1. Fundamentals of Mendelian and post-Mendelian genetics.
2. Genome (viral, prokaryotic and eukaryotic) organization, duplication and function.

UNIT I FUNDAMENTALS OF GENETICS

Review of basic terminologies (Allele, multiple alleles, pseudoallele, complementation tests) and principles of Mendelian (Dominance, segregation, independent assortment) and post Mendelian genetics (Codominance, incomplete dominance, gene interactions, pleiotropy), genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Maternal inheritance.

Overview of human genetics (Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders). Quantitative genetics. Population genetics.

Structural and numerical aberrations of chromosomes, linkage maps, tetrad analysis, recombination, sex determination.

Introduction to Microbial genetics (Transformation, Conjugation, Transduction). Mutation.

Focus of genetic studies as a platform for advances in molecular biology.

UNIT II DNA STRUCTURE AND GENOME ORGANIZATION

DNA structure and topology. Physical properties of DNA : Tm, hypo and hyper chromicity, solubility, mutarotation and buoyancy. Organization of Viral, Prokaryotic and Eukaryotic genome (Structure of chromatin, nucleosome, chromatin organization, chromosome, centromere, telomere. General organization (size, banding, microsatellites, Gene distribution and density) of plant (rice) and animal (human) genome including their organelle genomes, Organization of genes: rRNA encoding Genes, mRNA encoding Genes, small nuclear RNA genes. Overlapping genes, genes within genes, gene families, pseudo genes, truncated genes and gene fragments. Operon, Fine structure of gene (r-II locus), fine structure analysis of gene (complementation and recombination).

Techniques and Technology involved in genome mapping low and high resolution mapping; Strategies and milestones in mapping and sequencing of human genome approaches to physical and genetic mapping. Next generation sequencing: principles and platforms. Principles and strategies for identifying unknown disease or susceptibility genes. Major genomic databases, Glimpses and significance of the recently sequenced genomes of organisms.

UNIT III DNA REPLICATION AND REPAIR:

DNA Replication models, DNA replication mechanism (Prokaryotes/eukaryotes). RNA world and RNA Replication. DNA modifying enzymes: DNA polymerases: types and mechanism of action. DNA damage and repair and recombination: mechanisms and structure and functions of enzymes involved. RNA Polymerases and reverse transcriptase: structure and mechanisms of action. DNA methyl transferases, Topoisomerase, Gyrase, Nucleases etc. Types, mechanisms, and significance of mutations.

UNIT IV REGULATION OF GENE EXPRESSION

Chromatin structure and remodeling. Regulation of gene expression at chromatin level. Epigenetics: Genome imprinting, DNA methylation, Acetylation, Chromosome inactivation and sex determination. Gene silencing, RNA interference. Homeotic gene expression and pattern formation in plants and animals. Oncogenes and proto oncogenes.

Transcription in pro and eukaryotic organisms and transcription factors. Regulation of gene expression at transcriptional level (Phages, viruses, prokaryotic and eukaryotic genes). RNA processing: capping, polyadenylation, splicing, editing and transport of RNA. Structure and functions of ribonucleoproteins. Translation in pro and eukaryotic organisms and its regulation. Genetic code and factors. Translational proofreading, translational inhibitors. PTM.

References:

1. Birge, E. A. (2006) Bacterial and Bacteriophage Genetics. 5th Edition. Sriger Publications
2. Klug, W. S., Spencer, C. A. and Palladino, M. A. (2009) Concepts of Genetics, 9th edition, Pearson.
3. Dale, J. W. and Park, S. F. (2005) Molecular Genetics of Bacteria 4th Edition Wiley and Sons Inc.
4. Freifelder, D. (2005) Moleular Biology. 2nd Edition. Narosa Pub. House.
5. Lewin, B. (2008)- Genes IX.

