।। 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

M. Sc. Second Year

With Effect from June 2021

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
Chairman, Board of Studies in Botany, Horticulture and Herbal Medicine
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bsurwase@rediffmail.com

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-C202	Lab Course in Ecology, Plant Development and Reproduction	04	CC	02	25	25	50
	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.-II BOTANY (CREDIT SYSTEM) ,SEMESTER- III SYLLABUS (W.E.F. 2021)

BOT-C301 r-DNA TECHNOLOGY

Max Mark: 100 **Periods: 60**

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Course objectives:

The objective of this course is to familiarize the students with concept of r-DNA, clone and gene cloning, cloning strategies, tools and techniques, applications and advantages and alternatives to transgenics etc.

Course Outcomes:

Students will be GM literate i.e. aware about r-DNA technology, its advantages and disadvantages in addition to tools and techniques. It will help in avoiding spread of misconception about GMO in society.

UNIT I

Fundamentals of Genetic Engineering

Introduction to concept of r DNA, clone and gene cloning. Scope and Milestones in Genetic Engineering.

Strategies and Molecular Tools:Restriction and modifying enzymes. DNA and RNA markers.

Vectors: Cloning and expression vectors; vector components: Promoters, selectable markers, reporter genre, ori, URRs, codon optimization, Properties and Applications. Commonly used vectors: Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes.

UNIT II

Gene Cloning strategies and tools

Isolation and purification of chromosomal and plasmid DNA, Yield analysis, Nucleic acid amplification and its applications. Genomic and c DNA library preparation and application.

Cloning Methods: Blunt end cloning, Sticky end and sticky end PCR cloning, TA cloning, PCR recombination, Integration PCR, In-Fusion™ Cloning, TOPO Cloning, Gateway cloning etc.

Methods of screening: Selection by complementation, antibiotic resistance, colony PCR etc.

Expression analysis: Phenotype, RNA and Protein level. Northern blot, Primer extension, S1 mapping, Rnase protection assay, Reporter assays, RTPCR and Real time q PCR, Nucleic acid microarray, Transcriptome sequencing, Western blotting.

UNIT III

Applications of r DNA Technology

Heterologous expression of proteins. Vector engineering and codon optimization, host engineering, *E*xpression in bacteria, expression in mammalian and plant cells, Processing of Recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Process and applications of Phage Display.

GMO (Microorganims, Plants and animals) with traits having applications in different sectors:

A. Health, B. Agriculture, C. Environment and D. Industrial

UNIT IV

Gene silencing: Strategies, applications and advantages.

Genome editing: Strategies, applications and advantages.

Gene therapy: Principles of Gene therapy: Vector engineering. Strategies of gene delivery. Gene replacement/augmentation therapy, success and limitations of gene therapy.

Genetic engineering guidelines, Regulatory bodies, GEAC, RCGM and IBSC.

References:

1. Sambrook, J., Fritisch, E. F. and Maniatis, T. (2000) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.
2. Glover, D. M. and Hames, B. D. (1995) DNA Cloning: a Practical Approach, IRL, Press, Oxford.
3. Kaufman, P. B., Wu, W., Kim, D. and Cseke, L. J. (1995) Molecular and Cellular Methods in Biology and Medicine, CRC Press, Florida.
4. Berger, S. L. and Kimmel, A. R. (1998) Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, Academic Press, Inc. San Diego.
5. Goeddel, D. V. (1990) Methods in Enzymology Vol. 185, Gene Expression Technology, Academic Press, Inc., San Diegoo.
6. Mickloss, D. A. and Freyer, G. A. (1990) DNA Science. A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
7. Primrose, S. B. (1994) Molecular Biotechnology (2^{nd} edition), Blackwell Scientific Publishers, Oxford.
8. Davies, J. A. and Raznikoff, W. S. (1992) Milestones in Biotechnology, Classic papers on Genetic Engineering, Butterworth-Heinemann, Boston.

9. Walker, M. R. and Rapley, R. (1997) Route Maps in Gene Technology, Blackwell Science Ltd., Oxford.
10. Kingsman, S. M. and Kingsman, A. J. (1998) Genetic Engineering: An Introduction to gene analysis and exploitation in eukaryotes, Blackwell Scientific Publications, Oxford.
11. Glick - Molecular Biotechnology .

BOL-C301 Lab Course in r-DNA technology

1) Genetic recombination (conjugation, transformation, transduction) in bacteria.
2) Gene cloning: Restriction, digestion and ligation, DNA Cloning in plasmid vectors and analysis of gene products.
3) Preparation of competent cells and transformation by Cacl2 method.
4) DNA amplification.
5) DNA fingerprinting: RFLP, RAPD
6) Blotting and hybridization techniques: Western, southern, Northern hybridization.
7) Gene expression in *E. coli*
8) Agarose gel electrophoresis by using DNA markers for molecular weight determination

Reference:

1. Sambrook, J., Fritisch, E. F. and Maniatis, T. (2000) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER -III SYLLABUS (W.E.F. 2021)

BOT-C302 PLANT PHYSIOLOGY AND METABOLISM

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To acquaint with the processes of plant water relationship and mineral nutrition.
2. To understand growth reduction in abiotic and biotic stress.
3. To understand biochemical mechanisms of growth and development of plants.
4. To understand role of sunlight in photomorphogenesis and photoperiodism.
5. To acquaint with the nitrogen and sulphur assimilation in plants.

Learning Outcomes:

After completion of this course, students shall be able to:

1. Acquire knowledge on plant water relationship and mineral nutrition and physiological response of plants to various biotic and abiotic factors
2. Understand the in plants
3. Understand the photosynthetic and respiration mechanisms and role of various growth promoting substances and their mechanism of action
4. Understand photoperiodism & physiology of flowering, fruit ripening and seed dormancy

UNIT I PLANT WATER RELATIONS AND STRESS PHYSIOLOGY

Plant Water Relations: Structure and properties of water, plant water relation, concept of water potential, mechanism of water transport through xylem and phloem, phloem loading and unloading.

Stress physiology: Types, Plant responses to abiotic stresses, mechanisms of abiotic stress tolerance, water deficit and drought tolerance, salinity stress, metal toxicity, freezing and heat stress. Biotic stress.

UNIT II PHOTOSYNTHESIS AND RESPIRATION

Photosynthesis: General concepts of photosynthesis, Photosynthetic pigments and LHCs and Photosystems, Photooxidation of Water, mechanism of electron & proton transport, Photophosphorylation. A brief description of C3, C4 and CAM plants, photorespiration.

