Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Two Year Degree Programme

Postgraduate Programme of Science& Technology

M.Sc. in Botany

Board of Studies in

Botany

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2024

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **M.Sc. in Botany** Programme to be effective from the **Academic Year 2024-25.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 09/03/2024

Place: Latur

NEP CELL
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **M.Sc. in Botany Programme** to be effective from the Academic Year 2024-25.

Date:

Place: Latur

(S. N. Shinde)
Chairperson
Board of Studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Department of Botany

Members of Board of Studies in the Subject Botany

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Shri S. N. Shinde**, Head, Department of Botany, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Chairperson	HoD
2	**Dr. B. S. Survase,** Director, School of Life Sciences, S. R. T. M. U. Nanded	Member	V.C. Nominee
3	**Prof. Dr. A. S. Dhabe**, Head, Department of Botany, Dr. Babasaheb Ambedkar M. University, Aurangabad	Member	Expert from outside for Special Course
4	**Prof. Dr. A. B. Ade**, Head, Department of Botany, Savitribai Phule Pune University, Pune	Member	Academic Council Nominee
5	**Dr. V. S. Maske**, Head, Department of Botany, Bahirji Smarak Mahavidyalaya, Vasmat, Dist. Hingoli	Member	Academic Council Nominee
6	**Shri Laxman Done**, Done's Mushrooms, Kumbhari, Dist. Latur	Member	Expert from Industry
7	**Prof. Dr. N. B. Gaikwad,** Department of Botany, Shivaji University, Kolhapur	Member	P.G. Alumni
8	**Dr. S.H. Nile,** Senior Scientist, Zhejiang Chinese Medical University, Hanzhou Zhejans	Member	Expert from outside for Special Course
9	**Dr. K. D. Savant**	Member	Faculty Member
10	**Shri D. R. Awad**	Member	Faculty Member
11	**Ms. D.S. Chavan**	Member	Faculty Member
12	**Ms. P. V. Kumbhar**	Member	Faculty Member
13	**Ms. R.K. Mekle**	Member	Faculty Member
14	**Ms. R.L. Shaikh**	Member	Faculty Member
15	**Ms. P. S. Maskepatil**	Member	Faculty Member
16	**Dr. D. V. Vedpathak**	Member	Member from same Faculty
17	**Dr. D.G. Palke**	Member	Member from same Faculty

From the Desk of the Chairperson…

The Department of Botany is established in 1971. It is one of the leading departments in the field of teaching and student centric activities. After Autonomy, in keeping pace with the advances in various aspects of plant sciences, the department has introduced the courses like Molecular Biology, Cell Biology, Plant Biotechnology, Bioinformatics, Genetics, Instrumentation in Botany, Pharmacognosy, Gardening and Landscaping, Plant Breeding, Biostatistics, Forensic Botany etc. The Department has academic autonomy and has been revising its curriculum regularly. The department has successfully implemented the choice based credit system for grading the students. The department is known for the teaching, learning and the results. It is also known for strict implementation of rules and regulations formulated time to time by the administration of Autonomous College. The Curriculum of the M.Sc. has been designed by considering NET, SET, GATE and others competitive examinations.

The Higher Education system in India and all over the world has undergone paradigm shift in both qualitative and quantitative aspects. Its best example is National Education Policy (NEP-2020). The National Education Policy 2020 emphasizes on developing overall personality of students by incorporating Humanitarian and Constitutional values, creativity and critical thinking, harnessing innovation, use of modern technology and interaction with various stakeholders. It recognizes that the pedagogy should evolve to make education more experiential, holistic, integrated, learner-centric, flexible and developing skill etc. to shape the student that can face the challenges of the future, the new policy also envisages the refinement and improvement in the Learning Outcome based Curriculum Framework.

Botany is one of the most fundamental branches of Life Sciences. It is the broad subject encompassing classical and modern systemic aspects of plant diversity as well as contemporary subjects like Molecular Biology, Bioinformatics, Biotechnology, etc. to foster comprehensive understanding about various aspects of plant sciences. The present learning outcome based curriculum framework for M. Sc. in Botany is designed to provide a focused leering outcome based syllabus at the PG level providing structured teaching-learning experiences catering to needs of the students. The courses in Botany will prepare the students both academically and in terms of employability. This program also inculcates various attributes like Problem solving, Research skills, Critical thinking etc. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability.

The course is upgraded keeping in mind the aspirations of the students, changing nature of the subject as well as the learning environment. Courses of Botany have been designed to incorporate recent advancements, techniques to upgrade the skills of students. The new structure is expected to enhance the level of understanding among students and maintain the standard of Master Degree in Botany across the country. The efforts have been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process. This framework offers flexibility and innovation in syllabi designing and in methods adopted for teaching-learning process and learning assessment.

The new curriculum offers knowledge of wide areas in Botany including Diversity, Plant Systematics, Plant Biotechnology, Cell Biology, Genetics, Plant Physiology, Bioinformatics,

Medicinal Plants. Plant disease management etc. This new syllabus has been prepared keeping in view the unique requirement of M.Sc. Botany students. The contents of the syllabi have been drawn to accommodate the widening horizons of the Botany discipline and reflect the changing needs of the students. The semester wise course distribution and detailed syllabus for each course is appended with a list of suggested references.

The present structure comprises Discipline specific courses (DSC), Major Electives Course (MEC), Generic/Open Electives (GE/OE), etc. The discipline specific courses (DSC) are compulsory and the elective courses can be chosen from the given Basket. The project work is specially emphasized in this structure. The project will mainly involve experimental work. The students will be asked their choice for project. The Generic Electives will be offered to the students of other departments of the college. The students will have the option to choose one generic elective from the given Basket. The generic elective comprises theory as well as practical.

These courses offer skills to pursue research and teaching in the field of Botany and thus would produce best minds to meet the demands of society. This curriculum framework for M. Sc.in Botany is developed keeping in view of the students centric learning Pedagogy, which is entirely outcome oriented. The curriculum framework focuses on the pragmas approach whereby practical application of theoretical concepts is covered through Laboratory and Field works.

The major objective of this curriculum is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to Botany logically and efficiently.

(S. N. Shinde)
Chairperson
Board of Studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Department of Botany

Contents

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Botany

PG Skeleton in Accordance with NEP-2020

Illustrative Credit Distribution Structure for Two Year M.Sc. Degree

Year Level	Sem	Major 24-28(22-26) per Sem 46-56 for two years		RM	OJT/FP	RP	Cum. Cr	Marks	Degree
		Mandatory	Elective						
I 6.0	I	Major I 3Cr Major II 3Cr Major III 3Cr Lab Course I 1Cr Lab Course II 1Cr Lab Course III 1Cr	MEC I 3Cr Lab course IV 1Cr	RMC 4Cr	*NA*	*NA*	20 Cr	Theory: 01 Cr. = 25 M. Lab Course (Science): 01 Cr. = 50 M.	**PG Diploma (After 03 Year B. Sc Degree)**
	II	Major IV3Cr Major V 3Cr Major VI 3Cr Lab Course V 1Cr Lab Course VI 1Cr Lab Course VII 1Cr	MEC II 3Cr Lab course VIII 1Cr	*NA*	OJT I 4 Cr/ FP I 4 Cr	*NA*	20 Cr	OJT/FP: 01 Cr. = 25 M.	
	Total	**Major 24 Cr**	**MEC 08 Cr**	**RMC 04 Cr**	**OJT/FP 04 Cr**	**NA**	**40 Cr**		
Exit Option: PG Diploma with 40 Credits After 03 Year B. Sc Degree									
II 6.5	III	Major VII 3Cr Major VIII 3 Cr Major IX 3Cr Lab Course IX 1Cr Lab Course X 1Cr Lab Course XI 1Cr	MEC III 3Cr	*NA*	*NA*	RP-I 4 Cr	**20 Cr**	RP I & RP II: 01 Cr. = 25 M	**PG Degree (After 03 Year UG Degree)**
	IV	Major X 4 Cr Major XI 4 Cr Major XII 4Cr	MEC IV 4 Cr	*NA*	*NA*	RP-II 6 Cr	**22 Cr**		
	Total	**Major 24 Cr**	**MEC 08 Cr**	**NA**	**NA**	**RP 10 Cr**	**42 Cr**		
Cum. Total of I & II Year		**Major 48 Cr**	**MEC 16 Cr**	**RMC 04 Cr**	**OJT/FP 04 Cr**	**RP 10 Cr**	**40+42**		**82 Credits**
Exit Option: Two Years 04 Sem. PG Degree with 82 Credits After 03 Year UG Degree									

Abbreviations:

1. MMC : Major Mandatory Course
2. MEC : Major Elective Course
3. RMC : Research Methodology Course
4. OJT : On Job Training (Internship/Apprenticeship)
5. FP : Field Project
6. RP : Research Project
7. Cum. Cr : Cumulative Credit

Shiv Chhatrapati Shikshan Sanstha's
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Department of Botany
PG First Year

1. Courses and Credits: Sem-III

Sr. No.	Course Type	Course Code	Credits	Marks	Hours L/P
1	MMC-VII	602BOT3101	03	75	45
2	MMC-VIII	602BOT3102	03	75	45
3	MMC-IX	602BOT3103	03	75	45
4	MEC-III (A)	602BOT3201	03	75	45
5	MEC-III(B)	602BOT3202	03	75	45
6	Lab Course-IX	602BOT3104	01	50	30
7	Lab Course-X	602BOT3105	01	50	30
8	Lab Course-XI	602BOT3106	01	50	30
9	Lab Course-XII	602BOT3203	01	50	30
10	Lab Course-XII	602BOT3204	01	50	30
11	Project	602BOT3401	04		

Sem-IV

Sr. No.	Course Type	Course Code	Credits	Marks	Hours L/P
1	MMC-X	602BOT4101	03	75	45
2	MMC-XI	602BOT4102	03	75	45
3	MMC-XII	602BOT4103	03	75	45
4	MEC-IV (A)	602BOT4201	03	75	45
5	MEC-IV (B)	602BOT4202	03	75	45
6	Lab Course-XIII	602BOT4104	01	50	30
7	Lab Course-XIV	602BOT4105	01	50	30
8	Lab Course-XV	602BOT4106	01	50	30
9	Lab Course-XVI	602BOT4203	01	50	30
10	Lab Course-XVI	602BOT4204	01	50	30
11	Project	602BOT4401	06		

Shiv Chhatrapati Shikshan Sanstha's
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Department of Botany

Programme Outcomes (POs) for M.Sc. Botany	
PO1	**Academic Competence:** All-inclusive knowledge of biochemical process, Cell Biology, Diversity of Microbes, Pteridophytes, fossil plants and Cryptogams, Instrumentation and Biostatistics, plant physiology, reproduction in Angiosperms, Molecular biology, plant Biotechnology, Genetics Engineering, Cytogentics and plant breeding and plant nanotechnology.
PO2	**Scientific Outlook:** Scientific temperament with the help of experiments, and practicals in botany such as plant morphology, physiology, anatomy and application of economic botany, bioengineering, biotechnology and Genetic Engineering.
PO3	**Personal and Professional Competence:** Competency to analyse samples and data obtained from experiments, field visits, projects, survey and will make scientific draft/report for solving problems. They will exhibit self-learning, discipline and logical approach.
PO4	**Entrepreneurial Competence:** Applied knowledge of Botany to enter in start-up of mushroom cultivation, fruit and vegetable processing, plant pathology or work for the probable solutions for challenges in botanical and environmental issues.
PO5	**Research Competence:** An ability to assess and identify research problem and botanical techniques and instrumentation and with the help of integrated knowledge do the experiments, interpret the data and findings and provide valid conclusion.

After completion of Programme, the students will

Programme Specific Outcomes: for M.Sc. Botany	
PSO No.	
PSO1	**Academic Competence:** After successful completion of the course, a student is able to understand different fields of Botany like systematics, Cell Biology, Diversity of Microbes, Pteridophytes, fossil plants and Cryptogams, Instrumentation and Biostatistics, plant physiology, reproduction in Angiosperms, plant Biotechnology, Genetics Engineering, plant breeding and plant nanotechnology, evolution, ecology, physiology, biochemistry, plant interactions with microbes and insects, anatomy, morphology, reproduction, genetics and molecular biology of various life-forms. She/he even has an edge over other students as they will be trained in skill enhancement courses like tissue culture and breeding technology.
PSO2	**Scientific Outlook:** Scientific temperament with the help of experiments, and practicals in botany such as plant morphology, physiology, anatomy and application of economic botany, bioengineering, biotechnology and Genetic Engineering, also classify various life forms of plants, design and execute experiments related to basic studies on ecology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology etc.
PSO3	**Personal and Professional Competence:** Competency to analyse samples and data obtained from experiments, field visits, projects, survey and will make scientific draft/report for solving problems. They will exhibit self-learning, discipline and logical approach.
PSO4	**Research Competence:** An ability to assess and identify research problem and botanical techniques and instrumentation term research projects/dissertations using tools and techniques in any of the basic specializations of Botany under supervision and with the help of integrated knowledge do the experiments, interpret the data and findings and provide valid conclusion.
PSO5	**Entrepreneurial Competence:** Applied knowledge of Botany to enter in start-up of mushroom cultivation, fruit and vegetable processing, plant pathology or work for the probable solutions for challenges in botanical and environmental issues.
PSO6	**Practical skills:** Learn about practical technique in lab for detail study of plant cell structure, reproduction, anatomy, breeding procedures for hybridization. Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants. Create, select and apply appropriate techniques, resources and modern technology in multidisciplinary way. Practice of subject with knowledge to design experiments, analyze and interpret data to reach to an effective conclusion.
PSO7	**Problem analysis:** They would identify, formulate and analyze the complex problems with reaching a

	substantiated conclusion. Logical thinking with application of biological, physical and chemical sciences. Learning that develops analytical and integrative problem-solving approaches.
PSO8	**Personal and Professional Competence:** Students would perform functions that demand higher competence in national/international organizations with sporty and helping spirits. Prepare the students for many competitive exams like MPSC, UPSC NET SET GATE. Competency to analyse samples and data obtained from experiments, field visits, projects, survey and will make scientific draft/report for solving problems. They will exhibit self-learning, discipline and logical approach.
PSO9	**Ethics:** Knowledgeable, disciplined students with good values, ethics, and kind heart will help in nation building globally. Student should be aware of ethical issues and regulatory considerations while addressing society needs for growth with honesty

Semester - III

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Department of Botany

Course Type : MMC-VII
Course Title : Angiosperms Systematics
Course Code : 602BOT3101
Credits : 03 **Lectures: 45 Hrs.**

Learning Objectives:

LO 1 To understand the plant identification key concept and application
LO 2 To distinguish species on the basis of morphology and anatomy
LO 3 To distinguish between Taxonomy and Systematics
LO 4 To describe the reasons for preferring natural classifications over artificial classifications

Course Outcomes:

After completion of the course, students will be able to-

CO 1 Recognize members of the major angiosperm families through diagnostic features.
CO 2 Understand plant morphology, terminologies and identifying morphological peculiarities
CO 3 Distinguish between taxonomy and systematics
CO 4 Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches.

Unit No.	Title of Unit & Contents	Hrs.
I	**MORPHOLOGY OF ANGIOSPERMS-I**	**12**
	1. Root and its modifications 2. Stem and its modifications 3. Leaf: Typical leaf (Hibiscus), Types, Phyllotaxy, Venation and modifications 4. Inflorescence and its types 5. Flower: Types of flower, Calyx, Corolla, Androecium and Gynoecium. Floral formula and Floral diagram	
	Unit Outcome: UO1 Explain the vegetative and floral morphology of Angiosperms	
II	**MODERN TRENDS IN TAXONOMY AND CLASSIFICATION**	**11**
	1. Aims, principles and practices in taxonomy. Botanical Nomenclature: Brief history, Scientific name ICN, Principles, Taxonomic hierarchy 2. Taxonomy in relation to morphology and anatomy 3. Overview of pre- and post-Darwinian systems of classification 4. Artificial systems of classification - Linnaeus 5. Natural system of classification - Bentham and Hooker 6. Phylogenetic systems of classification – Takhtajan	
	Unit Outcome: UO1 Describe the reasons for preferring natural classifications over artificial classifications	
III	STUDY OF FAMILIES-I	**11**
	Systematic position, general characters, distinguishing features, floral formula, floral diagram and economic importance)	

Unit No.	Title of Unit & Contents	Hrs.
	A) Polypetalae: 1. Ranales -Annonaceae 2. Malvales- Malvaceae 3. Geraniales- Rutaceae 4. Passiflorales- Cucurbitaceae **B)Gamopetalae:** 1. Rubiales – Rubiaceae 2. Personales - Bignoniaceae 3. Lamiales –Verbenaceae	
	Unit Outcome: UO1 Identify the taxa on the basis of morphological features.	
IV	STUDY OF FAMILIES-II	**11**
	(Systematic position, general characters, distinguishing features, floral formula, floral diagram and economic importance). **A) Apetalae:** 1. Curvembryae – Amarantaceae 2. Unisexuales- Euphorbiaceae **B)Monocotyledonae:** 1. Microspermae- Orchidaceae 2. Epigynae – Musaceae 3. Coronarieae –Commelinaceae 4. Nudiflorae – Typhaceae	
	Unit Outcome: UO1. Identify the taxa on the basis of morphological features.	