6. Griffiths *et al*., (2008) Introduction to Genetic Analysis, 9 th edition.
7. Weaver, R. F. (2012)- Molecular Biology.
8. Alberts *et. al.* (2007) Molecular Biology of the Cell (5 th edn.).
9. Watson *et. al.* (2009) Molecular Biology of the Gene (6 th edn).
10. Lodish *et. al.* (2008) Molecular Cell Biology (6 th edn.).
11. Snustad *et al.* (2004) Principles of Genetics.
12. Speicher, M., Antonarakis, S. E., Motulsky, A. G. (1997) Problems and Approaches 3rd edition and 4th edition (revised2009).
13. Read, A. and Donnai, D. (2007) New Clinical Genetics, Scion Publishing Ltd, UK.
14. Strachan, T. and Read, A. P. (2004) Human Molecular Genetics , 3rd Edition, Garland Science (Taylor and Francis Group), London and New York.
15. Synder, L., Champness, W. (1997) Molecular Genetics of Bacteria. ASM Press.
16. Turn, N., Trempy, J. (2006) Fundamental Bacterial Genetics. Blackwell Publishers.
17. Vogel and Motulsky's Human Genetics.

BOL-C201 Laboratory course in Genetics and Molecular Biology

1. Use of drosophila as a model system in genetics: Life history, morphology, mutants, culture, sexing pupae for setting up crosses etc.
2. Gene interactions
3. Mutants of Drosophila Mono and Di-hybrid crosses in Drosophila.
4. Sex linked lethal in Drosophila.
5. Estimating gene frequencies in population, estimation of heterozygote frequencies, pedigree analysis.
6. Human karyotype and chromosomal aberrations.
7. Ames test for genotoxins.
8. UV mutagenesis.
9. Bacteriophage titration.
10. Bacterial transformation.
11. Bacterial conjugation.
12. Bacterial transduction.
13. Isolation of nuclei and chromatin. Determination of mononucleosomal size.
14. Chromatin gel electrophoresis.
15. Isolation of genomic DNA from different sources viz. plant, animal, yeast and bacteria.
16. Restriction digestion of genomic DNA and analysis.

17. Thermal melting of DNA.

18. Agarose gel electrophoresis of DNA.

19. Isolation of organelle genome and restriction digestion.

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M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER -II SYLLABUS (W.E. F. 2020)

BOT-C202 ECOLOGY, PLANT DEVELOPMENT AND REPRODUCTION

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To asquint the students with various aspects of Ecology
2. To understand the various aspects of plant development .
3. To understand sexual incompatibility and types of endosperms

Learning Outcomes:

After completion of this course, students shall be able to understand the each phase of development of seeds and different plant parts.

UNIT I

Principals of ecology:

Habitat and niche: Concept of Habitat and niche. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, S and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine.

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Population Ecology: Population growth curves (r and k selection).Ecological Succession : Types and mechanisms.

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches

UNIT II

Fundamentals of development:

Potency, Competence, determination, commitment, specification, induction. Morphogenetic gradients, cell fate and cell lineages, Formation of symmetry in plants, Juvenility and transition to adult phase, types of Meristem and activities of meristem, Regulation of meristem size, lateral organ initiation from root and shoot meristems. Secondary growth – cambium, gross structure of wood. Secretary tissues – Nectaries, laticifers, resin ducts.

Conversion from vegetative to reproductive phase– induction, morphological and histochemical changes in shoot apex, floral meristems.

UNIT III

Shoot Development: Organization of Shoot apical meristem, tissue differentiation (Xylem and Phloem)

Root development: Organization of root apical meristem, vascular tissue differentiation.

Floral Development: Floral development in Antirrhinum

Development of male gametophyte: Structure of anthers, microsporogenesis, role of tapetum, pollen development, pollen tube development and guidance.

Development of female gametophyte: Ovule development, megasporogenesis, organization of embryo sac and its types (mono, bi, tetra etc.).

Pollination and seed development: Pollination mechanism and vectors, Mechanism of pollen stigma interactions (self-incompatibility)

UNIT IV

Double fertilization and triple fusion, role of synergids, endosperm development and imprinting, Seed formation and germination: Seed formation, cotyledon, endosperm and seed coat development. Seed dormancy and germination, seedling development

Embryogenesis: Basic layout of dicot and monocot embryos, stages of embryo development, embryonic axis, cell division and pattern formation in embryo, genetic and hormonal regulation of embryo development, cell polarity in embryo, Embryogenesis mutants.