Respiration: General aspects, Glycolysis, TCA Cycle, Electron transport and ATP synthesis and alternate Oxidase system. Pentose Phosphate pathway and it's significance.

UNIT III PLANT GROWTH REGULATORS AND MINERAL NUTRITION

Plant growth regulators: Structural Chemistry, Biosynthesis, Transport and physiological effects and mechanism of action of Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid and Brassinosteroids;

Mineral nutrition: Physiological role of major and minor elements in plant growth.

UNIT IV PHYSIOLOGY OF FLOWERING, FRUIT RIPENING AND SEED DORMANCY, NITROGEN AND SULPHUR METABOLISM

Physiology of flowering, fruit ripening and seed dormancy

Phytochrome and physiological response, photomorphogenesis, photoperiodism and its significance, vernalization, endogenous clock and its regulation, floral induction , development and its regulation; Physiology of fruit ripening and seed dormancy.

Nitrogen and Sulphur Metabolism: Nitrogen fixation, Nitrogenase, "nif" genes, regulation of nitrogen fixation, products of nitrogen fixation and their transport, mechanism of nitrate uptake and reduction, transamination, nitrogen metabolism in relation to photosynthesis and respiration, Sulphate uptake, transport, reduction and assimilation.

References:

1. Lincoln, T. and Eduardo, Z. - Plant Physiology.
2. Salisbury, F. B. and Ross, C, W, - Plant physiology.
3. Devlin R. M. and Witham F. H- Plant physiology.
4. Pandey S. N. and Sinha B. K. - Plant physiology.
5. Dieter Hess (Narosa Publishing House) – Plant Physiology.
6. Singh, B. P. and Mengel K. – Plant physiology and Biochemistry.
7. Hess, D. – Plant Physiology: Molecular, Biochemical and Physiological fundamentals of Metabolism and Development.
8. Walter, S. – Principles of Plant Physiology (Atalantic Publishers & Distributors).
9. Arthur, C. G – Cell Physiology 5th Edition (W. B. Saunders Company).
10. Rabinowitch, E. and Govindjee – Photosynthesis .
11. Fogg, G. E. – Photosynthesis.
12. Raghavendra, A. S. – Photosynthesis A Comprehensive Treatise.
13. Devlin, R. M. and Barker, A. V. – Photosynthesis.
14. Jacob, W. P. – Plant Hormones and Plant development.
15. Thomas, C. M - Biochemistry and Physiology of Plant Hormones II Edition (Springer-Verlag).

16. Malcom, B. W. - Physiology of Plant Growth and Development.
17. Dennis, D. T., Layzell D. B., Lefebvre, D. D. and Thrpin, D. H. - Plant Metabolism (Longmann).
18. Emil, T. - Mineral Nutrition in Plants.
19. Dixon, R. O. D. and Wheeler, C. T. - Nitrogen Fixation in Plants.
20. James, D. M. - Botany: An Introduction to Plant Biology (Jones & Bartlett Publishers).
21. Bajracharya, D. -Experiments in Plant Physiology (Narosa Publishing House).
22. Bakshi, A. K. - Energy (National Book Trust India).

BOL-C302 Lab Course in Plant Physiology and Metabolism

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Demonstration of transpiration with the help of photometers.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of activity of catalyse and study of effect of pH and enzyme concentration.
5. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.
7. Separation of photosynthetic pigments by paper chromatography.
8. To determine the RQ of different respiratory substances.
9. Spectral analysis of Chlorophyll pigments (Isolation, Estimation and spectral analysis).
10. Demonstration of Hill reaction.
11. Study of Kranz anatomy.
12. Isolation of *Rhizobium* from the root nodules of leguminous plant.
13. Effect of auxins/GA_3 on plant growth.
14. Effect of Gibberellins on plant growth.
15. Effect of Cytokinins on plant growth.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606

SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) , SEMESTER-III SYLLABUS (W.E. F. 2021)

BOT-C303 TAXONOMY OF ANGIOSPERMS AND SYSTEMATICS

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To understand basic concepts of Identification, Classification and Nomenclature of plants using key marker characters proposed by Engler-Prantle and Hutchinson.
2. To understand rules and regulation of International Botanical Nomenclature system to make easier nomenclature of new plants identified.
3. To understand the classical and modern trends of Angiosperm taxonomy (Angiosperm Phylogeny Group system)
4. To understand the salient features of angiosperm families with special reference to sexual characters

Learning Outcomes:

This paper introduces several key markers and equips the students to identify the plants and plant groups.

UNIT-I TAXONOMY-I

Introduction, definition, aims & objective of Taxonomy, the species concept, Taxonomic hierarchy: species, genus, family & other categories, principles used in assessment of relationship, delimitations of taxa and attribution of rank. The concept of primitive flower Thornes' principles, Homology v/s analogy, alfa v/s Omega, Primitive v/s advanced character, qualitative v/s quantitative character, Salient features of the international code of botanical nomenclature. APG system of classification

UNIT-II TAXONOMY-II

Taxonomic evidences: Morphology, anatomy, palynology, embryology, cytology, phytochemistry, genome analysis and nucleic acid hybridization. Taxonomic tool: Herbarium, Floras, botanical garden, use of keys in plant identification, serological, biochemical and molecular techniques, computers in taxonomy, systems of angiosperm classification, Broad outline of Engler Prantle system of classification with merits and demerits and Hutchinson system of classification with merits and demerits, Principles

UNIT-III SYSTEMATICS-I

Comparative account of floral morphology, interrelationships, evolutionary trends and distribution of plant families belonging to following orders as per Englers-Prantle system of classification. Liliflorae, Glumiflorae, Scitaminae, Ranales, Rhoedales.

UNIT-IV SYSTEMATICS-II

Comparative account of floral morphology, interrelationships, evolutionary trends and distribution of plant families belonging to orders as per Engler - Prantle's system of classification. Myrtiflorae,, Tubiflorae, Rubiales, Malvales, Rosales, Contortae, and Cucurbitales.

