KALINGAUNIVERSITYRAIPUR

SYLLABUS

FOR

MASTER OF BOTANY

UNDER CHOICE BASED CREDIT, GRADING ANDSEMESTERSYSTEM

(TobeimplementedfromAcademicYear2021-2022)

FACULTY OF SCIENCE

KALINGAUNIVERSITY,RAIPUR,(C.G.)

The Syllabus Book presents broad objectives, structure, and contents of our Two-YearsMaster of Botany(M.Sc.)Program.TheSyllabusisdirectional inscopeandpermits the much-desired flexibility to keep pace with the ever-growing body of knowledge,experiments, and explorations in science education. In order to provide an opportunity tostudents todiscover amethodof thinking which will help them realize their true potential.The Faculty of Science offers a Learning Outcome-based CurriculumFramework(LOCF)forStudentsofM.Sc Botany.

I. IntroductiontoProgram:-

M.Sc. Botany Programme is a two-year (4 semesters) post-graduate programme, which deals with basic and advanced study on plants. It is one of the multi-disciplinary fields with great demand in various fields of research and development. The programme envisages developing understanding and knowledge for applying into sectors like agriculture, horticulture, floriculture, biotechnology, genomics, forest and environment.

ThenewcurriculumofM.Sc. Botany willempowerstudentstoinnovateandalsoinspirethemto convert their innovations intogood understanding of the scientific method and the rigors of scientific research.this course are expected to be prepared for employment asPlant Taxonomists, Ethnobotanists, Pathologists, Palaeobotanists and Palynologists, Plant cytologists, Plant geneticists, Plant ecologists, Plant Scientists and Weed Scientist etc.

II. NatureandExtentoftheM.Sc BotanyProgrammeofferedbyFacultyofScience,Kalinga University,Raipur:-

The courses in this program have been created to help students gain a better grasp of advanced biological sciences, with a focus on Botany and its applied branches. Students will be able to recognize and put ethical concepts into practice in research and studies. In order to align with the mission and goals of Kalinga University, the M.Sc Botany Programme is planned to deliver such a higher education in Botany subject that carries appropriate practical experiences that will enrich the students with scientific temperament.

III. Aimsof Master Degree Programmein Botany:-

1. The master's programme in Botany aims to prepare students for a career as scientists, who are able to deal with current research issues in the field of botany, using modern methods. In addition, graduates are qualified to represent the discipline adequately, both in basic research as well as in applied research areas
2. The degree program emphasizes the integration of the sciences of systematic and evolutionary botany, structural botany, and molecular plant biology. It encourages multidisciplinary collaboration, including with disciplines other than botany.
3. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum.

IV. The M.Sc. Botany program is designed with Graduate Attributes (Gas) aims toem power the students with:-

1. **Disciplinary Knowledge**:-

   The curriculum planning of M.Sc Botany course envisages the students demonstrating inclusive knowledge various kind of life forms of plant kingdom. Understand about anatomical, embryological, cellular and molecular level approach of science in studying plants

   The students will beunder stood about modern concepts like plant molecular biology, plant genetic engineering and plant tissue culture.

2. **Problem-solving skills: -**

   This programme enables the students to carry out innovative research projects thereby enkindling in them the spirit of knowledge creation. The graduates of this programme will be trained to develop skills and attitudes needed for critical thinking and adopting a comprehensive problem-solving approach. Its goal is to develop the fundamental ability to think critically, assess, and creatively solve complex problems. The content is designed in such a manner that students can consider many points of view and suggests solutions based on their own preferences.

3. **Communication Skills:-**

   Students are able to deliver and communicate information effectively with a mark because to the teaching learning pedagogies utilized in the curriculum.

4. **Research Related Skill:-**

   The curriculum planning of M.Sc Botany programme is to maintain a high level of scientific excellence in botanical research. The courses aim to equip students to perform functions that demand higher competence in National/International fields. . Inculcate genuine interest in Biological research.

5. **Moraland Ethical Awareness:-**

   This curriculum allows to promote an all round development of its students with a proper blending of knowledge and wisdom acquiring adequate skill in his own subject or trade or vocation through teaching learning process and human qualities like compassion, a sense of social responsibility and commitment and ethical sense (honesty), tolerance and empathy through various social, cultural, sports and ethical value addition programs**.**Appreciate and apply ethical principles to biological science research and studies

6. **Environment and Sustainability**

   The course aim is to sustain student's motivation and enthusiasm and to help them not only to appreciate the beauty of different life forms but also to inspire them in the dissemination of the concept of biodiversity conservation. The courses enlighten the students about biodiversity, conservation and Intellectual Property Rights.Inculcate interest in and love of nature with its myriad living forms.

7. **LifelongLearning:-**
   The curriculum is designed in such a way that the students are engage in continuous learning for professional growth and development.

8. **Information/Digitalliteracy:-**
   This curriculum allows students to stay technologically current by offering courses such as Biochemical Techniques, Molecular Techniques, and Bioinformatics, which prepare students to not only work with software but also to be self-sufficient in this digital age. Components relevant to technology advances have been incorporated into all of the courses, where applicable and possible, making them digitallyliterate.

9. **Human Resourse:-**
   This programme enables the students to build human resource with strong character and competence, having the strength to face the challenges of the changing realities both in global and local levels and to adapt to the fast evolving technologies.

10. **Technical Skills:**
    This curriculum allows to make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data. Develop the ability for the application of acquired knowledge in various fields of life so as to make our country self-sufficient.

V. Eligibilityfor Admission:-

Candidatesseeking admissiontothefirstyearofthedegreeofMaster of Science in Botanyshall require to pass graduation degree in Science (BSc (CBZ/Biotechnology/Microbiology/Bioscience).

VI. Assessment/Evaluationofthecourse:-

Candidates will be Continuously Evaluated/Assessed on the basis of their performance bothInternallyandExternally.TheWeightageofInternalMarkswouldbe30%andforTerm-endis 70%. The External Marks will be imparted on the basis of End-term Examination andInternal Marks will be imparted on the basis of Class attendance and Participation/Tests/Assignments/Presentations/Activities/Projectetc.Candidatesshouldmandatorilypass separatelyinbothInternal& External Exam.