Learning Resources:

1. Paleobotany- Agashe, S.N. 1995. Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi.
2. Embryology of Angiosperms- Bhojwani, S.S. and Bhatnagar, S.P. 1984Vikas Publ. House, New Dehli.
3. Plant microevolution and Conservation in Human-influenced Ecosystems- Briggs, David. 2009 Cambridge University Press.
4. . The Flora of Presidency of Bombay Cooke-T. 1903-1908, Vol. I-III.
5. An Integrated System of Classification of Flowering Plants- Cronquist, A. 1981, Columbia University Press, New York.
6. The Evolution and Classification of Flowering Plants- Cronquist, A. 1988 (2nded.) Allen Press, U.S.A.
7. Principles of Angiosperm Taxonomy. Today and Tomorrow Davis, P. H. and V. H. Heywood 1991, Publications, New Delhi.
8. Morphology of Angiosperms, McGraw Hill Book Co. Eames A.J. 1961.
9. Pollen Morphology and Plant Taxonomy of Angiosperms (An introduction to Palynology I)- Erdtman, G. 1966. Hafner Pub. Co. London.
10. Plant Anatomy- Fahn, A. 1979, Pergamon Press, London.
11. The Cambridge Illustrated Glossary of Botanical Terms- Hickey, M. and King, C. 2000 Cambridge University Press, UK.

12. Families of Flowering plants- Hutchinson, J. 1959, Clarendon Press, Oxford.
13. Handbook of Field and Herbarium Methods- Jain S.K. and Rao R.R. 1976, Today and Tomorrow Publishers, New Delhi.
14. . Comparative embryology of Angiosperms- Johri, B. M. 1984, Ind. Nat. Sc. Acad. New Delhi.
15. Plant Systematics- Jones, S. B. and Luchinger A.E. 1986,2ndedn, McGraw Hill Book Co.
16. Plant Systematics- A Phylogenetic Approach- Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. 2008Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
17. Flowering Plants Evolution and Classification of Higher Categories- Kubitzki, K. 1977, Plant Systematics – Evolution Supplement I.
18. The biology of parasitic flowering plants- Kuijt J. 1969. California University Press.
19. Taxonomy of Vascular Plants- Lawrence, G. H. M. 1951, Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
20. The Plant Book- Mabberly, T. J. 1997, 2ndedn Cambridge University Press, Cambridge.
21. An Introduction to Embryology of Angiosperms- Maheshwari, P. 1985, Tata McGraw Hill, New Delhi.
22. Handbook of Taxonomic Training- Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998.A DST, New Delhi.
23. Taxonomy of Angiosperms- Naik, V. N. 1984, Tata McGraw-Hill, New Delhi.
24. Pollen morphology of Angiosperms- Nair, P.K.K. 1966, Periodical Expert Book Agency, New Delhi.
25. Modern Methods of Plant Analysis- Paech, K. and M.V. Tracey. 1956, Vol-I &II. Springer- Verlag.
26. Principles and Techniques of Contemporary Taxonomy- Quicke, Donald L. J. 1993, Blakie Academic & Professional, London.
27. Fundamentals of Plant Systematics- Radford A.E. 1986, Harper and Row N Y.
28. Chromosome Technique- Sharma A.K. and A. Sharma,1980Theory and Practices(3rded.) Butterworths, London.
29. Pollen Biology- Shivanna, K.R. and N.S. Rangaswamy.1992, A Laboratory Manual. Springer-Verlag.
30. Plant Systematics- Simpson, M.G. 2010, Elsevier, Amsterdam.
31. Plant Systematics- Singh G. 2004, 2ndedn, Oxford and IBH, New Delhi.
32. Introduction to Principles of Plant Taxonomy- Sivarajan, V.V. 1984, Oxford and IBH, New Delhi.
33. The Chemotaxonomy of Plants- Smith, P. M. 1976. Edward Arnold Pub. Ltd.
34. Morphology of Angiosperms- Sporne, K. R. 1974. Hutchinson University Library, London.

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Department of Botany

Course Type : Lab Course
Course Title : Lab Course –IX (Based on MMC-VII)
Course Code : 602BOT3104
Credits : 01 **Maximum Marks : 50** **Hours : 30 Hrs.**

Learning Objectives:

LO1 To obtain most conclusive results.

LO2 To provide platform to develop computational biological methods.
LO3 Provide knowledge to distinguish species on morphology and anatomy basis.
LO4 Able to develop approach for embryology study.

Course outcomes:

After completion of the course, students will be able to-

CO1 Recognize members of the major angiosperm families by identifying their diagnostic features
CO2 Provide lab-based training and writing short species description and illustrations.
CO3 Understand plant morphology and identify plant up to species level.
CO4 Dissect the different tissue as well as structures of Angiosperms

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Practical 1-8. Study of at least 16 locally available families of flowering plants of genus and species family.

Practical 9. Identification of genus and species of locally available wild plants.

Practical 10. Comparative account of karyotypic analysis.

Practical 11. To study of pollen morphophytes of different family.

Practical 12. Study of fossil angiosperms of India with the help of slides and specimens.

Practical 13-16. Study of floral biology, visitations by pollinators, pollen viability, self and crosspollination, seed set of any two species.

Practical 17. Atleast two short excursion of one two days each and one long excursion of five

N.B: 1) Any ten Practicals from above list

2) Several Short Excursions, field visit and at least one Long Excursion.

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Course Type : MMC-VIII
Course Title : Molecular Biology
Course Code : 602BOT3102
Credits : 03 **Hours: 45**

Learning Objectives:

LO1 To study the detailed structure of nucleic acid.
LO2 To give information of DNA damage and repair mechanism.
LO3 To learn the molecular processes such as transcription and translation.
LO4 To understand gene expression and regulation of prokaryotes and eukaryotes.

Course Outcomes:

After completion of the course, students will be able to-

CO1 Justify structural aspect of DNA and RNA.
CO2 Explain the mechanisms of DNA damage and repair mechanism.
CO3 Correlate the gene expression and regulation of prokaryotes and eukaryotes.
CO4 Describe the molecular processes such as transcription and translation.

Unit No.	Title of Unit & Contents	Hrs.
I	**DNA STRUCTURES &TOPOLOGY**	**10**
	1. DNA structure Types of base pairing, unusual structures, topology, split gene. pseudogene, overlapping gene, cryptic gene Jumping gene (transposons). 2. Melting and renaturation of DNA, Cot curves and kinetic complexity of DNA. Organization of genomes (from whole genome sequences), repetitive and unique sequences, C-value paradox. 3. Chromosome organization, centromeres, telomeres, specialized chromosomes. 4. Initiation, elongation and termination of DNA replication, molecular machinery of DNA replication in Prokaryotes. 5. DNA damage and repair.	
	Unit Outcomes: UO1. study the detailed structure of nucleic acid.	
II	**RNA STRUCTURE AND PROCESSING**	**10**
	1. RNA structure – Modified bases, pairing, secondary structure. 2. Transcription units, RNA polymerases, initiation, elongation and termination of transcription in eukaryotes, proof reading. 3. RNA processing – Processing of t-RNA, r-RNA and m-RNA and m-RNA localization. 4. Non-coding RNAs, ribozymes and riboswitches.	
	Unit Outcome: UO1 learn the molecular processes such as transcription and translation	
III	**PROTEIN SYNTHESIS**	**12**
	1. Protein synthesis – The genetic code, t-RNA charging, ribosomal	

Unit No.	Title of Unit & Contents	Hrs.
	organization. Initiation, elongation and termination of protein synthesis in prokaryotes. Antibiotics used in inhibition of protein synthesis. Proof reading. 2. Post-translational processing of proteins, protein modifications. 3. Proteases. Ubiquitination and degradation of proteins by proteasomes.	
	Unit Outcome: UO1. Explain the mechanisms of protein synthesis	
IV	**REGULATION OF GENE EXPRESSION**	**13**
	1. Regulation of transcription – i) Operons, repressors and inducers (Catabolic and Anabolic) ii)positive and negative control. iii) regulation of lytic and lysogenic cycles in phages. 2.Regulation of gene expression at translational and post-translational level	
	Unit Outcomes: UO1 Correlate the gene expression and regulation of prokaryotes and eukaryotes	

Learning Resources:

1. Genes IX– Benjamin Lewin, Jones and Bartlett, 2008
2. Genes X– Benjamin Lewin, Jones and Bartlett, 2011
3. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999.
4. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2005
5. Cell and Molecular Biology- E.J. Dupraw – 1970, Academic Press, London
6. Cell and Molecular Biology - De Robertis and De Robertis -1997, (VIII); B.I.
7. Cytogenetics; Prentice- Waverly Pvt. Ltd., New Delhi C. P. Swanson, T. Merz, and W.J. Young – 1982, Hallof India Pvt. Ltd., New Delhi
8. The cell cycle- P. C.L. John (Ed.) – 1981, Cambridge University press
9. Genes - Benjamin Lewin VI, VII and VIII; Oxford Press.
10. Membrane proteins and their interactions with lipids - R. A. Chapoldi 1977, Marcel Dekker, inc. N. York
11. The enzymes of Biological Membrames- A. N. Mortonosi (Ed.) – 1985 Vol. I, II and III; Plenum press, New York
12. Molecular Biology of the gene - Watson and others – 2004, (V) pearses Educatias, Inc India.