References:

1. Sharma, O. P. (1993) Plant Taxonomy, Tata McGraw-Hill Publ. Company, New Delhi.
2. Singh, G. (2004) Plant systematic Theory and Practice, Oxford and IBH-Publ. Company. Ltd. New Delhi.
3. Bhattchairyya, B. (2005) Systematic Botany, Narosa Pub. House, New Delhi.
4. Sunder Rajan , S. (2000) Practical Manual of Angiosperm Taxonomy., Anmol Pub. New Delhi.
5. Manilal, K. S. and Muktesh Kumar, M. S. (1998) Hand Book on Taxonomy Training, DST. Pub. New Delhi.
6. Pande, A. K., Wen J. and Dogre, J. V. V. (2006) Plant Taxonomy Advances and Relevance, CBS. Pub. And Distributors. New Delhi.
7. Plant Systematic of 21st Century. Nordenstam M. EiGazaly G. And Kasses M., Portland Press Ltd. London, 2000.
8. Fundamentals of Plant systematic , Raford A. E., Harper and Row Publication USA, 1986.
9. Diversity and Classification of Flowering Plants,Takhtaji A.L., Columbia University Press, New York, 997.
10. Woodland, D. W. (1991) Contemporary plant systematic, Prentice Hall, New Jersy.

BOL -C303 Lab Course in Taxonomy of Angiosperms and Systematics

1. Introduction of morphological parts of higher plants with modifications.
2. Introduction of Taxonomical terms.
3. Floral formula and Floral Diagram.
4. Preparation of Herbarium.
5. Preparation of taxonomical keys and Identification of plants by using flora and Taxonomical keys.
6. Description and Identification of flowering plants up to Genus and species with their floral formula and floral Diagram of following Families:

A. <u>Monocot Orders</u>

I. Liliflorae (09)

a. Liliaceae - *Alluium cepa , Allium sativum , Chlorophytum sps, Urginea indica, Scilla indica, Dracaena sps, Asparagus racemosus*

b. Dioscoreaceae – *Disocorea bulbifera*

c. Amarylidaceae – *Polyanthus* sps, *Agave americana*, *Pancratium* sps, *Crinum* sps, *Zephranthus* sps.

II. Scitaminae – (04)

a. Musaceae – *Musa paradisica*, *Heliconia angustifolia*, *Ravenala madagascariensis*

b. Cannaceae – *Cana indica*

c. Marantaceae- *Maranta bicolor*

d. Zingiberaceae- *Hedychium coronarium*, *Zingiber officinale*, *Alpinia nutans*

III. Glumiflorae– (02)

a. Gramineae- *Zea mays, Sorghum vulgare, Cynodon dactylon, Eragrostis sps, Coix lacryma-jobi, Saccharum officinarum.*

b. Cyperaceae – *Cyperus rotundus*, *Kyllinga* sps, *Eliocharis* sps, *Scirpus* sps

B. <u>Dicot Orders and families</u>

I. Rhodales – (06)

a. Papaveraceae – *Argemone maxicana*

b. Capparidaceae – *Capparis zylanica*

c. Cruciferae – *Brassica compestris*

II. Malvales – (08)

a. Tiliaceae – *Triumfettarh rhomboidea*, *Grewia tilifolia*.

b. Malvaceae – *Hibiscus rosasinensis*, *Abelmoschus ficulneus*, *Abutilon pannosum*.

c. Bombacaceae – *Bombax ceiba*

d. Sterculiaceae – *Melochia corchorifolia*

III. Rosales – (18)

a. Rosaceae – *Rosa indica*

b. Leguminosae (Papilionaceae) –*Dalbergia sisso*, *Tephrosia perpuria*

c. Leguminosae (Caesalpinaceae) – *Delonix regia*

d. Leguminoceae (Mimosaceae) – *Acacia arabica*

IV. Contortae – (04)

a. Gentianaceae – *Exacum bicolor*

b. Apocynaceae – *Catharanthus roseus*

c. Asclepiadaceae- *Calotropis* sps.

V. Cucrbitales – (01)

a. Cucurbitaceae – *Coccinea indica*

VI. Ranales – (18)

a. Magnoliceae:*Magnolia* sps., *Michelia champaca*

b. Annonaceae – *Annona reticulata*, *Annona squamosa*, *Polyalthia longifolia, Artebotrys odoratissimus*

c. Menispermaeceae – *Cocculus villosus*, *Tinospora cordifolia*

d. Nymphaceae – *Nymphaea lotus, Nelumbo nucifera*

VII. Myrtiflorae – (19)

a. Myrtaceae- *Psidium guava, Callistemon lanceolatus, Eugenia jambolana, Eucalyptus globulus*

b. Lythraceae – *Lawsonia enermis, Woodfordia fruticosa*

c. Punicaceae – *Punica granatum*

d. Combretaceae – *Terminalia* sps.

VIII. Tubiflorae – (20)

a. Boraginaceae – *Heliotropium indium*

b. Verbenaceae – *Vitex negundo*

c. Labiatae – *Ocimum sanctum*

d. Solanaceae – *Solanum xanthocarpum*

e. Martyniaceae –*Martynia annua*

f. Bignoniaceae – *Tecoma stans*

g. Acanthaceae – *Acanthus sps*

IX. Rubiales – (05)

a. Rubiaceae – *Haemalia petens*

(Note: - The names of the genera mentioned above are the representatives of the selected families. However other genera belonging to selected families can also be considered for practical purpose)

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER -III SYLLABUS (W.E. F. 2021)

BOT-E301 COMMUNICATION SKILLS IN ENGLISH

(SKILL DEVELOPMENT ELECTIVE COURSE)

Max Mark: 50 **Periods: 30**

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Learning objectives: To provide the students with the essential skills required for effective communication and to provide a comprehensive view of business communication and its role in the corporate environment.

Course outcomes: Students will be able to:

1. Understand and demonstrate the use proper writing techniques relevant to the present day technological demands, including anticipating audience reaction.
2. Write effective and concise letters and memos, prepare informal and formal reports, proofread and edit copies of business correspondence.
3. Develop interpersonal skills that contribute to effective personal social and professional relationships.

Unit-I

Essentials of Communication: Meaning, Definition, process, feedback, emergence of communication as a key concept in the corporate and global world, impact of technological advancements on communication.

Channels of Communication: Formal and Informal: Vertical, horizontal, diagonal, and grapevine.

Unit-II

Methods and Modes of Communication: Verbal and nonverbal, Verbal Communication: Characteristics of verbal communication, Non-verbal Communication: Characteristics of non-verbal communication, kinesics, proxemics and chronemics.

Barriers to Communication: Physical, semantic, language, socio-cultural, psychological barriers, Ways to overcome these barriers.

Unit-III

Listening: Importance of listening skills, cultivating good listening skills

Written Communication: Business letters, memos, minutes of meeting, notices, e-mails, agendas and circulars.