VII. ProgrammeStructure:-

The program is designed as per **CBCS (Choice Based Credit System) Choice Based Credit System.** The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidates.

Definitions to understand while taking admission in the course

(i) Academic Programme' means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/ Centre

(ii) Course' means a segment of a subject that is part of an Academic Programme

(iii) Programme Structure' means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity to University Rules, eligibility criteria for admission

(iv) Core Course' means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course

(v) Elective Course' means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) Open Elective' means an elective course which is available for students of all programmes, including students of same department. Students of other Department will opt these courses subject to fulfilling of eligibility of criteria as laid down by the Department offering the course.

(vii) Credit' means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course

(viii) SGPA' means Semester Grade Point Average calculated for individual semester.

(ix) CGPA' is Cumulative Grade Points Average calculated for all courses completed by the students at any point of time. CGPA is calculated each year for both the semesters clubbed together.

Programme Structure-

The M.Sc in Botany programme is a two-year course divided into four-semesters. A student is required to complete 92 credits for the completion of course and the award of degree.

ThisProgrammeisdesignedasperthefollowingstructure:

1. CoreCourses.
2. GenericElective.
3. DisciplineSpecificElective.

List of Core Courses

- Phycology
- Mycology
- General Microbiology
- Cell and Molecular Biology
- Bryophytes, Pteridophytes and Gymnosperms
- Evolution, Taxonomy & Morphology of Angiosperms
- Plant Biochemistry and Biotechnology
- Ecology & Biodiversity Conservation
- Anatomy, Development, Reproduction and Embryology of Angiosperms
- Plant Physiology & Metabolism
- Plant, Cell, Organ & Tissue Culture

List of GenericElective.

- Research Methodology
- Science Journalism
- Entrepreneurship
- Intellectual Property Rights

List of DisciplineSpecificElective.

- Cytogenetics and Plant Breeding
- Plant Pathology
- Herbal Medicine
- Applied Microbiology
- Biochemical, Molecular Techniques and Bioinformatics
- Plant resource utilization and Ethnobotany

VIII. Miscellaneous:-

1. **Attendance**: The student must meet the requirement of 75% attendance per semester percourse for grant of the term. The institute may condone the shortage in attendance inexceptional circumstances, up to a maximum of 15%. The institute shall have the right towithhold the student from appearing for examination of a specific course if the aboverequirementisnotfulfilled.
2. **MediumofInstruction**: ThemediumofInstruction&EvaluationshallbeEnglish.

IX. Detailed Course List for each category of courses is providedinAnnexureI.

X. DetailedsyllabusofeachcourseisprovidedinAnnexureII.

XI. Programme Outcome:-

Program Learning Objectives & Program Specific Outcome

Program	PO	PSO
M.Sc (Botany)	PO-I: Students know about different types of lower & higher plants their evolution in from algae to angiosperm &also their economic and ecological importance. PO-II: Student can describe morphological & reproductive characters of plant and also identified different plant families and classification. PO-III: Understand the issues of environmental contexts and sustainable development PO-IV: Cell biology gives knowledge about cell organelles & their functions PO-V: Molecular biology gives knowledge about chemical properties of nucleic acid and their role in living systems. PO-VI: Genetics provides knowledge about laws of inheritance, various genetic interactions, chromosomal abrasions & multiple alleles. Structural changes in chromosomes. PO-VII: They knows economic importance of various plant products & artificial methods of plant propagation PO-VIII: Use modern Botanical techniques and decent equipments. PO-IX: To develop the scientific temperament in the field of plant science.	PSO-I: Application of knowledge and techniques of plant sciences related to biological sciences. PSO-II: Students acquire fundamental Botanical knowledge through theory and practical's. PSO-III: Perform procedures as per laboratory standards in the areas of Plant Biotechnology, Biochemistry, Bioinformatics, Taxonomy,Economic Botany and Ecology. PSO- IV: To know advance techniques in plant sciences like tissue culture, Phytoremediation, plant disease management, formulation of new herbal drugs etc.

M.Sc. (Botany)
CBCS based course curriculum

Semester I						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Core Course	MBOT101	Phycology	4	70	30	100
	MBOT102	Mycology	4	70	30	100
	MBOT103	General Microbiology	4	70	30	100
	MBOT104	Cell and Molecular Biology	4	70	30	100
	MBOT101-P	**Practicals**- Phycology	1	30	20	50
	MBOT102-P	**Practicals**- Mycology	1	30	20	50
	MBOT103-P	**Practicals**- General Microbiology	1	30	20	50
	MBOT104-P	**Practicals**- Cell and Molecular Biology	1	30	20	50
GE-1		**Choose Any One MBOT105A/ MBOT105B**	**4**	**70**	**30**	**100**
	MBOT105A	**Research Methodology**				
	MBOT105B	**Science Journalism**				
		TOTAL	**24**	**470**	**230**	**700**

Semester II						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Core Course	MBOT201	Bryophytes, Pteridophytes and Gymnosperms	4	70	30	100
	MBOT202	Evolution, Taxonomy & Morphology of Angiosperms	4	70	30	100
	MBOT203	Plant Biochemistry and Biotechnology	4	70	30	100
	MBOT204	Ecology & Biodiversity Conservation	4	70	30	100
	MBOT201-P	**Practicals**- Bryophytes, Pteridophytes and Gymnosperms	1	30	20	50
	MBOT202-P	**Practicals**- Evolution, Taxonomy & Morphology of Angiosperms	1	30	20	50
	MBOT203-P	**Practicals**- Plant Biochemistry and Biotechnology	1	30	20	50
	MBOT204-P	**Practicals**- Ecology & Biodiversity Conservation	1	30	20	50
		Choose Any One MBOT205A/ MBOT205B	4	70	30	100
GE-2	MBOT205A	**Entrepreneurship**				
	MBOT205B	**Intellectual Property Rights**				
		TOTAL	**24**	**470**	**230**	**700**