References:

1. Bhojwani, S. S., Dantu, P. K. and Bhatnagar, S. P. (2014) The Embryology of Angiosperms. (6th Edition) Vikas Pub. House. Paperback edition.
2. Bhojwani, S. S. and Soh, W. Y. (2001) Current Trends in Embryology of Angiosperms, Kluwer Academic Publishers.
3. Buchanan, B. B., Gruissem, W. and Jones, R. L. (2015) Biochemistry and Molecular Biology of Plants. Second Edition. Wiley Blackwell.
4. Burgess, J. (1985) An Introduction to Plant Cell Development, Cambridge UniversityPress.
5. Davies, P. J. (2004) Plant Hormones, Biosynthesis, Signal Transduction, Action Springer Publications.
6. Fahn, A. (1990) Plant Anatomy (4th Edition) Pergamon Press, London, New York.
7. Gilbert, S. F. (2013) Developmental Biology (10th Edition). Sinauer Associates, Inc., Massachusetts, USA.
8. Graham, C. F. and Wareing, P. F. (1984) Developmental Control in Animals and Plants, Blackwell Scientific Publications, UK.
9. Johri, B. M. and Srivastava, P. S. (2001) Reproductive Biology of Plants. Narosa Publishing House, New Delhi.
10. Jones R., Ougham, H., Thomas, H. and Waaland, S. (2013) The Molecular Life of Plants.

11. Krishnamurthy, K. V. (1988) Methods in Plant Histochemistry, S. Viswanathan Printers & Publishers.
12. Lyndon, R. F. (1990) Plant Development The Cellular Basis. (Topics in Plant Physiology, Vol. 3) Springer Publications.
13. Leyser, O. and Day, S. (2009) Mechansims in Plant Dvelopment, Wiley Blackwell.
14. Raghavan, V. (2000) Developmental Biology of Flowering Plants, Springer Verlag.
15. Wada, M., Shimazaki, K. and Iino M. (2005) Light sensing in plants, Springer.
16. Wareing, P. F. and Philips, I. D. J. (1981) Growth and Differentiation in plants, Pergamon Press.
17. Wolpert, L., Tickle, C. and Arias, A. M. (2015) Principles of Development (5th Edition) Oxford University Press.
18. Taiz and Zeiger (1998) Plant Physiology by, Sinauer Associate Inc. Publishers.
19. Fegeri, K. and Van Der Piji L. (1979) The Principles of pollination Ecology, Pergamon Press, Oxford.
20. Fosket, D. E. (1994) Plant growth and development, A Molecular Approach academic Press, San Diego.
21. Salibury, F. B. and Ross, C. W. (1992) Plant Physiology (4th edition) Wadsworth publishing Belmont, California.
22. Sedgely, M. and Griffin, A. R. (1989) Sexual reproduction of Tree crops, Academic Press London.
23. Rana ,S.V S. (2013) Essentials of Ecology and Environmental Science
24. Subramanyam, N. S. and Sambamurthy, A. V. S. S. Ecology.

BOL-C202 Lab Course in Ecology, Plant Development and Reproduction

1. Random sampling to measure the abundance of various different species on an area of grassland.
2. To study communities by quadrat method and to determine % Frequency, Density and Abundance.
3. To determine the basal cover, or vegetational cover of one herbaceous community by quadrate method.
4. To determine diversity indices (richness, Simpson, Shannon-Wiener) in grazed and protected grassland.
5. To determine transparency or turbidity of different water bodies.
6. To measure amount of dissolved oxygen content in polluted and unpolluted water bodies
7. Study of vascular tissues.
8. Comparative anatomy of dicot and monocot stem.

9. Study of types of trichomes, stomata and hairs.
10. Microtomy.
11. Study of T.S of anther.
12. *In vivo* germination of pollen grains on stigma.
13. Study and types of pollen grains
14. Pollen viability(Tetrazolium test) and Germination: Calculation of percentage germination in different media using hanging drop method
15. Study and types of Embryo sacs
16. Study of types of Ovules.
17. Megasporogenesis
18. Development of female gametophyte.
19. Educational tour to Sanctuaries and National park.

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M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER -II SYLLABUS (W.E. F. 2020)

BOT-C203 BIOINSTRUMENTATION

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To impart knowledge about basic principles of Bioinstrumentation.
2. To acquaint the students with knowledge on various techniques and methods of biochemical analysis.

Learning Outcomes: On completion of this course, the students shall:

1. Demonstrate the knowledge about the techniques of Bioinstrumention.
2. Acquire knowledge in biochemical analysis.
3. Shall develop scientific skills to analyze the structure of biomolecules and their functions.