Technical Report Writing: Types of Reports, contents of reports. Formatting, writing styles and documentation.

Unit-IV

Presentations: Principles of effective presentation, power-point presentation, video and satellite conferencing.

Interviews and Group Activities Personal interviews, group discussion and panel discussion

Creative writing: Paragraph and Essay writing, Book reviews, Movie Reviews, Editorials and articles.

Self-Learning: Paper writing: Styles of paper writing: Short Communication, Review papers and Research papers, referencing styles: MLA, Chicago Style and APA.

Text Books:

1. Lehman, C. M., DuFrene, D. D. and Walker- B-BCOM-An Innovative Approach to Learning and Teaching Business Communication, Cengage Learning, New Delhi.

2. McMurrey, A. M. and Buckley, J.- Handbook for Technical Writing, Cengage Learning, New Delhi.

Reference Books:

1. Lesikar, R. V. and Flately, M. E. (2000) Basic Business Communication-Skills for Empowering the Internet Generation, Tata McGraw-Hill Publishing Company Limited. New Delhi.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER -III SYLLABUS (W.E. F. 2021)

BOT-E302 FOREIGN LANGUAGE- FRENCH

(SKILL DEVELOPMENT ELECTIVE COURSE)

Max Mark: 50 **Periods: 30**

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Learning objectives:

1. To acquire the phonology of French language.
2. To present and talk about one self and others.
3. Introduction to Grammar.
4. To learn about France.

Course outcomes:

Students should be able:

1. To master the sounds of French language and its alphabet.
2. To talk about oneself and others briefly.
3. To have a notion of basic grammatical structures of French.
4. To communicate effectively in oral and written format in simple personal and professional situations in French using the linguistic and extra-linguistic skills gained during the course.

UNIT I COMMUNICATIVE AND LINGUISTIC COMPONENTS

Communicative: Formal and informal greetings- To Introduce oneself and to introduce others- Ask and give details of personal information: age, profession, nationality, address, e-mail etc.- To give and ask for time and date – to describe persons and things.

Grammar and Structure: Alphabet and pronunciation- Subject personal pronouns- Indicative Simple Present: Conjugation of -er, - ir, -re ending verbs (Regular verbs, selected irregular verbs)- Basic Negative and interrogative constructions- Gender and number- Question Words - Definite, Indefinite Articles–-Qu'est-ce que c'est?, C'est/ce sont, Il y a.

Vocabulary: Classroom communication - Nationalities, countries and languages- Parts of the day, days of the week and months- Numbers- Adjectives of Quality -Professions –Internet.

UNIT II CULTURAL COMPONENTS

Introduction to France - institutions, symbols, history, culture, physical features, polity.

References:

1. Régine, M. and Yves, L. (2004) Select units from *Connexions Niveau 1,* (Text book and Work book), Didier, Paris.

2. Other select print, illustrated, audio and video material from books, CDs, DVDs and online sources.
3. Débutant (Livre + corriges) –CLE Grammaire 450 nouveaux Exercices.
4. DELF/DALF practice books available in the University Library.
5. Haine, S. W. (2000) *The History of France*, Greenwood Publishing.
6. Northcutt, W. (1996) *The Regions of France: A Reference Guide to History and Culture*, Greenwood Press.
7. Dictionaries and reference books available in the University Library.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER-III SYLLABUS (W.E. F. 2021)

BOT-E303 FOREIGN LANGUAGE- SPANISH

(SKILL DEVELOPMENT ELECTIVE COURSE)

Max Mark: 50 **Periods: 30**

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Learning Objectives:

1. To develop the skills of listening, speaking, reading & writing.
2. To read and understand simple texts.
3. To be able to write brief texts.
4. To be able to listen to simple texts and answering questions on them.
5. To have conversations based on visual texts.

Learning Outcomes:

Learners should be able to -

1. Participate in simple conversations in various day to day situations.
2. Organize ideas and communicate both in the written as well as oral form.
3. Know different aspects of life and culture of the people who speak the language.
4. Know basic concepts of grammar as well as functional and notional questions of language use/registers.

UNIT I COMMUNICATIVE FUNCTIONS & CULTURAL COMPONENTS

Formal and informal greetings. To introduce oneself and to introduce others.To ask and give details of personal information: name, age, profession, nationality, address, email etc. To give and ask for time and date. To describe every day activities and habits with frequency. To talk of relations with other persons. To talk about one's family.

Life and culture of the people where the language is spoken. Diversity of the countries where the language is used. Spanish speaking countries. Spanish songs, music and dance.

UNIT II FUNCTIONAL GRAMMAR AND VOCABULARY

Alphabet and pronunciation.Subject personal pronouns. Indicative simple present: conjugation of *-ar, - er, -ir* ending verbs (regular verbs, reflexive verbs and selected irregular verbs).Negative and interrogative constructions.Gender and number. Articles and contractions.Interrogative pronouns: *qué, cuál, quién, cómo, dónde, cuándo, cuánto, etc.*

Classroom communication. Greetings. Parts of the day. Days of the week. Months of the year. Seasons. Colours. Numbers (0 to 100). Family relations. Languages.

References:

- Aula Internacional- Inicial, I, (Libro de alumno, cuaderno de ejercicios, CD). J. Madrid, 2010. OR
- Nuevo ele inicial 1 (Libro del alumno, cuaderno de ejercicios, casete), Virgilio Borobio, Ediciones SM, Madrid, 2005.
- *450 Ejercicios Gramaticales*, *Aquilino Sánchez*, SGEL, Spain, 2007.
- *Cuadernos de Gramática Española, Emilia Conejo*, CIPD, Barcelona, 2008.
- Dictionaries available in the university library.
- Other print, audio and video material from various books, CDs, DVDs and the internet.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER- IV SYLLABUS (W.E.F. 2021)

BOT-C401 PLANT BIOTECHNOLOGY

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To acquaint the students with basic principles and various methods of Tissue Culture.
2. To impart knowledge about varied methods of gene transfer and transgenic plant development.
3. To underhand basics of secondary metabolites and their engineering.
4. To acquire knowledge about molecular markers and their use in plant breeding.

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

1. Demonstrate the knowledge about the techniques of Plant Tissue Culture and acquire comprehensive knowledge on GM technology for quality characteristics and their role in crop improvement.
2. Acquire knowledge in metabolic engineering and industrial products.
3. Develop skills in molecular markers studies and their use in plant breeding.
4. Shall develop scientific skills to work in Plant tissue culture, Pharmaceutical and Research laboratories.