Semester III						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Core Course	MBOT301	Anatomy, Development, Reproduction and Embryology of Angiosperms	4	70	30	100
	MBOT302	Plant Physiology & Metabolism	4	70	30	100
DSE-1 Course		**Choose Any One MBOT303A/ MBOT303B**	4	70	30	100
	MBOT303A	Plant Pathology				
	MBOT303B	Cytogenetics and Plant Breeding				
		Choose Any One MBOT304A/ MBOT304B	4	70	30	100
	MBOT304A	Herbal Medicine				
	MBOT304B	Applied Microbiology				
	MBOT301-P	**Practicals**- Anatomy, Development, Reproduction and Embryology of Angiosperms	1	30	20	50
	MBOT302-P	**Practicals**- Plant Physiology & Metabolism	1	30	20	50
		Practical Choose Any One MBOT303A(P)/ MBOT303B(P)	1	30	20	50
	MBOT303A-P	**Practicals**-Plant Pathology				
	MBOT303B-P	**Practicals**-Cytogenetics and Plant Breeding				
		Practical Choose Any One MBOT303A(P)/ MBOT303B(P)	1	30	20	50
	MBOT304A-P	**Practicals**- Herbal Medicine				
	MBOT304B-P	**Practicals**- Applied Microbiology				
		TOTAL	**20**	**400**	**200**	**600**

Semester IV						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Core Course	MBOT401	Plant, Cell, Organ & Tissue Culture	4	70	30	100
DSE-2 Course		**Choose Any One MBOT402A/ MBOT402B**	4	70	30	100
	MBOT402A	Biochemical, Molecular Techniques and Bioinformatics				
	MBOT402B	Plant resource utilization and Ethnobotany				
	MBOT401-P	**Practicals**- Plant, Cell, Organ & Tissue Culture	1	30	20	50
		Practical Choose Any One MBOT402A(P)/ MBOT402B(P)	1	30	20	50
	MBOT402A-P	**Practical-**Biochemical, Molecular Techniques and Bioinformatics				
	MBOT402B-P	**Practical-**Plant resource utilization and Ethnobotany				
	MBOT403P	Project Work/Dissertation (Seminar+ Viva Voce)	10	200	100	300
		TOTAL	**20**	**400**	**200**	**600**

***Project Dissertation 75**
***Presentation 50**
***Viva Voce 50**
***Scientific Paper 25**

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Core Course I: Phycology	**Internal Marks: 30**
Paper Code: MBOT101	**No. of Hours: 60hrs**
Course Objective: The objective of this course is to make students up to date level of understanding of Phycology. The content in Phycology provides information on the overview of algae, their recent taxonomic status and economic significance as well.	**Total Credit: 4 Credit**

Course Outcomes: After completion of these courses students will be able to understand-

CO-I: A brief account on Algae classification, occurrence, habit, cell structure and reproduction .

CO-II. Study of Xanthophyta, Bacillariophyta, Dinophyta. Chlorophyta by their representative genera.

CO-III: Know the systematics, morphology and structure of algal species like their occurrence, habit, cell structure and reproduction

CO-IV: Know economic importance of Algae.

CO-V: Know Maintenance and preservation of algal cultures. Mass cultivation of microalgae and macroalgae.

UNIT I	**12 hrs**
Algae and their position in "Domains and Kingdoms" System, Trends in classification of	
algae.Cyanophyta: Ultrastructure; strategy of cell division; thallus organization, heterocyst. Detailed account of occurrence, habit, cell structure and reproduction of *Oscillatoria*, *Nostoc*, *Scytonema*, *Gleotricha*.	
UNIT II	**12 hrs**
Brief introduction, structural and reproductive features of, Xanthophyta, Bacillariophyta, Dinophyta. Chlorophyta – structure and evolution of thallus, unicellular eukaryotes (endosymbiotic theory). Detailed account of occurrence, habit, cell structure and reproduction of *Chlamydomonas*, *Volvox*, *Ulothrix*, *Oedogonium*, *Spirogyra*, *Vaucheria.*	
UNIT III	**12 hrs**
Charophyta and Euglenophyta: structure and reproduction and interrelationship.	
Detailed account of occurrence, habit, cell structure and reproduction of *Chara*, *Euglena*.	
UNIT IV	**12hrs**
Phaeophyta: general account of morphology, anatomy, reproduction and life histories.	
Rhodophyta: classification, thallus structure, reproduction, reproductive strategies and life	
histories. Detailed account of occurrence, habit, cell structure and reproduction of *Ectocarpus*, *Polysiphonia*.	
UNIT V	**12 hrs**
Algae in diverse habitats, symbiotic algae, algal blooms and Phycoviruses. Algae as food, biofertilizers and source of agar. Algae and water pollution, algal toxins. Method of isolation of algae from fresh water and marine ecosystems. Maintenance and preservation of algal cultures. Mass cultivation of microalgae and macroalgae.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNITNO.	COURSELEARNINGOUTCOME	TEACHING ANDLEARNINGACTIVITY	ASSESSMENTTASK
I	A brief account on Algae classification, occurrence, habit, cell structure and reproduction .	Discussion &Presentation/Lecture.	Evaluation of Students on the basis ofPresentation,Assignment Evaluation,Quiz.
II	Study of Xanthophyta, Bacillariophyta, Dinophyta. Chlorophyta by their representative genera.	ApplicationBasedlearning/Video , Lecture.	Evaluation of Studentson the basis ofApplication-BasedActivity,Evaluation,Assignment,Classtest.
III	Know the systematics, morphology and structure of algal species like their occurrence, habit, cell structure and reproduction	Presentation/Video.	Quiz,Assignment, seminar.
IV	Know economic importance of Algae.	Presentation/Video/ResearchStudy	Evaluation of Studentsbased on ResearchStudyPresentation,Assignment Evaluation,Classtest.
V	Know Maintenance and preservation of algal cultures. Mass cultivation of microalgae and macroalgae.	Lecturing / ResearchStudy/video	Evaluation of Studentsbased on ResearchStudyPresentation,Assignment Evaluation,Classtest.