UNIT I: SEPARATION TECHNIQUES, CHROMATOGRAPHY AND CENTRIFUGATION

General principles, classification, separation, mechanisms, Thin layer, Paper, affinity, gel permeation, ion exchange, GLC, HPLC, HPTLC, Preparative and analytical centrifugations and their applications.

Unit II: ELECTROPHORETIC TECHNIQUES

Basic principles of electrophoresis, factors affecting electrophoresis, Electrophoretic mobility, paper and gel electrophoresis, Native and denaturing PAGE, iso-electric focusing, purse field gel electrophoresis.

Unit III : SPECIAL TECHNIQUES

Theory and applications of ultra violet and visible spectroscopy, Infrared (IR), Nuclear magnetic resonance (NMR), AAS, Mass(MS) Raman, Fluorescence and X-ray spectroscopy and applications.

Unit IV: RADIATION AND NON-RADIOACTIVE TECHNIQUES

Tracer Technology, dose response relationship, radioisotopes in diagnostic and biotechnology. Geiger Muller Counter, Scintillation counter, Metabolic tracer techniques, non-radioactive labels, labelling and detection methods using florescent molecules.

References:

1. Willard,H. H., Merrit, L. L. Jr. and others (1986) Instrumental methods of Analysis 6th edition - CBS Publishers and Distributors.

2. Chatwal, G. and Anand, S. (1989) Instrumental Methods of Chemical Analysis., Himalaya Publishing House, Mumbai.
3. Williams, B. L. and Wilson, K. A (1975) Biologist's Guide to Principles and Techniques of Practical Biochemistry.
4. Straughan, B. B. and Walker Spectroscopy Volume I –, Chapman and Hall Ltd.
5. Hanes -Gel Electrophoresis of Proteins- A Practical Approach.
6. Jaines Miller (1988) Chromatography: Concepts and Contrasts, John Wiley and Sons Inc New York.
7. Holme – Analytical Biochemistry
8. Straughan, B. P. and Walker, S. Introduction to High Performance Liquid Chromatography –Spectroscopy.
9. Gordon (1984)Practical Aspects of Gas Chromatography and Mass Spectrometry. M. Message, John, Wiley and Sons New York.
10. Tibor Kremmery -Gel Chromatography, wiley Publications
11. Thornburn, C. C. Isotopes and Radiations in Biology. Butterworth and Co. Ltd. London
12. Chapman,J. M. and Ayrey The Use of Radioactive isotopes in the Life Sciences. George Allen and Unwin Ltd. London.

BOL-C203 Lab Course in Bioinstrumentation

1. Separation of Lipids by thin layer chromatography
2. Gel filtration
3. Separation of blue dextran and cobalt chloride on Sephadex G25
4. The separation of proteins by ion exchange chromatography
5. The separation of serum proteins by electrophoresis on cellulose acetate
6. Separation of sub cellular organelles by differential centrifugation
7. Separation of amino acids by paper chromatography.
8. Separation and identification of plant pigments by Thin Layer Chromatography.
9. Demonstration of HPTLC
10. Determination of absorption maxima of proteins and nucleic acids.
11. Demonstration of Giger Muller Counter (GMC)
12. Separation and identification of plant pigments by Radial Chromatography.

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M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER -II SYLLABUS (W.E. F. 2020)

BOT-E201 PHARMACOGNOSY (Elective)

Max Mark: 100 **Periods: 60**

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Course Objective:

1. To know the crude drugs and their chemical nature
2. To carry out the pharmacognostic evaluation of crude drugs
3. To know the cultivation and marketing of crude drugs.

Course Outcomes:

Upon completion of the course, the student shall be able to know different crude drugs, their evaluation, cultivation techniques, production and regulation of crude drugs.

UNIT-I: PHARMACOGNOSY I

Definition, scope and development of Pharmacognosy, classification of drugs.

(a) Sources of Drugs – Plants and Animals.

(b) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilage, oleoresins and oleo- gum -resins).

Comparative study of IP, European Pharmacopoeia, BP / Ayurvedic Pharmacopoeia of India

UNIT-II: PHARMACOGNOSY II

Medicinal plants of Marathwada and Maharashtra: morphology, distribution, characteristics of powder constituents, chemical tests and uses of following drugs.