UNIT I

History: Important events in the history of plant tissue culture ; 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; Triploid production.

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: Introduction, strategies used to optimize product yield, commercial aspects.

UNIT III

Introduction to transgenic technology: Conventional breeding versus Transgenesis; Introduction to *Agrobacterium tumefaciens* and *A. rhizogenes,* Features of Ti and Ri Plasmids and their use as vectors, Binary and co-integrate vectors, *Agrobacterium* mediated

transformation, Direct DNA transfer to plants , Detection, characterization and expression of transformants.

Applications of plant transformation for productivity and performance: GM technology for: Conferring resistance to biotic stresses (pests, viruses and fungi) and abiotic stresses (draught and salt), Herbicide resistance**,** Increasing shelf life of fruits and flowers**,** Enhancing the nutritional quality (pro-vitamin A),□ Chloroplast Transformation.

UNIT IV

Metabolic engineering and industrial products: Plant secondary metabolites: alkaloids, industrial enzymes, biodegradable plastic: polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, oleosin partitioning technology etc, Aspects related to commercial release of transgenic crops.

Molecular marker aided breeding: RFLP, RAPD, Microsatelites, AFLP etc.

References:

1. Razdan, M. K. (2002) Introduction to Plant Tissue Culture, Oxford and IHB publishing Co. Pvt. Ltd.,
2. Kumar, U. (1999) Methods in Plant Tissue Culture, Bikaner, Agro Botanica.
3. Misawa, M. (1994) Plant tissue culture: An alternative for production of useful metabolites, Daya Publishing House, New Delhi.
4. Bhojwani, S. S. and Razdan, M. K. (1996) Plant tissue culture, theory and practice a revised edition, Elsevier India Ltd.
5. Ignacimuthu, S. J. Applied Plant Biotechnology, Tata McGrew Publishing Company, New Delhi.
6. Flower, M. W. and Wasven, E. S. (1992) Plant Biotechnology comprehensive Biotechnology supplement, Oxford Pergaman press.
7. Hammand, J., McGarvey, P. and Yusibov, V. (2000) Plant Biotechnology, New Products and applications Springer, New Delhi.
8. Mantell, S. H., Matthews, J. A. and Makee, R. A. (1985) Principles of Plant Biotechnology: An introduction to genetic Engineering in plants, Oxford, Blackwell-Scientific publication.
9. Singh, C. H. N. (1998) Biotechnology in crop improvement, International Book Distribution Company, Lucknow.
10. Gupta, P. K. (1996) Elements of Biotechnology Rastogi and Company Meerut.

11. Pareek, L. K. (1997) Trends in Plant tissue culture and Biotechnology, Agro Botanica publishers.
12. Galum, E. and Breiman, A. (1997) Transgenic plants, Imperial College Press.
13. Singh, B. D. (1998) Biotechnology, Kalyani Publishers.
14. Narayanswami- Plant tissue culture.
15. Hammond, J., McGarvey, P. and Yusibov, V. (2000) Plant Biotechnology, (Eds.), Springer Veriag.
16. Fu, T. J., Singh, G. and Curist, W. R. (1999) Plant Cell and Tissue Culture for the production of Food Ingredients (Eds.), Kluwer Academic/Plenum press.
17. Chawla, H. S. (1998) Biotechnology in Crop Improvement, International Book Distribution Company.

BOL-C401 Lab Course in Plant Biotechnology

1 Preparation of MS medium
2 Surface sterilization
3 Micropropagation of plant through multiplication of pre-existing meristems.
4 Hardening of *in vitro* raised plants
5 Encapsulation of somatic embryos
6 Embryo culture and embryo rescue.
7 Protoplast isolation, fusion and culture.
8 *In vitro* production of fast growing normal root culture for production of secondary metabolites
9 Elicitation of plant sells for secondary metabolites
10 *Agrobacterium* Ti plasmid based vector mediated transformation, selection of transformants, reporter gene assay.
11 Transformation of plant tissues using *Agrobacterium rhizogenes* for hairy root production
12 Transformation and expression of GFP gene in suitable host.
13 Developing RFLP maps , Developing RAPD maps

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606

SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER-IV SYLLABUS (W.E. F. 2021)

BOT-C402 BIOSTATISTICS AND BIOINFORMATICS

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To understand the statistical data and its analysis
2. To asquint with how bioinformatics data is stored and organized in data bases like NCBI and EBI
3. To impart knowledge about how to locate and extract data from key bioinformatics databases and resources

Learning Outcomes: After completion of this course student shall be able to:

1. Apply basic statistics in the field of Botany.
2. Locate and use the main databases at the NCBI and EBI resources
3. Know the difference between databases, tools, repositories and also be able to use each one to extract specific information

UNIT I BIOSTATISTICS I

Statistics: Introduction, its role and uses; Collection; Organization; Graphics and pictorial representation of data; Measures of central tendencies and dispersion; Coefficient of variation. Probability: Basic concepts; Common probability distributions and probability distributions related to normal distribution; Sampling: Simple random and other sampling procedures; Distribution of sample mean and proportion.

UNIT II BIOSTATISTICS II

Estimation and Hypothesis testing: Concepts of hypothesis testing and types of errors; Student-t and Chi square tests; Sample size and power; Experimental design and analysis of variance, Correlation and regression: Graphical presentation of two continuous variables; Multiple and partial correlations; Linear regression; Regression line; Coefficient of determination; Interval estimation and hypothesis testing for population slope; Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies; Statistical quality control.

UNIT III BIOINFORMATICS I

Bioinformatics basics: Computers in biology and medicine; Database concepts; Protein and nucleic acid databases; Structural databases; Computational tools for DNA sequence analysis; MEGA; Resources on RCSB. Databases and search tools: Biological background for sequence analysis; Identification of protein sequence from DNA sequence; Searching of databases similar

sequence; The NCBI; Publicly available tools; Resources at EBI; Resources on the web; Database mining tools.

UNIT IV BIOINFORMATICS II

DNA sequence analysis: The gene bank sequence database; Submitting DNA sequence to the databases (NCBI-Bank, SEQUIN) and database searching; Sequence alignment; Pair wise alignment techniques; multiple sequence analysis; Multiple sequence alignment.