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Department of Botany

Course Type : Lab Course X
Course Title : Lab Course (Based on MMC-VIII)
Course Code : 602BOT3105
Credits : 01 **Hours: 30**

Learning Objectives:

LO1 To know the techniques of Molecular biology.
LO2 Develop understanding about inheritance Biology.
LO3 Solve problems independently on Genetic disorder.

Course outcomes:

After completion of the course, students will be able to-

CO1 Associate the processes that unfold an individual cell compartments.
CO2 Analyze the main structural elements and processes that participate in reproduction growth, maintenance and regulation of the cell.
CO3 Discuss the molecular mechanisms by which DNA controls development, growth or morphological characteristics of organisms.

Practical 1. Isolation of plasmid DNA and quantification.

Practical 2. Electrophoretic separation of plasmid isoforms.

Practical 3. Restriction digestion of plasmid DNA, electrophoresis and molecular Weight determination of DNA fragments.

Practical 4. Isolation of plant genomic DNA and quantification.

Practical 5. Effect of temperature and alkali on absorbance of DNA – hyperchromicity.

Practical 6. Separation of SSP from leguminous seed &quantitation of each fraction.

Practical 7. SDS-PAGE separation of seed storage proteins from legumes.

Practical 8. Determination of molecular sizes of the globulin subunits.

Practical 9. Isolation of DNA from plants and Estimation by DPA method.

Practical 10. Isolation of RNA and Estimation of RNA by orcinol method.

Practical 11. Visit to Biotechnology Research center.

Practical 12. solation of DNA from various sources.

Practical 13. Determination of Electrical conduction of DNA.

Practical 14. Isolation and separation of cell organelles.

Practical 15. 2D- Electrophoresis technique for separation of proteins.

Practical 16. Synthesis of Gold Nanoparticles by biogenic methods.

Practical 17. Synthesis of Silver Nanoparticles by biogenic methods.

Practical 18. Isolation of enzymes involved in biosynthesis of nanomaterials.

N.B: 1) Any ten Practicals from above list

2) Several Short Excursions, field visit and at least one Long Excursion.

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Course Type : MMC-IX
Course Title : Plant Biotechnology Genetic Engineering
Course Code : 602BOT3103
Credits : 03 **Hours: 45**

Learning Objectives:
LO1 To learn the various types of tissue culture techniques.
LO2 To understand concept of proteomics and genomics.
LO3 To study Agrobacterium mediated gene transfer.
LO4 To know the DNA sequencing methods.
LO5 To know the role of molecular markers and its applications.

Course Outcomes:
After completion of the course, students will be able to-
CO1 Describe the various types of tissue culture techniques.
CO2 Correlate the concept of proteomics and genomics.
CO3 Explain Agrobacterium mediated gene transfer.
CO4 Identify the different methods of DNA sequencing.
CO5 Justify the role of molecular markers and its applications

Unit No.	Title of Unit & Contents	Hrs.
I	**PLANT TISSUE CULTURE**	**11**
	1. History of plant tissue culture. 2. Laboratory condition requirement. 3. Tools and techniques for tissue culture. 4. Culture media and their constituents 5. Types of culture (Anther, callus, Micropropagation) and application of tissue culture. 6. Somaclonal variation and its significance. 7. Protoplast culture and somatic hybridization. 8. Cryopreservation.	
	Unit Outcomes: UO1. Describe the various types of tissue culture techniques	
II	**RECOMBINANT DNA TECHNOLOGY AND GENE CLONING**	**11**
	1. Introduction to recombinant DNA technology. 2. Enzymes used in recombinant DNA technology. 3. Recombinant technology and gene cloning. 4. Use of vectors in cloning- Plasmids, cosmids, BACs and YACs. 5. DNA Sequencing methods (Maxum Gillbert, Sangers, Pyrosequencing and Next generation sequencing).	
	Unit Outcomes: UO1. Describe the various types of r-DNA Techniques. UO2. Identify the different methods of DNA sequencing	
III	**GENE LIBRARIES AND SCREENING OF RECOMBINANTS**	**12**

Unit No.	Title of Unit & Contents	Hrs.
	1. Genomic and cDNA libraries – choice of vectors and construction. 2. RNA Interference mechanism, synthesis and its application. Virus Induced Gene Silencing(VIGS). 3. Concept of genomics and proteomics. 4. Concept of Human genome Project (HGP).	
	Unit Outcome: UO1. Correlate the concept of proteomics and genomics.	
IV	**GENETIC TRANSFORMATION OF PLANT**	**11**
	1. Agrobacterium: Ti and Ri plasmids, transfer of DNA into host by Agrobacterium, mechanism of integration of DNA into plant genomes, vectors for chloroplast transformation, vectors for marker-free selection. 2. Transformation technique -Agrobacterium-mediated transformation, Factors affecting on Agrobacterium-mediated transformation. 3. Molecular markers and their applications.	
	Unit Outcome: UO1. Explain Agrobacterium mediated gene transfer.	

Learning Resources:

1. Principles of gene manipulation. Primrose SB, Twyman RM and Old RW, 6th Edition, Blackwell Science, Oxford, 2001
2. Differentially expressed gene in plants. Hansen and Harper, Taylor and Francis Ltd. London, 1997.
3. Engineering plants for commercial products and applications. Eds. Collins GB and Shepherd RJ, NY Acad. Of Science Publishers 1996.
4. DNA markers. Eds. Caetano-Anolles and Gresshoff, Wiley-VCH Publishers, NY, 1998
5. Introduction to Bioinformatics. Attwood, T.K., Parry-Smith, DJ, Addison Wesley Longman, Harlow, Essex, 1999.
6. Bioinformatics. Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003
7. Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi, 2003
8. Collins GB and Shepherd RJ Eds., 1996, Engineering plants for commercial products and application. , NY Acad. Of Science Publishers
9. Essentials of Genomics and Bioinformatics-Wiley-VCH Publishers, NY,
10. Secondary products from plant tissue culture- Charlwood B.V. and Rhodes MV Edt. 1999, Clarendon Press, Oxford.
11. Plant cell culture: Secondary metabolism towards industrial application- Dicosmo F and Misawa M, Edt 1996, CRC press, Boca Raton ,N.Y.
12. Biotechnology: Secondary metabolites- Ramawat K G and Merillon J M, Edt.,1999 Oxford IBH Publishing Co., New Delhi Biochemistry and molecular biology of plants- Buchanan BB, Grussem Wand Jones RL, 2000. IK International Pvt Ltd. New Delhi.
13. Biochemistry and molecular biology of plants- Buchanan BB, Grussem Wand Jones RL, 2000. IK International Pvt Ltd. New Delhi.

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Course Type : Lab Course XI
Course Title : Lab Course (Based on MMC-IX)
Course Code : 602BOT3106
Credit : 01 **Hours: 30**

Learning Objectives:

LO1 To know the molecular aspect.
LO2 To study Agrobacterium mediated gene transfer.
LO3 To know the DNA sequencing.
LO4 To know the tissue culture techniques.

Course outcomes:

After completion of the course, students will be able to-
CO1 To understand the steps involved in recombinant DNA technology.
CO2 To explain the construction of DNA & c DNA library and their applications
CO3 To understand principles of animal culture, media preparation
CO4 To explain In-vitro fertilization and embryo transfer technology
CO5 To describe meristem culture and Clonal propagation of plants on a commercial -

Practical 1. Sterilization Techniques.

Practical 2. Preparation of stock solutions.

Practical 3. Preparation of Media MS Medium.

Practical 4. Surface sterilization of explants.

Practical 5. Characterization of Callus.

Practical 6. Protoplast isolation.

Practical 7. Preparation of Synthetic seeds.

Practical 8. Growth characteristics of E. coli using platting & turbidiometric method.

Practical 9. To detect mutants variant of a given platting techniques.