Suggested Readings/ Books

1. Kumar H.D. (1988) Introductory Phycology. Affiliated East –West press Ltd. New Delhi.
2. Smith G.M. Cryptogamic Botany Vol (2 nd edition) Tata Mcgraw – Hill publishing Ltd Bombay – New Delhi
3. Lee, RE (2008) Phycology. Oxford University Press.
4. Fritsch, FE (1965) The Structures and Reproduction of Algae. Cambridge University Press
5. Kumar HD and Singh HN (1979) A textbook of Algae. McMillan Publishers Ltd.
6. Awasthi AK (2015) Textbook of Algae. Vikas Publishing House Pvt Ltd. New Delhi.
7. Sambamurthy AVSS (2005) A textbook of Algae. IK International,
8. Bellinger, EG and Sigee, DC (2010) Freshwater Algae- Identification and use as bioindicators. Wiley Publishers.

Phycology Lab (MBOT101-P) Practicals

Lab Objective: Microscopic observation and identification of algae.

1. To identify the given algae of Cyanophyceae family.
2. To identify and write characteristics of the given algae –

i) Chlamydomonas
ii) Volvox,
iii) Chlorella

3. To identify and write characteristics of the given algae-

i) Ulva
ii) Zygnema

4. To identify and write characteristics of the given algae

i) Chara
ii) Spirogyra

5. To identify and write characteristics of the given algae –

i) Ectocarpus
ii) Sargassum

6. To identify and write characteristics of the given algae –

i) Porphyra
ii) Batrachospermum
iii) Polysiphonia

7. To prepare culture media for fresh water algae.
8. To isolate algae from soil samples.
9. Isolation of algae from water samples.
10. To study the algal diversity of nearby pond and river through field visit.

- **Lab Outcome:-**

✓ To understand general characters and classification of algae.
✓ Learn about the structure, pigmentation, food reserves and methods of reproduction of Algae

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Core Course II: Mycology	**Internal Marks: 30**
Paper Code: MBOT102	**No. of Hours: 60hrs**
Course Objective: To provide a basic understanding of the biology, taxonomy and phylogeny of fungi. Locate and evaluate sources of scientific information on fungi and fungal-like organisms.	**Total Credit: 4 Credit**

Course Outcomes: After completion of these courses students will be able to understand-
CO-I: To provide a basic understanding of the biology, taxonomy and phylogeny of fungi..
CO-II: Study of classification, biology and general characteristics and reproduction of Myxomycotaand Oomycota.
CO-III: To understand life cycle of Saccharomyces, Aspergillus, Neurospora, Peziza. .
CO-IV: Know the Life cycle of Agaricus, Ustilago, Puccinia.
CO-V: know the methods of Preservation and maintenance of living fungi.

UNIT I	**12 hrs**
Conventional and Modern (Phylogeny based) classification of Kingdom Fungi. General characters of True and Pseudo fungi. Substrate relationship in fungi: cell ultra structure, unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic and symbiotic), reproduction (vegetative, asexual, sexual), parasexuality, heterothallism.	
UNIT II	**14 hrs**
Myxomycota-Classification, biology and general characteristics and reproduction. Life cycle of *Chytriomyces*, *Coelomomyces*. Chytridiomycota- Classification, biology, general characteristics and reproduction. Generalized life cycle of a slime mould. Oomycota- Classification, biology, general characteristics and reproduction. Life cycle of *Pythium* and *Phytophthora*.	
UNIT III	**12hrs**
Zygomycota- Classification, biology, general characteristics and reproduction. Life cycle of *Mucor*, *Rhizopus*, *Entomopthora*, Ascomycota-Classification, biology, general characteristics and reproduction. Life cycle of *Saccharomyces*, *Aspergillus*, *Neurospora*, *Peziza*.	
UNIT IV	**10 hrs**
Basidiomycota- Classification, biology, general characteristics and reproduction. Life cycle of *Agaricus*, *Ustilago*, *Puccinia*.	
UNIT V	**12hrs**
Anamorphic fungi- Classification, Conidium ontogeny, types of conidiomata.	
Economic importance of fungi (food, medicine, plant, human and animal disease), Methods of isolation of fungi from different habitats. Preservation and maintenance of living fungi.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	To provide a basic understanding of the biology, taxonomy and phylogeny of fungi.	Discussion &Presentation/Lecture.	Evaluation of Studentson the basis ofPresentation,Assignment Evaluation,Quiz.
II	Study of classification, biology and general characteristics and reproduction of Myxomycotaand Oomycota.	Application Based learning/Video , Lecture.	Evaluation of Studentson the basis ofApplication-BasedActivity, Evaluation,Assignment,Class test.
III	To understand life cycle of Saccharomyces, Aspergillus, Neurospora, Peziza. .	Presentation/Video.	Quiz,Assignment, seminar.
IV	Know the Life cycle of Agaricus, Ustilago, Puccinia.	Presentation/Video/ Research Study	Evaluation of Studentsbased on ResearchStudyPresentation,Assignment Evaluation,Classtest.
V	Know the methods of Preservation and maintenance of living fungi.	Lecturing / ResearchStudy/video	Evaluation of Studentsbased on ResearchStudyPresentation,Assignment Evaluation,Classtest.

Suggested Readings/ Books

1. Alexopoulus , C. J. Mims , C.W. and Blackwel, M. 1996 Introductory Mycology, John Wjley& Sons Inc.
2. Mehrotra. RS. And Aneja, RS. (1998) An Introduction to Mycology. New Age Intermediate Press.
3. Webster, J and Weber R (2007) Introduction to Fungi (3rd Ed), Cambridge University Press.
4. Kendrick WB. The Fifth kingdom, Mycologue Publication, Canada.
5. Dube HC (2012) Introduction to Fungi (4thed) Vikas*Publishing* House Pvt Limited.
6. Sharma OP (1989) Textbook of Fungi. McGraw Hill Publication.
7. Vashishta, BR. Sinha AK and Kumar A (2016) Botany for Degree students-FUNGI. S Chand Publishing.