References:

Biostatistics:

1. Sundarraao, P. S. S., Richard, J. and Richard, P. H. J. (2003) An introduction to Bio-statistics, Prentice Hall of India (P) Ltd., New Delhi, 2003.
2. Gupta, S. P. (2005) Statistical Methods, Sultan Chand & Sons, New Delhi.
3. Jerrold, H. Z. (2003) Bio Statistical Analysis, Tan Prints(I) Pvt. Ltd., New Delhi.
4. Goulden (1962) Methods of Statistical Analysis, Asia Publishing Co., New Delhi.

Bioinformatics:

5. David, W. M. (2004) Bioinformatics: Sequence and Genome Analysis 2nd Edition, CSHL Press.
6. Baxevanis, F. and Ouellette, B. F. (2001) Bioinformatics: a practical guide to the analysis of genes and proteins, 2nd Edition, John Wiley.
7. Jonathan, P. (2003) Bioinformatics and Functional Genomics, 1st Edition, Wiley-Liss.
8. Bourne, P. E. and Weissig, H. (2008) Structural Bioinformatics, 2nd Edition, Wiley.
9. Branden, C. and Tooze, J. (1998) Introduction to Protein Structure, 2nd Revised Edition Garland Publishing.

BOL-C402 Lab Course in Biostatistics and Bioinformatics

Biostatistics: Measures of central tendencies and dispersion; Coefficient of variation, Probability, t-test, ANOVA etc.

Bioinformatics: Practical's are based on theory which will explore different dimensions of Bioinformatics

Gene bank, Swissprot, RCSB, Exon, intron identification, Splice site prediction, Prediction of protein secondary structure, Tertiary structure prediction – homology modelling, Introduction to structure visualization by Cn3D, Rasmol etc.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER-IV SYLLABUS (W.E. F. 2021)

BOT-C403 MYCOLOGY AND PLANT PATHOLOGY

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To have detailed knowledge of fungal characters and their classification.
2. To have detailed understanding about pathogens causing plant diseases
3. To understand the management to control diseases

Learning Outcomes:

This paper helps to study different economically important fungi as well as pathogenic one. Their study will help in integrated disease management.

UNIT I : **MYCOLOGY I**

General characters of fungi, substrate relationship in fungi, cell ultra structure, unicellular and multicellular organization, cell wall composition, nutrition (saprophyli, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification systems.

Salient features and life cycle of representative genera of the following orders. Phylogenetic relationships of fungi.

Myxomycotina: Plasmodiophorales

Mastigomycotina: Peronosporales

Zygomycotina: Entomophthorales

Ascomycotina: Erysiphales, Eurotiales

Basidiomycotina: Uredinales, Ustilaginales, Agaricales,

Deuteromycotina: Moniliales

UNIT II: MYCOLOGY II

Lichens: Thallus structure, reproduction and economic importance

Fungi in industry as medicine, fungal toxins and diseases in humans

Mushroom: Introduction, Cultivation technology, nutritional and medicinal properties of mushrooms.

Mycorrhizae: Types, Salient features, role and application as biofertilizer and bio protector in forestry and agriculture

UNIT III: FUNDAMENTALS OF PLANT PATHOLOGY AND DEFENCE MECHANISM

Mechanism of Pathogenesis, factors affecting disease development, Dissemination of plant pathogens, plant quarantines.

Mode of infection and role of enzymes and toxins in plant diseases, Structural and biochemical defence mechanisms in plants, Molecular aspects of host pathogen interactions**,** degradation of phytoalexins, systemic resistance mechanism.

UNIT IV: DISEASES OF CROP PLANTS AND THEIR MANAGEMENT

Classification of major crop plant diseases in India, Symptoms, causal organism, disease cycle and control measures of following diseases:

Wheat: Rust, Smut; Groundnut: Tikka disease; Tur : Wilt; Sugarcane : Whip smut & Red rot; Cotton : Black arm; Bhendi : Yellow vein mosaic; Brinjal : Little leaf; Citrus : Canker

Principles of plant disease control, cultural methods, chemical methods, Biological plant disease control.

References:

Mycology:

1. Kirk, P. M., Cannon, P. F., Minter, D. W. and Stalpers, J. A. (2008) Ainsworth and Bisby's Dictionary of the fungi (10thed) by C.A.B. International, Oxon, Europe- UK.
2. Moore, D., Geoffrey, D., Robson and Anthony P. J. T. (2011) 21st Centaury guidebook of fungi, Cambridge University Press.
3. John, W. and Roland, W. (2007) Introduction of Fungi, Third edition, Cambridge, University Press.
4. Alexopolous, J., Mims, C. W. and Blackwell, M. (2007) Introductory Mycology, fourth edition, Wiley India Pvt. Ltd,.
5. Nair, L. N. (2007) Topics in Mycology and Pathology first edition, New Central Book Agency, Kolkata.
6. Deacon, J. W. (2006) Fungal Biology, fourth edition, Blackwell Publishing Ltd.
7. Foster, M. S., Wills, G. F. and Mueller, J. M. (2004) Biodiversity of Fungi: Inventory and Monitoring methods first edition, Academic Press.
8. Singh, H. (2006) Mycoremediation: Fungal Bioremediation, First edition, John Wiley and Sons, Hoboken, New Jersey.
9. Dube , H. C. (2015) An introduction to fungi:, Scientific publisher India, fourth edition.

10. Hibbett, D. S., Binder, M., Bischoff, J. F., Blackwell, M., Cannon, P. F. and Eriksson O. E., *et al.* (2007) A higher level phylogenetic classification of the Fungi, *Mycological Research* 111(5): 509–547.

Plant Pathology:

11. Agrios, G. N. - Plant Pathology(5th Edition).
12. Rangaswami, G. - Diseases of crop plants in India.
13. Sharma, P. D - Plant pathology (Narosa).
14. Lucas, J. A. - Plant pathology and plant pathogens(3rd Edition).
15. Walker, J. C. - Plant pathology.
16. Trivedi, P.C. - Plant Diseases.
17. Mukerji, K. G. *et al.* - Recent Development in Bio-control of plant diseases.
18. Wood, R. K. S., Ballio and Grantiti, A. -Phytotoxin in Plant Diseases.
19. Datta, S. K. and Muthukrishnan, S. -Pathogenesis-Related proteins in Plants.
20. Robinson, R. A. - Plant pathosystem.
21. Mehrotra, R. S. (1982) Plant Pathology, First edition, McGraw-Hill Education, Publication.
22. George, N. (2005) Agrios Plant Pathology, Fifth edition, Academic Press, London.
23. Jeng-Sheng (2001) Huang Plant Pathogenesis and Resistance, First edition, Springer, Netherlands.
24. Trivedi, P. C. (2007) Biocontrol of Plant Diseases, first edition, Aavishkar Publishers and Distributors.