Root drugs: *Asperagus, Withania.*

Rhizome drugs: *Zingiber, Curcuma*

Stem/ Bark drugs: *Tinospora, Acacia. Arjuna*

Leaf drugs: *Adhatoda, Vitex.*

Fruit and Seed drugs: *Mucuna, Terminalia belerica*

Fruit Drug: *Coriandrum sativum* Linn

UNIT III: EVALUATION OF DRUGS

Concept, considerations, parameters (Identity, quality and purity) and methods of quality control for medicinal plant materials as per various pharmacopoeia and other guidelines: Organoleptic (Morphological) evaluation, Microscopic or anatomical evaluation, physical evaluation, chemical evaluation, analytical evaluation (Chromatographic techniques and spectrophotometric methods), biological evaluation (Introduction and Indication, significance, Methods of studies).

Presentation of data Monographs and Revisions, Synopsis. Use of GPS and computational in field work.

UNIT-IV: CULTIVATION OF DRUGS, PROCESSING AND QUALITY CONTROL

Cultivation and Collection of drugs of natural origin. Factors influencing cultivation of medicinal plants. Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha and Homeopathy (AYUSH).

Formulation & Manufacturing, Quality Control & Analysis, Drug adulteration, type of adulterants, Regulatory Affairs.

References:

1. Buchanan, B. B., Gruissem, W. and Jones, R. L. (2015) Biochemistry and Molecular Biology of Plants. Second Edition. Wiley Blackwell.
2. Cseke, L. J., Kirakosyan, A., Kaufman P. B., Warber S., Duke J. A. and Brielman, H. L. (2006) Natural Products from Plants. 2nd Edition, CRC Press, Taylor & Francis Group.
3. Dewick, P. M. (2002) Medicinal Natural Products (A Biosynthetic Approach), 2nd Edition, John Wiley and Sons Ltd., England.
4. European Pharmacopoeia. 9th Edition. (2017). 3 Volume Set.
5. Evans, W. C. (2009) Trease and Evans' Pharmacognosy. Elsevier Health Sciences.
6. Fu, T.-J., Singh, G. and Curtis, W. R. (2000) Plant Cell and Tissue Culture for the Production of Food Ingradients. Springer International Edition, Springer (India) Pvt. Ltd., New Delhi.
7. Harborne, A. J. (1998) Phytochemical Methods A Guide to Modern Techniques of Plant Analysis. Third Edition. Chapman and Hall.
8. Indian Pharmacopoeia 7th Edition (2014). 4 Volume Set.
9. Pushpangadan, P., Nyman, U. L. F., George, V. (1995) Glimpses of Indian Ethanopharmacology. Tropical Botanic Garden and Research Centre Thiruvananthapuram, India and The Royal Danish School of Pharmacy, Copenhagen, Denmark.
10. Raman N. (2006) Phytochemical Techniques. New India Publishing Agency, New Delhi, India.
11. Ramavat, K. G. and Goyal, S. (2009) Comprehensive Biotechnology. 1st Edition. S. Chand Publishing.
12. Ramawat, K. G. and Merillon, J-M. (Editors) (2008) Bioactive Molecules and Medicinal Plants. Springer Verlag, Berlin, Heidelberg.
13. Schirmer, R.E., (2000) Modern Methods of Pharmaceutical Analysis, Vol. 1, 2. CRC Press, Boca Raton, Florida.

14. Sensen, C. W. (Editor) (2002) Essentials of Genomics and Bioinformatics, Wiley-VCH, Germany.
15. Wagner, H. and Bladt, S. (1996) Plant Drug Analysis A Thin Layer Chromatography Atlas. 2nd Edition. Springer.

BOL-E201 Lab Course in Pharmacognosy:

1. Pharmacognostic evaluation of roots of *Asparagus*
2. Separation of alkaloids from roots of *Withania somnifera* by HPTLC
3. Pharmacognostic evaluation of *Zingiber officinale* rhizome (Ginger) and stem of *Tinospora cordifolia.*
4. Quantitative estimation of curcumin from rhizome of *Curcuma longa.*
5. Detection of curcumin from rhizome of *Curcuma longa* using TLC.
6. Pharmacognostic evaluation of bark of *Acacia Arabica* and fruits and seeds of *Mucuna prurenes*
7. Pharmacognostic evaluation of leaves of *Adhathoda vasaka/ Vitex nugendo*
8. Study of adulteration of leaf of Sanna (*Cassia aungustifolia*) /Adulteration of Oil- Test for Neem, Karanj, Castor.
9. Chemical test for primary metabolites- Fats, Protein, Carbohydrates, (Morphology of starch grain)
10. Estimation of Phenolics from plant sample
11. Determination of antifungal activity by picrate paper method
12. Determination of antibacterial activity by well plate method
13. Extraction of alpha amylase from germinating seeds
14. Determination of Km and Kmax of alpha amylase
15. Location of Plant species using Global Positioning system
16. Field Trips: Departmental arranged one long (7 days/6 night) and four short field visits for plant collection and study of local flora.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606

SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER- II SYLLABUS (W.E. F. 2020)

BOT-E202 BIODIVERSITY AND CONSERVATION (Elective)

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To understand the origin and diversity of plants
2. To understand the various threats of biodiversity and the strategies for conservation
3. To analyze the biogeography, status and loss of biodiversity

Learning Outcomes:

This paper creates awareness about significance and conservation of biodiversity and their relevance with the socio-economical aspects .This paper also helps to aware students about various rules, regulations and their amendments about the conservation of plant resources.

UNIT I: INTRODUCTION TO PLANT DIVERSITY AND RESOURCES

Concept, scope, and significance of plant diversity in sustainable development, Concept and scope of genetic diversity, Major types of floristic found in India, Forest resources for sustainable development.

UNIT II: BIODIVERSITY AND CONSERVATION OF PLANT RESOURCES

Causes and Strategies for Conservation of Plant Resources, *ex situ* and *in situ* conservation, Significance of National parks, Sanctuaries, reserved forest, protected areas in plant Resource conservation, Peoples participation in plant resource management; Social forestry and other programmes, movements of afforestation.

UNIT III: BIOTECHNOLOGY & PLANT RESOURCE MANAGEMENT

India as a major biodiversity centre, Biotechnological innovations in plant resource management, Computational methods for plant resource management. Recent scientific trends in plant resource management.

Endemism, definition and types, endemism in India, RED list categories of IUCN, Hot spots and Hottest hotspots, Keystone and Flagship species

UNIT IV: LEGAL PROVISIONS IN THE MANAGEMENT OF PLANT RESOURCES

Aims, objectives and legal provisions in Forest conservation act 1980 and related amendments; Endangered Plant Protection Laws (provisions of wild life (Protection) Act 1972 & related Amendments, scope of IPR in plant resource management.

References:.

1. Sinha, P. C. Biodiversity Depletion ,Anmol publications.

2. Rana, S.V S. (2013) Essentials of Ecology and Environmental Science.
3. Subramanyam, N. S. and Sambamurthy, A. V. S. S. Ecology
4. Chaudhuri, A. B. and Sarkar, D. D. Megadiversity Conservation
5. Day, J. G. (1999) Conservation strategies for algae. In Benson, E. E. (ed.) *Plant conservation biotechnology*. Taylor & Francis, pp. 111-124.

BOL E202 Lab Course in Biodiversity and Conservation

1. To determine the Biodiversity Index for given ecological habitat (Dominance index, Shannon-Wiener Index, Simpson Index, Derger-Parker Index, Similarity Index, Diversity index. Evaluate and interpret each of the index values)
2. Study of tissues and diversity in shape and size of plant cells (palisade cells, guard cells, parenchyma, collenchyma, sclerenchyma, xylem and phloem through temporary/permanent slides
3. Using a hand held GPS instrument, locate coordinates of a demarcated field
4. Estimation of Primary productivity of water bodies.
5. Study of the traditional knowledge of biodiversity conservation of any local communities.
6. Determination of requisite size of the quadrant for vegetation analysis.
7. Analysis of frequency distribution of plants in a piece of vegetation by quadrat method.
8. To measure the above-ground plant biomass in a grassland/To determine the biomass of a particular area.
9. To study the biotic components of a pond.
10. To measure the vegetation cover of grassland through point-frame method.
11. To prepare a list of plants occurring in grassland and also to prepare chart along the line transect.
12. Visit to National Botanical Garden / Sanctuaries / Parks etc.

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SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM) , SEMESTER-I SYLLABUS (W.E. F. 2020)

BOT-OE101 FUNDAMENTALS OF PLANT TISSUE CULTURE

(Open Elective for Other Schools)

Max Mark: 50 **Periods: 30**

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Learning Objectives:

1. To impart knowledge about basic principles of plant tissue culture.
2. To underhand basics of secondary metabolite production.