Mycology Lab (MBOT102P)

Practicals

Lab Objective: Microscopic observation and identification of fungi.

1. Preparation of PDA media for culture of fungi.
2. To isolate fungi from soil using spread plate technique.
3. Isolation and identification of fungi from air.
4. To calculate the CFU of fungi present in a soil sample.
5. To isolate keratinophilic fungi from soil using hair baiting technique.
6. To raise pure culture from a mushroom fruit body (Agaricusbisporus)
7. To study different fungi colonizing bread.
8. To isolate yeasts from rotten fruits and vegetables.
9. To isolate and identify fungi from infected fruit or vegetable.
10. To isolate DNA from a fungal colony.

Lab Outcomes:-

- ✓ To understand general characters and classification of fungi.
- ✓ Learn about the isolation and identification of fungi from different habitat.

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Core Course III: General Microbiology	**Internal Marks: 30**
Paper Code: MBOT103	**No. of Hours: 60hrs**
Course Objective: -This course aims to increase the understanding of the students about the diversity of microoganisms, their classification, structure and growth.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: The students will increase the understanding the diversity of microoganisms, their classification, structure and growth **.**

CO-II: Understand classification, general account of Actinobacteria, Mycoplasma and Rhizobium .

CO-III: Know how viruses are classified and their structure.

CO-IV: Understand genetics of bacteria.

CO-V: Scope, importance of Industrial Microbiology.

UNIT I	**12 hrs**
Introduction to Microbiology, history of microbiology Germ theory of Louis Pasteur and Koch postulates. Microbial diversity- present status and future prospects. Three domains of life. General account of Archea.	
UNIT II	**12 hrs**
Eubacteria-classification, general account of Actinobacteria, Mycoplasma, Rickettsiae, Chlamydiae and their significance. Nitrogen fixation by microorganisms, *Rhizobium*-legume symbiosis and mycorrhiza. Anoxygenic photosynthesis with special reference to light reaction in purple bacteria; methanogenesis.	
UNIT III	**12 hrs**
Viruses- classification, general properties (viral genome, hosts), structure of viruses. General features of viral replication. Overview of bacterial, animal and plant viruses. Retroviruses.	
UNIT IV	**12 hrs**
Genetics of bacteria: genetic recombination, mechanism of transformation, conjugation and transduction in bacteria. Role of microorganisms in genetic engineering. Lytic cycle of T even bacteriophages and its regulation, lysogeny and its regulation in lambda phage; brief account of viroids and prions.	
UNIT V	**12 hrs**
Industrial microbiology-antibiotics production, vitamin and amino acids, enzymes from microbes. Fermentation process and its application in alcohol production.	
Water-borne pathogenic microbes; role of microbes in wastewater treatment with special reference to activated sludge. Basic design of a fermentor; biosensors; bioremediation of hydrocarbon and metal polluted waters.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	The students will increase the understanding the diversity of microoganisms, their classification, structure and growth	Discussion &Presentation/Lecture.	Evaluation of Studentson the basis ofPresentation,Assignment Evaluation,Quiz.
II	Understand classification, general account of Actinobacteria, Mycoplasma and Rhizobium .	Application Based learning/Video , Lecture.	Evaluation of Student son the basis ofApplication-BasedActivity, Evaluation,Assignment,Class test.
III	Know how viruses are classified and their structure.	Presentation/Video.	Quiz,Assignment, Class test.seminar.
IV	Understand genetics of bacteria.	Presentation/Video/ Research Study	Evaluation of Studentsbased on ResearchStudy Presentation,Assignment Evaluation,Classtest.
V	Scope, importance of Industrial Microbiology.	Lecturing / Research Study/video	Evaluation of Studentsbased on Research Study Presentation,Assignment Evaluation,Classtest.

Suggested Readings/ Books

1. Madigan MT and Martino JM (2006) Brock Biology of Microorganisms (11th ed) Pearson Prentice Hall Publication.
2. Peclzar MJ, Chan, ECS, Krieg, NR (1993) Microbiology. Tata Mc Graw Hill.
3. Clifton, A (1958) Introduction to Bacteria. McGraw – Hills Book Co. New Delhi.
4. Caseda LE (2019) Industrial Microbiology. New Age International Publishers.
5. Singleton, P. Bacteriology (6th ed). Wiley Publication.
6. Sukesh K, Joe MM, Sivakumar PK (2010) An Introduction to Industrial Microbiology. S Chand Publishing.
7. Stanier RY, Ingrahm JL, WHeelis ML, Painter PR () General Microbiology. McMillan
8. Schlegel HG (1993) General Microbiology. Cambridge University Press
9. PowarDaginawala (2015) General Microbiology Vol I &II. Himalaya Publishing.
10. Sullia SB and Shantharam S (2017) General Microbiology. Oxford and IBH Publishing.

General Microbiology Lab (MBOT103P)

Practicals

Lab Objective: Microscopic observation and identification of microorganism.

1. To prepare various medium (NA, SDA, PDA) for growth of microbes.
2. To isolate bacteria from various soil samples.
3. To isolate & purify microorganism by pure culture techniques.
4. To isolate actinobacteria from soil.
5. To test the effect of different antibiotics on growth of bacteria.
6. To study amylase production by bacteria/ fungi using starch medium.
7. To isolate bacteria from waste water sample.
8. To perform gram staining of bacteria.
9. To perform CFU count in a given soil sample.
10. To isolate Rhizobium from root nodules of gram or pea.

Lab Outcomes:-

- ✓ To understand general characters and classification of bacteria, viruses, fungi, mycoplasma and actinomycetes..
- ✓ Learn about the technique of microbial culture.
- ✓ Develop theoretical and technical skills of basic microbiology (sterilize, isolate, culture, preserve microbes).