BOL-C403 Lab course in Mycology and Plant Pathology

Mycology

1. Study of the representative genera belonging to Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina with respect to observations made, based on accessory organs, asexual and sexual structures and fruiting body.

   Lichen: 1P
2. Mushroom cultivation
3. Isolation and identification of mycorrhizae.
4. Preparation of biofertilizer.
5. Preparation of PDA medium, isolation and culture of plant pathogenic fungi
6. Study of antagonistic activity of *Trichoderma* against fungi

Plant Pathology

7. Isolation and identification of plant pathogen from diseased plant part.
8. Demonstration of cellulolytic and pectinolytic enzyme activity.
9. Detection of Aflatoxin using TLC.
10. Study of symptoms and causal organism and preparation of temporary slides of crop diseases
11. Study of symptoms of
    (a) Little leaf of Brinjal
    (b) Yellow vein mosaic of Bhendi.
12. Demonstration of fungicidal activity by fungal spore germination method.
13. Submission of herbariums of diseased plant samples.
14. Botanical excursion report.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED-431 606

SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) ,SEMESTER-IV SYLLABUS (W.E. F. 2021)

BOT- E401 PHYTOCHEMISTRY AND PHYTOTHERAPY (Elective)

Max Mark: 100 **Periods: 60**

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Learning Objectives:

1. To understand structure, uses, source and properties of phytochemicals.
2. To understand significance of phytotherapy in modern day medical science.
3. To know the basics of enzymes and its applications
4. To asquint with the effect of phyto-constituents to cure various ailments and their mode of action.

Learning Outcomes: After completing this course, students shall beaware of drugs produced by the different plants for the treatment of major diseases and their mode of action along with bio-safety. They will also acquire knowledge about basics of enzymes and their various applications.

UNIT I PHYTOCHEMICAL ANALYSIS AND ENZYMATICS

Phytochemicals: General methods for extraction, separation of phytochemicals, Identification of major groups of phytochemicals, Bioactivity assay for antibacterial, antifungal and antiviral activity of plants.

Enzymes: Introduction, properties, classification, extraction and purification of enzymes, Enzyme kinetics: Michaelis Menten equation, Lineweaver-Burk equation, Types of enzyme inhibition, Industrial and medical applications of enzymes.

UNIT II PHENOLICS, ALKALOIDS AND TERPENOIDES

Structural chemistry, classification and biological properties of phenolics, alkaloids and terpenoides from plants. Structure and properties of cyanogenic glycosides and their derivatives. Biosynthesis of terpenes, phenols and nitrogenous compounds.

UNIT III DRUGS

Introduction, properties of the drug molecules, Outline of the steps involved in conventional drug development process, Computer aided drug design: an outline

Major drugs from plants (crude and isolated), Plant drugs for treatment of diabetes, cancer, inflammation and cardio protective with possible mode of action. Plants in Nutraceuticals.

UNIT IV PLANT DRUG ACTIVITY AND SAFETY

Introduction, Major groups of antimicrobial agents from plants with possible mode of action, Antioxidants: Role in health amelioration, Plants used in cosmetics with possible mode of action. Evolution of microbial drug resistance towards present day synthetic antibiotics, Major group of

phytochemicals involved in toxicity, toxicity evaluation assay, limitations and future prospective of phototherapy.

References:

1. Wagner, H., Bladt, S. and Zgainski, E. M. - Plant Drug Analysis- (Springer- Verlag).
2. Harborne, J. B. - Methods in Plant Biochemistry Vol. I: Plant Phenolics (Academic Press).
3. Dey, P. M. and Harborne, J. B. - Plant Biochemistry (Academic Press).
4. Singh, B. K - Plant Amino Acids (Marcel Dekker, Inc.).
5. Henry, T. A. - The Plant Alkaloids- (Anmol Publications Pvt. Ltd.).
6. Nicholas, C. P. and Lewis, S. - Fundamentals of Enzymology (3rd Edition) (Oxford University).
7. Linskens, H. F. and Jackson, J. F. - Plant toxins Analysis (Springer-Verlag).
8. Lea, P.J. and Leegood, R. C. - Plant Biochemistry Molecular Biology (John Wiley and Sons).
9. Shewade, J. G. - Enzyme Everywhere (CSIR Publication).
10. Daniel, M. - Methods in Phytochemistry .
11. Sabnis, S. D. and Daniel, M. - Phytochemical approach to Economic Botany (Kalyani Publications).
12. Hostettmann, K. - Methods in Plant Biochemistry Vol. VI : Assay for Bioactivity (Academic Press).
13. Dey, P. M., Harborne, J. B., Banthorpe, D. V. and Charlwood, B. V. (1991) Methods in Plant Biochemistry Vol. VII- Terpenoids.
14. Heldt, H. W. - Plant Biochemistry and Molecular Biology (Oxford University Press).

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM), SEMESTER-IV SYLLABUS (W.E. F. 2021)

BOT- E402 FUNGAL BIOTECHNOLOGY (Elective)

Max Mark: 100 **Periods: 60**

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Learning Objectives:

The main objective of this course is to provide the students tools needed for research with fungi and to study certain representative groups of fungi in production of fungal enzymes, secondary metabolites, and agriculture based products and industrial uses of fungi.

Learning Outcomes: After completing this course, students shall be able to do research with fungi and get familiar production of enzymes and agriculturally/ industrially important fungal products

UNIT I

Fungal Insecticides: Introduction, mode of action of entomo pathogenic fungi, life cycle and infection process, large scale production, liquid fermentation, solid state fermentation, application , examples.

Fungi as agents of biological control: Introduction, biological control of foliar diseases, biological control of post-harvest diseases, bio control of soil born diseases. Examples, mechanisms involved in biological control.

UNIT II

Mycoherbicides: Introduction, classical approach, mechanism of action, formulation, production, examples of fungi.

Production of pharmacologically active products by fungi. Examples, production of cyclosporine, cyclosporine producers, cyclosporine biosynthetic system, fermentation, molecular genetics approaches of improvement, Cyclosporine synthesis.

UNIT III

Production of agrochemicals by fungi: Gibberellins: Procedures, examples, function of GA produced. Metabolism of GA formation, Effect of medium components.

Lignolytic fungi: Introduction- lignolytic enzymes, examples, lignin degrading fungi, regulation of enzyme production, application of lignolytic fungi and their enzymes.