Practical 10. Isolation of plasmid from E. coli by enzymatic method.

Practical 11. Effect of temperature and alkali on absorption of DNA: hyperchromicity

Practical 12. Isolation of RNA and its quantification.

Practical 13. Visit to Plant tissue culture laboratory.

N.B: 1) Any ten Practicals from above list
2) Several Short Excursions, field visit and at least one Long Excursion.

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Course Type : MEC-III (A)
Course Title : Plant Pathology-I
Course Code : 602BOT3201
Credits : 03 **Hours: 45**

Learning Objectives

LO1 To awaken the students about microbial world and the nature of diseases of plants.
LO2 To understand the principles and concept in plant pathology.
LO3 To understand the relationships between pathogens and plants.
LO4 To become familiar with terms and references used to diagnose plant disease.
LO5 To learn the basic biology of major groups of plant pathogens.
LO6 To explain the concept of plant disease and disease pyramid.

Course Outcomes:

After completion of the course, students will be able to-

CO1 Identify plant diseases caused by biotic and abiotic agents.
CO2 Describe the effective methods of crop disease management.
CO3 Correlates principle of disease control to the recent legislation of integrated and biological disease management.
CO4 Explain the concept of plant disease and disease pyramid.

Unit No.	Title of Unit & Contents	Hrs.
I	**INTRODUCTION TO PLANT PATHOLOGY**	10
	1. Scope and Importance of Plant Pathology; Contributions of E. F. Smith E. J. Butler and K. C. Mehta, in the field of plant pathology. 2. Careers in Plant Pathology, The Practice and Practitioners of Plant Pathology. Certification of Professional Plant Pathologists. 3. Aerobiology: Scope and applications of aerobiology. Airborne pathogens, Methods for detection of Aerospora. 4. Methods in Plant Pathology	
	Unit Outcomes: UO1. Explain the concept of plant disease and disease pyramid	
II	**DISEASES OF CROP PLANTS-I**	12
	History, symptomology, causal organism, etiology and management of: 1. Rice: - Blast disease. 2. Jowar: - Leaf Spot 3. Pigeon pea: - Leaf Spot 4. Tomato: - Early Blight. 5. Bhendi: Powdery Mildew 6. Brinjal: - Leaf Spot. 7. Chilly: - Anthracnose. 8. Bean Mosaic 9. Tomato: Mottle –virus 10. *Soybean Cyst Nematode: Heterodera glycines*	

Unit No.	Title of Unit & Contents	Hrs.
	11. Cucumber - Annular Leaf Spot - Bacteria *Pseudomonas* 12. Corn: Stunt Disease of Caused by Mollicutes **Unit Outcome**: UO1. Identify plant diseases caused by biotic and abiotic agents.	
III	**DISEASE OF CROP PLANTS – II**	**12**
	(History, symptomology, causal organism, etiology and management of) 1. Banana: - Panama disease. 2. Grapes: - Powdery Mildew. 3. Sugarcane: - Grassy Shoot. 4. Sunflower: - Rust. 5. Groundnut: - Rust 6. Sesamum: - Leaf Spot. 7. Green gram: - Powdery mildew. 8. Rose: Powdery Mildew -Fungus *Podosphaera pannosa*. 9. Corn: Stewarts Wilt -Bacterial *Pantoea stewarfii subsp. Stewarfii (syn. Erwinia stewarfii)* 10. Tomato: Speck -Bacterial **Unit Outcome**: UO1. Identify plant diseases caused by biotic and abiotic agents.	
IV	**HOST RESISTANCE, DISEASE MANAGEMENT AND CONTROL OF DISEASE**	**11**
	1. Plant defenses: Non-host and host resistance. 2. Pre-existing and induced structural and chemical defenses. 3. Pathogenicity genes, a virulence genes, effector molecules. 4. Control of disease using fungicides. 5. Biocontrol agents for controlling disease. **Unit Outcomes**: UO1. Correlates principle of disease control to the recent legislation of integrated and biological disease management	

References Book:

1. Plant Pathology- Agrios, G. N. 2006, 5th Edition
2. Experiments in Microbiology, plant pathology and Tissue culture - Aneja, K. R. 1993
3. Diseases of Tropical and Subtropical field, Fiber and oil plants- Cooke, A. A. 1981
4. Clinical Plant Pathology- Gangopadhyay , S. 2004
5. The Biology of parasitic flowering plants- Kuijit, J. 1969
6. Methods in physiological plant pathology- Mahadevan, A. and R. Shridhar, 1982.
7. Plant Pathology- Agarwal A. and Mehrotra, R. S. 2012
8. Field Crop Diseases Handbook- Nyvall, R. F. 1979

9. Pathological Problems of Economic crop plants and their management - Paul Khurama, S. M. 1998
10. Disease Resistance in plants- Planke, J. E. ander, 1968
11. Plant Diseases Epidemics and control- Planke, J. E. Vander. 1963
12. Diseases of crop plants in India- Rangaswami, G. 1979
13. Plant Diseases- Singh, R. S. 2009, 9th Edition
14. Indian journal of phytopathology III. Journal of Mycology and plant pathology

Course Type : Laboratory Course XII
Course Title : Laboratory Course-VIII (Based on MEC-III(A))
Course Code : 602BOT3203
Credit: 01 **Hours: 30**

Learning Objectives:

LO1 To understand the principles and concept in plant pathology.
LO2 To understand the relationships between pathogens and plants.
LO3 To develop the awareness about the importance of plant disease in human life.
LO4 To explain the concept of plant disease and disease pyramid.

Course outcomes:

After completion of the course, students will be able to-
CO1 The general bases of plant diseases caused by biotic and abiotic agents.
CO2 Major infective crop diseases with severe economic impact.
CO3 The measurement of disease symptoms.

Practical 1. Study of different equipments for sterilization (Autoclave, Laminar air flow,Incubator and Oven).

Practical 2-4. To study different staining methods.

Practical 5-18. Symptomology, histopathology of disease given in theory

Practical 19-20. Estimation of chlorophylls, sugars and polyphenols from healthy and infected leaves.

Practical 21. Isolation and identification of plant pathogens from air over infected field

Practical 22. Use of Aerobiological technique to study fungal flora of different localities by Tilak air Sampler

Practical 23. Study of rhizosphere mycoflora from different soil samples of infected and healthy plants by serial dilution technique

Practical 24. Effect of temperature on growth of plant pathogenic fungi

Practical 25. Effect of pH on growth of plant pathogenic fungi

Practical 26. Study of Phyllosphere mycoflora of infected and healthy plants by leaf print method.

N.B: 1) Any Ten Practicals from above list.
2) Several Short Excursions, Field visits and at least one Long Excursion

Semester - IV

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Course Type : MMC-X
Course Title : Cytogenetics and Plant Breeding
Course Code : 602BOT4101
Credits : 03 **Hours: 45**

Learning Objectives:

LO1 To understand the cell structure, function and different aspects of cytogenetical studies.
LO2 To study importance of plants and inculcate the importance of farming based
LO3 To reveal the different aspects of plant breeding.
LO4 To provide platform to develop the investigation abilities by using biological tools.
LO5 To provide training in scientific and transferable skills through modular lecture.
LO6 To provide basic knowledge to be able to sustain in upcoming green revolution

Course Outcomes:

After completion of the course, students will be able to-

CO1 Explain the concepts of Cytogenetics.
CO2 Perform human cell culture, chromosome preparations, karyotyping and FISH analysis of human chromosomes.
CO3 Diagnose and interpret pathology of human chromosomes (chromosome aberrations, trisomy, rearrangements etc.).
CO4 Demonstrate a professional knowledge of the cytogenetic disorders and clinical diagnosis.
CO5 Describe the principles and techniques of plant breeding.