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Core Course IV: Cell and Molecular Biology	**Internal Marks: 30**
Paper Code: MBOT104	**No. of Hours: 60hrs**
Course Objective: To provide an overview of **cell** structure and function at the **molecular** level, Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I: Gain knowledge about cell and its function.
CO-II: Understand ultra structure of cell wall, plasma membrane and cell organelles.
CO-III: Study of Structure and function of Nucleus and nucleic acid.
CO-IV: Understand Cell cycle and Apoptosis .
CO-V: Know about the DNA/gene manipulating enzymes

UNIT-I	**12hrs**
The dynamic cells, Structural organization of plant cell, specialized plant cell types chemical foundation. Cell wall- Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps, receptors. Plasmodesmata and its role in movement of molecule.	
UNIT-II	**12hrs**
Chloroplast-structure and function, genome organization, gene expression, RNA editing, Mitochondria; structure, genome organization, biogenesis. Plant Vacuole - Tonoplast membrane, ATPases transporters as a storage organelle. Structure and function of other cell organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies.	
UNIT-III	**12 hrs**
Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome- Structure and functional significance. RNA and DNA Structure. A, B and Z Forms. Replication, transcription, translation in prokaryotes and eukaryotes. DNA damage and repair (Thymine dimer, photoreactivation, excision repair).	
UNIT-IV	**12 hrs**
Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.	
UNIT-V	**12 hrs**
DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase. Gene cloning: cloning vectors, molecular cloning and DNA libraries. Molecular genetic elements, insertion elements, transposons.	

Suggested Readings/ Books

1. Karp, G, Iwasa J, Marshall W. (2016) Karp's Cell and Molecular Biology (8th ed), Wiley
2. Watson JD. (2017) Molecular Biology of Gene. Pearson
3. Krebs JE, Goldstein ES, Kilpatrick, ST (2014) Lewin's Gene XI. John and Bartlett Learning.
4. Robertis EDP, Robertis EMF. (2011) Cell and Molceular Biology (8th ed). Lippincott.
5. Freifelder D (2004) Molecular Biology. Narosa Publishing
6. Verma PS, Agarwal VK (2010) Molecular Biology, S Chand Publisher
7. Kumar HD Molecular Biology (2nd ed), Vikas Publishing House Ltd.
8. Campbell NA and Reece JB (2008) Biology (8th ed), Pearson Publication

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Gain knowledge about cell and its function.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand ultra structure of cell wall, plasma membrane and cell organelles.	Application Based learning/Video , Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Study of Structure and function of Nucleus and nucleic acid.	Presentation/Video.	Quiz,Assignment, Class test.seminar.
IV	Understand Cell cycle and Apoptosis .	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Classtest.
V	Know about the DNA/gene manipulating enzymes	Lecturing / ResearchStudy/video	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Classtest.

Cell and Molecular Biology Lab (MBOT104P) Practical

Lab Objective:To understand cell division (Mitosis and Meiosis), cell cyle etc. Training students to prepare micropreparation and showing the stages of mitosis Onion root tips) and showing permanent slides/photographs of mitosis and meiosis.

1. Identification of different stages of mitosis from suitable plant material. (Onion root tips, garlic root tips).
2. Identification of meiosis from suitable plant material. (Onion /Tradeschantia floral buds).
3.Isolation of Mitochondria from plant material.
4.Isolation of cell organelles Chloroplast and Nucleus from different plant material, and there assay by succinate dehydrogenase activity (Mitochondria)acetocarmine staining (Nucleus) and microscopic observation (Chloroplast).
5.Study of mitotic index from suitable plant material.
6. Study of cyclosis in cells of suitable plant material.
7. To study plant vacuole in cells of onion leaf peel.
8.To study the structure and organization of cell in various tissues of various plants root.
9. To study the structure and organization of cell in various tissues of various plants stem.

Lab Outcome:-

- ✓ The eukaryotic cell cycle and mitotic and meiotic cell division
- ✓ Structure and organization of cell membrane

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Elective Course V **Research Methodology**	**Internal Marks: 30**
Paper Code: MBOT105 (A)	**No. of Hours: 60hrs**
Course Objective: To familiarize Students with basic of research and the research process. To enable the participants in conducting research work and formulating research synopsis and report. To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.

CO-II: Have basic knowledge on qualitative research techniques

CO-III:. Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis

CO-IV: Have basic awareness of data analysis-and hypothesis testing procedures

CO-V: Undestand about research tools.

Unit I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit II

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance , Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit III

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit V

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Learning Outcomes:

1. Students will understand a general definition of research design.
2. Students will know why educational research is undertaken, and the audiences that profit from research studies.
3. Students will be able to identify the overall process of designing a research study from its inception to its report.
4. Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research

Assessment Tools:

Written examinations, Case study discussions, Viva examinations.

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

MSc (BOTANY)	Total Marks: 100
Semester : I	**External Marks: 70**
Elective Course V **Science Journalism**	**Internal Marks: 30**
Paper Code: MBOT105 (B)	**No. of Hours: 60hrs**
Objectives Students will learn the mechanics of science writing, including research, sourcing, and generating story ideas; interviewing, note-taking, and organization; fact-checking, editing, writing for story, structure, and formatting. Students will practice writing for multiple public, academic, and professional audiences and contexts using writing strategies, conventions, genres, technologies, and formats to communicate effectively.	**Total Credit: 4 Credit**

UNIT 1 Science communication at the end of the Enlightenment and the importance of notions of the public in the origin of modern science - development of new audiences for science in the Nineteenth century and the emergence of new science communication media (e.g. mechanics' institutes, science journalism, public museums and zoos) - advent of the figure of the scientist as public expert and the debate about 'Two Cultures' – difference between science journalism and science communication

UNIT 2 Introduction of Western science in India through missionaries, travelers, army and civilian army of the East India Company– science in the 18th and 19th century –emergence of Indian pioneer scientists – science teaching–- developments during post-Independence period – emerging areas of science and technology – convergence in study of science

UNIT 3 Institutions of science in India - the role of the Asiatic Society – Bose Institute – Indian Institute of Science - Council of Scientific and Industrial Research (CSIR) – Indian Space Research Organization (ISRO) – Indian Science Congress organizations for popularization of science – NCSTC and Vigyan Prasar – noted science societies at state level – Science and Technology Academies – awards for science communication and popularization.