Learning Outcomes: On completion of this course, the students shall:

1. Acquire knowledge in Plant Tissue Culture including secondary metabolite production
2. Shall develop scientific skills to work in Plant tissue culture, Pharmaceutical and research laboratories.

UNIT-I

History, Laboratory Requirements and General Techniques; Cellular Totipotency; Tissue Culture Media: Introduction, media constituents, media selection, media preparation; Callus Culture. Micropropagation: Introduction, techniques, applications, production of pathogen free plants; Somatic Embryogenesis; Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny of androgenic haploids, plant regeneration from pollen embryos, homozygous diploids, applications, limitations.

UNIT-II

Somaclonal & gametoclonal variations; Protoplast Culture: Protoplast isolation, fusion and regeneration, Cybrids; Embryo Culture and embryo rescue: Introduction, techniques; Synthetic Seeds; Cell and Suspension Culture. Introduction, isolation of single cells, suspension cultures, culture of single cells, plant cell reactors, applications of cell culture; Production of secondary metabolites.

References:

1. John, H., Dodds and Lorin, W. Robert. Experiments in Plant Tissue Culture
2. Bhojwani, S. S. and Razdan, M. K. (1996) Plant tissue Culture : Theory and Practice Elsevier, Amsterdam.
3. Chawla, H. C. (2002) An Introduction to Plant Biotechnology Oxford and IBH.
4. Razdan, M. K. (2002) Introduction to Plant Tissue Culture; Oxford and IHB publishing Co. Pvt. Ltd.
5. Kumar, U., (1999) Methods in Plant Tissue Culture, Bikaner, Agro Botanica.
6. Singh, B D (1998) Biotechnology; Kalyani Publishers.

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SCHOOL OF LIFE SCIENCES

M. Sc.-I BOTANY (CREDIT SYSTEM), SEMESTER-II SYLLABUS (W.E. F. 2020)

BOT- OE 201 BASICS OF PLANT IDENTIFICATION

(Open Elective for Other Schools)

Max Mark: 50 **Periods: 30**

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Learning Objectives:

1. To impart knowledge about basic principles in plant identification
2. To acquaint the students with identification of plants.

Learning Outcomes: On completion of this course, the students shall develop scientific skills in identification of plants.

UNIT I: IDENTIFICATION OF MEDICINAL PLANTS

- ✓ Introduction, Nomenclature and Classification
- ✓ The Evolution of Plants: Learning Plants by Family (By using characters)
- ✓ Anatomy: Stems, Roots, Leaves, Reproductive Tissue
- ✓ Botanical Keys and Herbaria
- ✓ Herbs: Annuals, Perennials, Biennials
- ✓ Shrubs: Perennials, Biennials
- ✓ Trees: Perennials

UNIT II: IDENTIFICATION OF EDIBLE AND ORNAMENTAL PLANTS

- ✓ Woody Ornamentals
- ✓ Turf & Vines
- ✓ Indoor Plants
- ✓ Aquatic Plants
- ✓ Vegetables & Edible Plants
- ✓ Plant Identification & Horticulture: bringing it all together

References:

1) Sharma, O.P (1993) Plant Taxonomy. Tata McGraw-Hill Publ. Company. New Delhi.
2) Singh, G. Plant systematic Theory and Practice, Oxford and IBH-Publ. Company. Ltd. New Delhi.
3) Pande, B.P. (1981) Text book of Botany Angiosperms'. Chand Com. Ltd. New Delhi.
4) Bhattchairyya, B. (2005) Systematic Botany, Narosa Pub. House, New Delhi.
5) Sunder, R.S. (2000) Practical Manual of Angiosperm Taxonomy. Anmol Pub. New Delhi.

6) Manilal, K. S., Muktesh, K. M. S. (1998) Hand Book on Taxonomy Training. DST. Pub., New Delhi.
7) Pande, A. K., Wen, J., Dogre, J. V. V. (2006) Plant Taxonomy Advances and Relevance CBS. Pub. And Distributors. New Delhi.
8) Nordenstam, M. E., Gazaly, G. and Kasses, M. (2000) Plant Systematic of 21st Century. Portland Press Ltd. London.
9) Takhtaji, A. L. (1997) Diversity and Classification of Flowering Plants. Columbia University Press, New York.

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