UNIT IV

Mycotoxins and their prevention: Introduction, types of mycotoxins, health effects, examples, major producing organism, economic impact, detection and prevention.

Heterologous gene expression in fungi, introduction, general techniques, transformation, Host organisms, expression vectors, secretion, production of heterologous proteins.

References:

1. Biotechnology volumes, Spinger Verlag, USA.
2. Anke, T., Chammann and Hall (1997) Fungal Biotechnology New York, USA.
3. Arora, D. K. and Khachatourians, G. G. (2003) - Applied mycology and Biotechnology (Ed). Elsevier Publishers, Amsterdam.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM) , SEMESTER-III SYLLABUS (W.E. F. 2021)

BOT-OE301 BIOFERTILIZERS

(Open Elective for Other Schools)

Max Mark: 50 **Periods: 30**

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Learning Objectives:

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

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

1. Acquire knowledge in Biofertilizer production.
2. Shall develop scientific skills to in the field of Biofertilizers.

UNIT I

General account about the microbes used as biofertilizer, *Rhizobium*: isolation, identification, mass multiplication, carrier based inoculants; Actinorhizal symbiosis.

Azospirillum: isolation and mass multiplication, carrier based inoculant, associative effect *Azotobacter:* isolation, identification, mass multiplication, crop response to *Azotobacter* inoculums.

UNIT II

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth.

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield ,colonization of AM , isolation and inoculum production of AM and its influence on growth and yield of crop plants.

Organic farming: Green manuring and organic fertilizers, Biocompost: Recycling of biodegradable municipal, agricultural and Industrial wastes; biocompost making methods; types and method of vermicomposting, field Application.

References:

1. Dubey, R.C. (2005) A Text book of Biotechnology , S.Chand & Co, New Delhi.
2. Kumaresan, V. (2005) Biotechnology, Saras Publications, New Delhi.
3. John, J. P. E (2004) Outlines of Plant Biotechnology, Emkay Publication, New Delhi.
4. Sathe, T.V. (2004) Vermiculture and Organic Farming, Daya publishers.
5. Subha Rao, N. S. (2000) Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas, S. C, Vayas, S. and Modi, H. A. (1998) Bio-fertilizers and organic Farming, Akta Prakashan, Nadiad.

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SCHOOL OF LIFE SCIENCES

M. Sc.-II BOTANY (CREDIT SYSTEM), SEMESTER-IV SYLLABUS (W.E. F. 2021)

BOT OE401 HERBAL BOTANY

(Open Elective for Other Schools)

Max Mark: 50 **Periods: 30**

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Learning Objectives:

1. To study the importance of Indian traditional systems of medicine.
2. To acquaint therapeutical and pharmaceutical knowledge about medicinal plants.
3. To understand the cultivation aspects of medicinal plants.

Learning Outcomes:

After completion of this course, students shall be able to understand medicinal plant specimens based on an understanding of plant morphology. Students shall also be able to critically evaluate the various pharmaceutical forms for administration of herbs and their appropriateness to different health conditions.

UNIT I

History of Medicinal plants. Importance of herbal drugs in Indian systems of medicine: Ayurveda, Siddha, Unani, Naturopathy and Folklore. Definition of Drug, Classification of natural drugs (Alphabetical, Morphological, Pharmacological, Chemical and Chemo taxonomical).

Detailed pharmacognostic study of the following drugs with respect to source, collection, macroscopic/microscopic characters, chemical constituents and therapeutical and pharmaceutical applications of Indian *Senna, Aloes,* Safed Musli, Liquorice, Brahmi, Arjuna, Amla, Peppermint, Tulsi, Clove, Belladona, Ashwagandha, *Vinca,Adhatoda,* Turmeric etc.

UNIT II

Adulteration: Introduction, Types and detection, Drug evaluation (Chemical, Physical and Biological), Phytochemical investigations, standardization and quality control of herbal drugs. Chemical tests for the active constituents of the following plants: *Acorus calamus, Curcuma longa, Senna angustifolia, Strychnos nux-vomica.*

Cultivation practices with reference to soil, propagation methods, irrigation, manuring, harvesting, processing, storage, pests, diseases, marketing and utilization of selected medicinal plants: *Bacopa monnieri, Acorus calamus, Curcuma longa, Phyllanthus amarus* and *Rauwolfia serpentina*. National Medicinal Plants Board of India.

References:

1. Sharma, O. P (2004) Economic Botany, TATA McGraw Hill Publication, New Delhi.
2. Gokhale, S. B., Kokate, C. K. and Purohit, A. P. (2003) Pharmacognosy., Nirali Prakashan, Pune.
3. Treas, G. E. and Evans, W. C. (2000) Pharmacognosy, ELBS Publication, London.
4. Arumugam, K. R. and Murugesh, N. (1990) Text book of Pharmacognosy, Sathya Publishers, Chinnalapatti (Tamilnadu).
5. Agarwal, S. S. and Paridhave, M. (2007) Herbal Drug Technology, University Press, New Delhi.
6. Chaudhuri, A. B. (2007) Endangered Medicinal Plants, Daya Publishing House, New Delhi.
7. Biswas, P. K. (2006) Encyclopedia of Medicinal plants (Vol. I-VII), Dominant Publishers, New Delhi.
8. Trivedi, P.C. (2006) Herbal Medicine: Traditional practices, Aarishkar Publishers, Jaipur.
9. Bhattacharjee, S. K. - Hand Book of Medicinal plants. Pointer Publishers, Jaipur.
10. Anonymous (2004) Cultivation of Selected Medicinal Plants, National Medicinal Plants Board, Govt. of India, New Delhi.
11. Prajapathi, Purohit, Sharma and Kumar (2003) A Hand book of Medicinal plants, Agrobios Publications, Jodhpur.
12. John J. P. (2003) Medicinal Botany and Pharmacognosy, JPR Publication, Vallioor, Tirunelveli.
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14. Anonymous (1999) Pharmacognosy of Indigenous Drugs (Vol. I-III), Central Council for Research in Ayurvedha and Siddha, New Delhi.
15. Harbourne, J. B. (1998) Phytochemical methods: A Guide to Modern Techniques of Plant Analysis (3rd edition), Chapman and Hill Co., New York.
16. Nandkarni, K.M. (1998) Indian Materia Medica (Vol. I-III), Popular Prakasam, New Delhi.
17. Handa, S. S. and Kapoor, V. K. (1993) Pharmacognosy, Vallabh Prakashan, New Delhi.

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