UNIT 4 The boom in new media during the twentieth century and their impact on science journalism - role of a science page editor – popular science magazines in the west – science magazines in India – the ideal science reporter - scope of science journalism on radio & television in developing countries – science serials on radio and television – Bharat ki Chaap on Doordarshan – Science serials on All India Radio - tech news - understanding present market trends.

UNIT 5 Science as an essential element in political, corporate and community news – major issues in science journalism – environmental pollution – genetically modified crops – research for disease prevention and eradication – nuclear power – disaster mitigation – scientific knowledge for

effective governance – the North-South divide in science research and scientific development.

Learning Outcomes

- They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work (pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building).
- Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and critique those data, extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

Reference Book:

1. Mass Communication: A Critical analysis, Keval J Kumar
2. Professional Journalism, M V Kamat
3. Theory and Practice of Journalism, B N Ahuja
4. Professional Journalist, John Hohenberg
5. Understanding Media, Marshall McLuhan 6. Journalism in India,Nadig Krishnamurthy, Mysore University Press
6. Barbara Gastel, Presenting Science to the Public.
7. Blum, Deborah, Knudson, Mary & Marantz Henig, Robin. A Field Guide for Science Writers: The Official Guide of the National Association of Science Writers. (2005)
8. D. Perlman, Science and the Mass Media.
9. Elise Hancock, Ideas into Words: Mastering the Craft of Science Writing. Baltimore and London: Johns Hopkins, 2003.
10. N Corcoran (Ed.). Communicating health: strategies for health promotion. Sage. (2013).
11. O.P. Jaggi, A Concise History of Science including Science in India.
12. R. Sundara, Popular Science in Mass Media.
13. Renata Schiavo, Health Communication: From Theory to Practice. John Wiley & Sons. 2013
14. Sharon, M. Friedman, Sharon, Woody, Carlol, L. Rogers (Ed) : Scientists and Journalists, Reporting Science as News.
15. Warren Burkett, News Reporting : Science Medicine and High Technology

SEMESTER II

MSc (BOTANY)	Total Marks: 100
Semester : II	**External Marks: 70**
Core Course I: Bryophytes, Pteridophytes and Gymnosperms	**Internal Marks: 30**
Paper Code: MBOT201	**No. of Hours: 60hrs**
Course Objective: To study general characteristics, classification, trends in classification, phylogeny and inter-relationships of Bryophyta, Pteridophyta and Gymnosperms	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: Study of morphology, structure, reproduction and life history of Bryophytes.
CO-II: Understand morphology, structure, reproduction and life history of Pteridophytes .
CO-III: Understand the morphology, structure, reproduction and life history of Gymnosperms
CO-IV: Know about the structure, life history and Economic importance of Gymnosperms.
CO-V: Classification and interrelationships between order of gymnosperms.

UNIT I	**12hrs**
Morphology, structure, reproduction and life history of Bryophytes. Classification of Bryophytes; General account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Life cycle of *Riccia*, *Marchantia*, *Anthoceros*, *Polytrichum*.	
UNIT II	**12 hrs**
Morphology, structure, reproduction and life history of Pteridophytes. Classification of Pteridophytes; Evolution of vascular system, heterospory and origin of seed habit. General account of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Life cycle of *Selaginella*, *Equisetum*, *Pteris*	
UNIT III	**12 hrs**
Morphology, structure, reproduction and life history of Gymnosperms. Classification of Gymnosperms (Morphology & Phylogeny based). Biogeography of Gymnosperms and their distribution in India. General account of Pteridospermales, Cycadeoidales and Cordaitales. Structure and reproduction of Cycadales. Life cycle of *Cycas*	
UNIT IV	**12Hrs**
Structure and reproduction of Ginkgoales. Life cycle of *Ginkgobiloba*. Structure and reproduction of Welwitschiales, Gnetales and Ephedrales. Life cycle of *Ephedra* and *Gnetum*.	
UNIT V	**12Hrs**
Structure and reproduction of Pinales, Araucariales, Cupressales. Life cycle of *Pinus*, *Taxus*.	
Affinity of Gymnosperms with Pteridophytes and Angiosperms. Brief account of Fossil records of Gymnosperms in terms of geological time scale. Economic importance of Gymnosperms.	

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Study of morphology, structure, reproduction and life history of Bryophytes.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand morphology, structure, reproduction and life history of Pteridophytes .	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand the morphology, structure, reproduction and life history of Gymnosperms	Presentation/Animated Video lecture.	Quiz,Assignment, Class test.seminar.
IV	Know about the structure, life history and Economic importance of Gymnosperms.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Classification and interrelationships between order of gymnosperms.	Lecturing / ResearchStudy/video	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Classtest.

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

Suggested Readings/ Books

1. Vanderpoorten A Goffinet B (2002) Introduction to Bryophytes. Cambridge University Press
2. Malcolm B () Mosses and other bryophytes-An
3. Goffinet B (2010) Bryophyte Biology (2nd ed), Cambridge University Press.
4. Watson EV (2015) The Structure and life of Bryophytes Scientific Publisher.
5. Goffinet B, Hollowell V, and Magill R (2004) Molecular Systematics of Bryophytes. Missouri Botanical Garden Press, St Louis
6. Sharma OP (2006) Pteridophyta MacMillan India Ltd.
7. Do N. Dai, Tran D. Thang et al. (2016) Bryophytes Pteridophytes and Gymnosperms. Intelliz Press
8. Johri RM, Lata S and Sharma S (2012) Textbook of Pteridophyta (2nd ed) Vedam eBooks P Ltd New Delhi
9. Johri BM and Biswas C () The Gymnosperms. Narosa Publishing, New Delhi

10. Byng JW (2015) The Gymnosperm Handbook. Plant Gateway Ltd.
11. Bhatnagar SP and Moitra A (1996) Gymnosperms. New Age International Publisher

Bryophytes, Pteridophytes and Gymnosperms Lab (MBOT201P)

Practical

Lab Objective: Microscopic study of Bryophytes, Pteridophytes and Gymnosperms through specimens and permanent Slides.