Unit No.	Title of Unit & Contents	Hrs.
I	**Cytogenetics-I**	**13**
	1. Cell division: Mitosis and Meiosis. 2. Concept of Gene: Allele, Multiple allele, Pseudo allele, Complementation test. 3. Mendelian Principles: Dominance, Segregation and Independent assortment. 4. Extensions of Mendelian Principles: Codominance, Incomplete dominance, 5. Gene interactions (Epistatic and Non Epistatic) 6. Pleiotropy, Genomic imprinting, Penetrance, Expressivity and Phenocopy.	
	Unit Outcome: UO1. Explain the concepts of Cytogenetics.	
II	**Cytogenetics-II**	**10**
	1. Microbial genetics: Mapping of bacterial genome by interrupted mating. 2. Linkage and mapping in eukaryotes: Linkage and crossing over, Sex linkage, Sex limited and sex influenced characters. 3. Recombination: Homologous and Non-homologous including transportation. 4. Linkage maps, Lods score for linkage testing, Mapping by 3-point test cross 5. Mapping by tetrad analysis in Yeast and Neurospora, mapping with molecular	
	Unit Outcome: UO1. Demonstrate a professional knowledge of the cytogenetic disorders and	

Unit No.	Title of Unit & Contents	Hrs.
	clinical diagnosis	
III	**Cytogenetics-III**	**11**
	1. Extra chromosomal inheritance: Inheritance of mitochondria and chloroplast genes, Maternal inheritance and its effect. 2. Quantitative genetics- Introduction to complex traits, Polygenic inheritance. Heritability & its measurement, QTL Mapping. 3. Karyotypes and genetic disorders. 4. Structural alterations of chromosomes: Deletion, Duplication, Inversion, Translocation, Complex translocation heterozygotes, Robertsonian translocations, BA translocations and their genetic implications. 5. Numerical alterations of chromosomes: Euploidy and aneuploidy and their genetic implications.	
	Unit Outcome: UO1. Diagnose and interpret pathology of human chromosomes (chromosome aberrations trisomy, rearrangements etc.	
IV	**PLANT BREEDING**	**11**
	1. Plant Breeding- Introduction, Definition, History (phases), Objectives. 2. Hybridization methods in plants. 3. Mutation breeding: Types, Mutagens: Physical and chemical mutagens, Mutant types, Role of mutation in breeding. 4. Induction of polyploidy, in plant. 5. Methods of Breeding for Biotic stress (Disease resistance) and abiotic stress resistance (drought resistance). 6. Procedure for of new variety.	
	Unit Outcome: UO1. Describe the principles and techniques of plant breeding	

Learning Resources:

1. The science of genetics- Atherly, A.G., Girton, J.R. and Mcdonald, J. F. (1999) Sauders College Pub. Fort Worth USA.
2. Disscussions in cytogenetics- Burnham, C.R.(1962) ,Burgess Pub. Co., Minnesota.
3. Genetics: Principle and analysis- Hartl, D.L., Jones E.W.(2001), (4th edn) Jones and Barlett Pub., USA.
4. Cytogenetics of Aneuploids- Khush, G S (1973) ,Academic press New York, London.
5. Lewin, B. Genes VIII. Oxford, University press. New York, USA.
6. Genetics- Russel, P.J. 1998, (5th edn).The Benjamin/ Cummins Pub. Co., Inc. USA.
7. Principles of genetics- Snustad, D.P. and Simmons, M.J. 2000 ,(4th edn). John Wiley and Sons, Inc., USA.
8. Microbial Genetics- Freifelder, D. (1987)
9. Genetics- Strickberger, M.W, (4th edn). Mcmillan Publishing company, New York.
10. Modern genetic analysis- Griffiths, A.J.F. and Gilbert, W.M (2nd edn) W.H. Freeman and Company, New york.
11. Plant breeding: principles and methods- Singh, B.D.(2005), 7th edn. Allard, R.W.(1960).
12. Principles of plant breeding.John Wiley and sons, Inc., New York.

13. Plant breeding: Theory and practice- Chopra, V.L. (2000) 2nd edn. Oxford & IBH Pub., Co., Ltd. New Delhi.
14. Plant breeding: Mendelian to molecular Approaches- Jain, H.K. and Kharwal, M.C. (2003), Navrosa Publishing House Pvt. Ltd., New Delhi.
15. Advances in Plant breeding. Vol 1 and 2, CBS Pub.& distributors.
16. Principles and practices of Plant Breeding -Sharma, J.R. 1994. -Mandal, A.K. Ganguli, P.K., Banergee, S.P. (1991), Tata Mcgraw Hill.Pub. Co. Ltd. New Delhi.
17. Principles of crop improvement- Simmonds, N.W.1979 Longman, London and New York.

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Course Type : Laboratory Course XIII
Course Title : Laboratory Course- (Based on MMC X)
Course Code : 602BOT4104
Credit : 01 **Hours: 30**

Learning Objectives:

LO1 To study the gene mapping.
LO2 To learn the chromosomal aberrations in irradiated plant material.
LO3 To learn the Polygenic inheritance
LO4 To know the chromosomes banding techniques such as C-Banding,G-Banding and Q-Banding.

Course outcomes:

After completion of the course, students will be able to-
CO1 Analyse the gene mapping.
CO2 Correlates the plant pathogen from healthy and infected plant parts
CO3 Evaluates the methods for chromosomes banding techniques.
CO4 Explain the Polygenic inheritance

1. Preparation of stains, Fixatives, preservatives and pretreatments to plant material.
2. Problems on determination of blood grouping
3. Problems based on Multiple alleles.
4. Problems based on Gene mapping.
5. Problems based on linkage.
6. Study of meiotic configuration from suitable plant material.
7. Study of chromosomal aberrations in irradiated plant material.
8. Study of Polygenic inheritance.
9. Problems of Mendelian inheritance and estimation of gene frequencies and heterozygotic frequencies, population genetics and Linkage.
10. Neurospora tetrad analysis.
11. Linear differentiation of chromosomes through banding techniques such as C-Banding,G-Banding and Q-Banding.
12. Floral Biology, study of Pollen Viability, germination in vitro and staining of any two major crops.
13. Study of monohybrid and dihybrid crosses and interactions.
14. Study of quality traits in rice, cotton/wheat/soybean/Brassica.
15. Use of Colchicine for induction of polyploidy in appropriate plant material.
16. Demonstration of techniques of hybridization.

17. Effect of physical or chemical mutagens on crop plants of M1 and M2 population.

18. Visit to research institutes / Biotechnology/ Tissue culture laboratories/Agriculture Universities.

N.B: 1) Any Ten Practicals from above list.

2) Several Short Excursions, Field visits and at least one Long Excursio

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Course Type : MMC XI
Course Title : Immunology, Plant Nanotechnology and Forensic Botany
Course Code : 602BOT4102
Credits : 03 **Hours: 45**

Learning Objectives:

LO1 To identify the use of nanotechnology indifferent fields.
LO2 To study the fundamental principles and functions of forensic science.
LO3 To learn the Cells and molecules involved in innate and adaptive immunity.
LO4 To know the immunization and different vaccination

Course Outcomes:

After completion of the course, students will be able to-

CO1 Describe the scope, principles and functions of forensic Botany.
CO2 Correlate the immunization and different vaccination.
CO3 Identify the use of nanotechnology indifferent fields.
CO4 Discuss basic techniques for identifying antigen antibody interactions.

Unit No.	Title of Unit & Contents	Hrs.
I	**PLANT NANOTECHNOLOGY AND ITS CONCEPTS**	**15**
	1. Plant Nanotechnology: An Overview on Concepts, Strategies, and Tools 2. Physical and Chemical Nature of Nanoparticles. 3. Effects of Nanoparticles on Plant Growth and Development 4. Agri-Nontechniques for Plant Availability of Nutrients 5. Utilization of Nanoparticles for Plant Protection 6. Nanotechnology in Soil-Plant System	
	UO1. Identify the use of nanotechnology indifferent fields.	
II	**INTRODUCTION TO FORENSIC BOTANY**	**12**
	1. Introduction to forensic botany. Botanical evidence on legal investigations. Legal plant definition. Botanical evidence in legal investigations 2. The Use of Botanical Evidence in Criminal Investigations. Evidence collection and analysis: i. Documentation of botanical evidence ii. Collection information needed for each botanical sample iii How to have botanical evidence analyzed iv Evidence analysis v. Laboratory report 4. Fundamentals of wildlife forensic. Significance of wildlife forensic.	
	Unit Outcome: UO1. Explain the fundamental principles and functions of forensic science	
III	**IMMUNOLOGY-I**	**11**
	1. Cells and molecules involved in innate and adaptive immunity. 2. antigens, antigenicity and immunogenicity 3. B and T cell epitope, structure and function of antibody molecules.	

Unit No.	Title of Unit & Contents	Hrs.
	4. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen antibody interaction MHC molecules. 5. Antigen processing and presentation, activation and differentiation of B and T cells.	
	Unit Outcome: UO1. Explain the basic techniques for identifying antigen antibody interactions	
IV	**IMMUNOLOGY-II**	**12**
	1. B and T cell receptors, humoral and cell mediated immune responses, primary and secondary immune responses. 2. The complement system. 3. Toll-like receptors, cell mediated effector functions, inflammation, hypersensitivity and autoimmunity, 4. Immune response during bacterial (tuberculosis), Parasitic (malaria) and viral (HIV) infections congenital and acquired immunodeficiencies. 5. Vaccines.	
	Unit Outcome: UO1. Explain the basic techniques for identifying antigen antibody interactions	

Learning Recourses:

1. Biochemistry- L. Stryer, 3rd Edition, W.H. Freeman and Company, New York (1988).
2. Biochemistry- R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's
3. Forensic Biology- S. Chowdhuri, BPRD, New Delhi (1971).
4. Forensic Science Handbook- R. Saferstein ,Vol. III, Prentice Hall, New Jersey (1993).
5. Serology and DNA typing in, Introduction to Forensic Sciences, G.T. Duncan and M.I. Tracey, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
6. Nano materials synthesis, properties and applications- Edelestein A.S and Cammarata RC
7. Nanotechnology-An Introduction to Nano structuring Techniques Wiley (Practical), Michael Kohler, Wolfgang Fritzsche, Michael Kohler
8. MEMS and Microsystems, Design, Manufacture and Nanoscale Engineering- Tai Ran – Hsu, John Wiley & Sons, 2008.
9. Nanolithography: A Borderland between STM, EB, IB and X-Ray Lithographies (NATO ASI Series)- M. Gentili, C. Giovannella, S. Selci, Kluwer Academic Publishers, 1994.
10. Nanoparticle Assemblies and Superstructures‖- Nicholas A. Kotov, CRC, (2006).
11. Nanostructures &Nanomaterials Synthesis, Properties G; Z, Applications- Guozhong Cao, World Scientific Publishing Pvy. Ltd., Singapore 2004
12. Nanofabrication, Principles, Capabilities and Limits- Zheng Cui ,Springer Science business media, New York (2008).
13. Kostya (Ken) Ostrikov and ShuyanXu, Plasma-Aided Nanofabrication: From Plasma
14. Sources to Nanoassembly, WILEY-VCH Verlag GmbH & Co. KGaA (Weinheim) (2007)
15. Cell & Molecular Biology- H. Baltimore, WH Freeman
16. The Cell A Molecular Approach‖-Geoffrey M. Copper, 2nd Edition, ASM press, Sinauer Associates, Inc., Washington, (2000)
17. Daniel, Molecular Cell Biology‖- Harvey Lodish, Arnold Berk, S.L Zipursky, Paul Matsudaira, David Baltimore and James 4th Ed., W.H Freeman and company, (2000).
18. Cell and Molecular Biology- E.D.P. De Robertis, and E.M.F De Robertis,. 8th Ed, Lippincott Williams and Wilkins, (2001).
19. Albert Bruce, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter.

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Course Type : Laboratory Course XIV
Course Title : Laboratory Course (Based on MMC-XI)
Course Code : 602BOT4105
Credit : 01 **Hours: 30**

Learning Objectives:
LO1 Understand and appreciate the scope of forensic biology.
LO2 After studying this paper the students will know –. The significance of forensic science to human society.
LO3 To Study the fundamental principles and functions of forensic science.
LO4 To know the divisions in a forensic science laboratory.

Course outcomes:
After completion of the course, students will be able to-
CO1 Apply basic techniques for identifying antigen antibody interactions.
CO2 Elucidate the reasons for immunization and aware of different vaccination
CO3 Understand the basics Electronic Nanomaterial Properties
CO4 To impart understanding on Nanoparticle based Drug Delivery

1. Immunodiffusion test.
2. Determination of blood groups.
3. Determination of clotting time.
4. Determination of bleeding time.
5. Differential count of RBC/Leucocytes.
6. Widal test.
7. ELISA Tests.
8. Western blots.
9. RPR Test.
10. Preparation of thiolated silver nanoparticles
11. Zinc Selenide quantum dot preparation.
12. Synthesis of Iron Oxide Nanoparticle
13. Synthesis of Nickel metal nanoparticle by urea decomposition method
14. Synthesis of Zinc Oxide nanoparticle
15. To carry out microscopic examination of pollen grains.
16. To carry out microscopic examination of diatoms.
17. To cite a crime case in which diatoms have served as forensic evidence.

N.B: 1) Any Ten Practicals from above list.
2) Several Short Excursions, Field visits and at least one Long Excursion

Course Type : MMC XII
Course Title : Plant Pathology-II
Course Code : 602BOT4103
Credits : 03 **Hours: 45**

Learning Objectives:

LO1 To awaken the students about microbial world and the nature of diseases of plants.
LO2 To understand the principles and concept in plant pathology.
LO3 To understand the relationships between pathogens and plants.
LO4 To become familiar with terms and references used to diagnose plant disease.
LO5 To develop the awareness about the importance of plant disease in human life.
LO6 To learn the basic biology of major groups of plant pathogens.
LO7 To explain the concept of plant disease and disease pyramid.
LO8 To describe main modes of plant disease transmission.

Course Outcomes:

After completion of the course, students will be able to-

CO1 Explain symptoms caused by Fungi, Bacteria, Viruses, Mycoplasma and Nematodes.
CO2 Discuss the mode of dissemination of plant pathogens.
CO3 Describe the pathogenesis and disease forecasting.
CO4 Identify the effects of infection on the host.

Unit No.	Title of Unit & Contents	Hrs.
I	**INTRODUCTION TO PLANT PATHOLOGY**	**10**
	1. History: Beginning of modern plant pathology; Contribution of Anton De Bray; Benedict Prevost; J.C. Kuhn; Paul Neergaard, P.H. Geregory. History of the development of plant pathology in India; plant disease clinics. 2. Disease inciting agents: i) Biotic agents: Bacteria, viruses, fungi, Mycoplasma, nematodes. ii) Abiotic agents: Air pollution; mineral elements, temperature, toxic effects of improperly used chemicals. iii) Symptoms of plant diseases: Symptoms caused by Fungi, Bacteria, Viruses, Mycoplasma and Nematodes. 3. Dissemination of plant pathogen: Dissemination by Air, Water, Buds, Insects, Man and transmission of plant viruses. 4. Economic importance of plant diseases	
	Unit Outcome: UO1.	
II	**DISEASES OF CROP PLANT- I**	**12**
	Symptomology, causal organism, etiology and control measures of: - 1. Wheat: Stem rust. 2. Jowar: Head smut. 3. Arhar: Wilt. 4. Potato: Leaf spot (Cercospora).	

	5. Groundnut: Tikka. 6. Gram: Blight Disease. 7. Tomato: Broom rape (Orobanche). 8. Radish: Mosaic. 9. Citrus: Canker	
	Unit Outcome: UO1.	
III	**DISEASES OF CROP PLANTS II**	**11**
	Symptomology, causal organism, etiology and control measures of 1. Mango: Anthracnose. 2. Pea: Rust. 3. Sugarcane: Wilt. 4. Sugarcane: Whip Smut 5. Chilly: Leaf curl. 6. Mustard: White Rust 7. Crucifers: Black rot 8. Cucurbits: Fruit rot 9. Sugarcane: Gummosis 10. Giant mistletoes (Loranthus) – Mango	
	Unit Outcome: UO1.	
IV	**EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES**	**12**
	1. Epidemiology and forms of epidemics: i) Compound interest diseases, simple interest, diseases slow and rapid epiphytotic. ii) Essential conditions of epidemics, decline of epidemics. iii) Disease measurement, disease severity, analysis of epidemics. 2. Disease assessment and forecasting. 3. Pathogenesis**:** Penetration and entry by plant pathogen; Pre-penetration; Entry through natural opening; Direct penetration; Entry through wounds, root hairs and buds**.** 4. Survivals of plant pathogen. 5. Effects of infection on the host: i. Tissue disintegration. ii. Effect on growth of host. iii. Effect on reproduction iv. Effect on uptake and translocation of water and nutrient v. Effect on respiration of host.	
	Unit Outcome: UO1.	

Learning Recourses:

Reference Book:

1. Plant Pathology- Agrios, G.N. (1969), Academic Press, New York.

2. Disease of crop plants in India- Rangaswami, G. and A. Mahadevan (2001) Printic Hall of India, Pvt. Ltd., New Delhi.
3. Disease of vegetable crops- Gupta, V.K. and V.S. Paul (2001), Kalyani Publ. Ludhiana,
4. Disease of fruit crops- Gupta, V.K. and S.K. Sharma (2000), Malyani Publ. Ludhiana.
5. Virus and Mycoplasma disease of plants in India- Raychaudhari, S.P. and T.K. Nariani (1977), Oxford and IBK Publ. Corp., New Delhi.
6. Plant viruses, unique and intriguing pathogens- Bos L. (1999), Backhugs Publ. Leiden.
7. Bacterial plant pathology Rangaswami, G. and S. Rajagopalan (1973), T.N. Agri. Uni.Coimbatore.

Shiv Chhatrapati Shikshan Sanstha's
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Botany

Course Type : Laboratory Course XV
Course Title : Laboratory Course (Based on MMC-XII)
Course Code : 602BOT4106
Credit : 01 **Hours: 30**

Learning Objectives:

LO1 To study the techniques of extraction and estimation of plant pigments
LO2 To learn the extraction and separation of alpha toxins.
LO3 To know the Symptomology, histopathology of diseases of crop plants.
LO4 To understand the role of cellulolytic and amylase enzymes.

Course outcomes:

After completion of the course, students will be able to-
CO1 Correlates the techniques of extraction and estimation of plant pigments
CO2 Evaluate the techniques of extraction and separation of alpha toxins.
CO3 Describe the Symptomology, histopathology of diseases of crop plants.
CO4 Analyse the role of cellulolytic and amylase enzymes

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1. Extraction and estimation of pigments in healthy and diseased plants.
2. Detection of sugars from healthy and infected leaves by paper chromatography.
3. Production and assay of macerating enzymes.
4. Production and assay of polygalactronase, cellulolytic enzymes, amylase.
5. Estimation of plant pigment from diseased and healthy plants
6. Detection of sugars from healthy and diseased leaves by paper chromatography.
7. Estimation of total phenol from diseased plant part.
8. Extraction and separation of alpha toxins
9-25. Symptomology, histopathology of disease given in theory.
26. Visits to fields for study of diseases.

N.B: 1) Any Ten Practicals from above list.
2) Several Short Excursions, Field visits and at least one Long Excursion

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Course Type : MEC-IV
Course Title : Plant Pathology III
Course Code : 602BOT4201
Credits : 03 **Hours: 45**

Learning Objectives:

LO1 To awaken the students about microbial world and the nature of diseases of plants.
LO2 To understand the principles and concept in plant pathology.
LO3 To understand the relationships between pathogens and plants.
LO4 To become familiar with terms and references used to diagnose plant disease.
LO5 To develop the awareness about the importance of plant disease in human life.
LO6 To learn the basic biology of major groups of plant pathogens.
LO7 To explain the concept of plant disease and disease pyramid.
LO8 To describe main modes of plant disease transmission.

Course Outcomes:

After completion of the course, students will be able to-

CO1 The general bases of plant diseases caused by biotic and abiotic agents;
CO2 Major infective crop diseases with severe economic impact;
CO3 The measurement of disease symptoms;
CO4 Principle of disease control in according to the recent legislation of integrated or biological disease management

Unit No.	Title of Unit & Contents	Hrs.
I	**EFFECT OF ENVIRONMENT ON PATHOGENESIS**	**11**
	1. Effect of environment, temperature, moisture, humidity, shade, wind, light, pH, O_2 and CO_2 concentration. 2. Role of Toxins in Plant pathogenesis: Pathotoxins, Vivo toxins and Phyto toxins. 3. Effect of toxins on plant tissues: Selective and non-selective toxins. 4. Seed Pathology: Scope and importance; seed health testing; methods and procedures; detection of seed borne-fungi, Bacteria and viruses. Seed bio deterioration: Biochemical changes, Morphological abnormalities, loss in germinability. Mycotoxins, fusarium toxinandaflatoxin. Control of Post-harvest spoilage of grains.	
II	**DISEASES OF CROP PLANTS-I**	**11**
	Symptomology, causal organism andcontrol measures of: 1. Sorghum: Long Smut. 2. Chilly: Die back. 3. Soyabean: Charcoal rot. 4. Potato: Stem canker. 5. Tomato: Fusarium Wilt 6. Wheat: Loose Smut 7. Sugarcane: Red Rot	

Unit No.	Title of Unit & Contents	Hrs.
	8. Papaya: Leaf Curl 9. Potato: Black Heart. 10. Potato/Flax: Dodder or Cuscuta.	
III	**DISEASES OF CROP PLANTS-II**	**12**
	Symptomology, causal organism and control measures of: 1. Crucifers: Black spot. 2. Sorghum: Loose smut. 3. Bean: Rust 4. Wheat: Brown Rust. 5. Cucurbits: Powdery mildew. 6. Grapes: Downy mildew. 7. Potato: Late Blight 8. Wheat: Ear cockles. 9. Sugarcane: Mosaic 10. Sandal: Spike.	
IV	**GENETIC VARIABILITY**	**10**
	1. Genetic Variability in plant pathogen: i Genetic Variability in viruses ii Genetic Variability in Fungi iii Level of variability in pathogen iv Loss of virulence 2. Genetics and molecular basis of host parasite interaction: i Evolution of parasitism. ii Genetics of host parasite interaction. iii Gene for gene relationship. iv Criteria for gene for gene relationship. v Molecular basis of host parasitic interaction. 3. Physiologic specialization: General accounts.	

Learning Recourses:

1. Recent advances in plant pathology- Chandnivala, M. (1955). Amol Publication, Pvt. Ltd.,
2. Pollution and their ecotoxicological significance- Nurenburg, H.W. (1985), John Wiley and Sons, New York.
3. Plant Pathology- Mehrotra, R.S. Tata McGraw Hill Publication Co., Ltd., New Delhi.
4. Plant Pathology- Agrisos, G.N., Academic Press, New York and London.
5. A text book of Modem plant pathology- Bilgrami, K.S. and H.C. Dubey, Vikas Publishing House, New Delhi.

6. Fungicides in plant disease control - Nene, Y. and P.N. Thaphyal II lidiv Oxford and IBH Publishing Co., New Delhi
7. Systemic fungicides- Vyas, S.C. Vol. 1 - 3, Tata Mc(Jrnw Hill Publishing Co., Ltd., New Delhi.
8. Pesticides and crop plant in India- Gangawane, L.V. and Jayashree Deshpande,Ajay Prakashan, Aurangabad.
9. Plant Pathology: Problems and progess Holton, C.S., Fischr, C.N. Fulton, R.W., Hart, H. and S.K.A.Macallan

Course Type : Laboratory Course XVI
Course Title : Laboratory Course (Based on MEC- IV)
Course Code : 602BOT3203
Credit : 01 **Hours: 30**

Learning Objectives:

LO1 To study the Bioagents against plant pathogenic fungi.
LO2 To isolate the plant pathogen from infected plant parts.
LO3 To learn the seed borne-fungi and Bacteria
LO4 To know the Symptomology, histopathology of diseases of crop plants.

Course outcomes:

After completion of the course, students will be able to-
CO1 Analyse the Bioagents against plant pathogenic fungi
CO2 Correlates the plant pathogen from healthy and infected plant parts
CO3 Evaluates the methods for detection of seed borne-fungi and Bacteria
CO4 Explain the Symptomology, histopathology of diseases of crop plants.

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1. Detection of seed borne-fungi and Bacteria.
2. Evaluation of fungicide against plant pathogenic fungi.
3. Evaluation of Bioagents against plant pathogenic fungi
4. Evaluation of antibiotics against pathogenic bacteria.
5. Extraction and estimation of pigments in healthy and diseased plants.
6. Isolation of plant pathogen from infected plant parts.
7. Preparation of nutrient agar medium and PDA.
8. Study of common effect of pollutants –So2, No and NH3 on leaves of common crop plants.
9. Estimation of protein from infected seeds.
10-25. Symptomology, histopathology of disease given in theory.
26. Visits to fields for study of diseases.

N.B: 1) Any Ten Practicals from above list.
2) Several Short Excursions, Field visits and at least one Long Excursion

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PG First Year

Extra Credit Activities

Sr. No.	Course Title	Credits	Marks	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.	1
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.	2
3	IIT Spoken Tutorial Courses	Min. of 02 credits	Min. of 30 Hrs.	3

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.

3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

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Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
Research Methodology	100	10	10	20	10	-	-	40	60	100
MMC/MEC	75	05	10	15	10	-	-	30	45	75
Lab Course	50	-	-	-	-	05	20	-	25	50
Field Project	100	10	10	20	10	-	-	40	60	100

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks

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Semester End Examination Paper Pattern

Pattern - I

Course: Theory **Max. Marks: 45** **Time: 2 Hrs.**

Q.1	**Answer the following questions (3 Marks each)**	**12 Marks**
	a) Based on Unit - I	
	b) Based on Unit - II	
	c) Based on Unit - III	
	d) Based on Unit - IV	
Q.2	**Answer any THREE of the following (5 Marks each)**	**15 Marks**
	a) Based on Unit - I	
	b) Based on Unit - II	
	c) Based on Unit - III	
	d) Based on Unit - IV	
Q.3	**Answer any ONE of the following**	**08 Marks**
	a) Based on Unit – I	
	b) Based on Unit – II	
Q.4	**Answer any ONE of the following**	**10 Marks**
	a) Based on Unit - III	
	b) Based on Unit – IV	

(S. N. Shinde)
Chairperson
Board of Studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)