1. To study the permanent slide of thallus structure of Riccia and Marchantia .
2. To study the permanent slide of Polytichum and draw well labelled diagram.
3. To study the preserved specimen of Selaginella and Equisetum and draw its diagram.
4. To study the permanent slide of stem of Selaginella.
5. To study the permanent slide of strobilus of Selaginella.
6. To study the permanent slide of strobilus of Equisetum.
7. To study the permanent slide of Equisetum stem.
8. To prepare hand sections of Pinus needle and draw labelled diagram of internal structure with the help of permanent slide.
9. To prepare hand sections of Cycas leaflet and draw labelled diagram of internal structure with the help of permanent slide.
10. To study the given permanent slides of Pinus male and female cone.
11. To study the given permanent slide of male and female strobilus of Ephedra.

Lab Outcome:-

- ✓ To get knowledge about classification, mode of reproduction and detailed study of some important bryophytes.
- ✓ To impart knowledge to general characters, classification and stelar evolution of pteridophytes.
- ✓ Know about the structure, life history and Economic importance of Gymnosperms.

MSc (BOTANY)	Total Marks: 100
Semester : II	**External Marks: 70**
Core Course II: Evolution, Taxonomy and Morphology of Angiosperms	**Internal Marks: 60**
Paper Code: MBOT202	**No. of Hours: 50hrs**
Course Objective: The ultimate aim of taxonomy is to understand the evolution at work. Angiosperms being the dominant as well as most evolved plant group, the sources of characters for taxonomy are also varied. It is also being practiced at various levels, from morphology to phylogenomics. This course aims to give comprehensive understanding in angiosperm taxonomy as well as its practice and application	**Total Credit: 4 Credit**

Course Learning outcomes: After completion of these courses students will be able to understand-

CO-I: Deals with naming and classification of plants their interrelationships and evolution.
CO-II: Highlights the strategies adopted by flowering plants for their reproduction.
CO-III: Deals with recent developments in plant systematic and phylogenetics.
CO-IV: Know the techniques of herbaria preparation.
CO-V: know the methods of morphological characterization of different families and field collection and documentation

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Deals with naming and classification of plants their interrelationships and evolution.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Highlights the strategies adopted by flowering plants for their reproduction.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Deals with recent developments in plant systematic and phylogenetics.	Presentation/Animated Video lecture.	Quiz,Assignment, Class test.seminar.
IV	Know the techniques of herbaria preparation.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Know the methods of morphological characterization of different families and field collection and documentation	Lecturing / Research Study/video lecture/field study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Classtest.

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

Suggested Readings/ Books

1. Simpson MJ. (2019) Plant Systematics. Academic Press.
2. Soltis et al. (2018) Phylogeny and evolution of Angiosperms. University of Chicago Press.
3. Briggs D. (2016) Plant Variation and Evolution. Cambridge University Press.
4. Bhatnagar S.P. and Moitra A. 1996 Gymnosperms. New Age International Pvt New Delhi.
5. Singh H. 1978 Embryology of Gymnoosperms , Encyclopedia of Plant Anatomy X GebruderBortraeger Berlin.
6. Spome K. R. 1991 : The Morphology of Gymnospwems; Hutchinson Univ. Library ,London .
7. Foster A.S. & Gifford E.M. Comparative morphology of vascular plants Vakilsfeffer&simons private Ltd. Bomay .
8. Chamberlain; Gymnosperms- Structure & Evolution CBS publishers & Distributors Delhi.
9. Shukla A.C. & Mishra S.P. Essentials of PaleobotanyVikas Publishing House Ptd. Delhi Bombay – 6 angalore – Calcutta – Kanpur.
10. Heywood & Moore, D.M. : 1984 : CWTent concept in plant Taxonomy Academic press.
11. Banson L.B. 1957: Plant classification . Health & Co. Boston.
12. Davis, P. R. &Heywood . V.H. 1973 : Principles of Angiosperms and Taxonomy , Robert E. Kreiger pub. Co. New York USA.
13. Eames , Al 1961: Morphology of Angiosperms , Mc- Graw Hill, New York.
14. Jeffery. C. ; 1968: An Introducaton to plant Taxonomy J & H Churchill Limited.
15. Lawrence , G. H. M. ; 1951 Taxonomy of Cascular plants Macmillan , New York.
16. Naik . V. K. 1984: Taxonomy of Angiosperms. Tata Mc – Graw Hill Pub. Co. Ltd. New Delhi.

Evolution, Taxonomy and Morphology of Angiosperms Lab
(MBOT202-P)

Practical

Lab Objective:Identification of Angiospermic plant by making herbarium.

1. Methods of non-destructive field collection and documentation.
2. Techniques of herbaria preparation.
3. Morphological characterization of selected families of dicots (10 families) and monocots (5 families) and identification upto families.
4. Preparation of artificial key (at least five) based on appropriate character combination.
5. Identification of genus and species from – (at least ten) Monocots and Dicots.
6. Identification of given plant (at least six) up to species with the help of modern flora keys.
7. To study different types of leaves in plants available in Raipur.
8. To study different types of leaf arrangement in plants available in Raipur.
9. To study different types of fruits.
10. To study pollen morphology of different species of plants of University campus.
11. To visit any botanical garden situated in India, CSIR Lab Visit,

Lab Outcome:-

- ✓ Understand diverse varieties of plant.
- ✓ Students able to draw floral diagram and learned about taxonomic terminologies.
- ✓ Aware various plant families and able to identify plant and its economic importance
- ✓ Get knowledge on structure and development plant embryo.

MSc (BOTANY)	Total Marks: 100
Semester : II	External Marks: 70
Core Course III: Plant Biochemistry and Biotechnology	Internal Marks: 30
Paper Code: MBOT203	No. of Hours: 60hrs
Course Objective: The goal of this course is to introduce Plant Biochemistry and Biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes. To acquaint students with concepts in Enzymology	Total Credit: 4 Credit
Course Learning outcomes: After completion of these courses students will be able to understand- **CO-I:** Understand Energetics of metabolic processes. **CO-II:**Describe the mechanism of enzyme action and identify the classes of enzymes and factors affecting action. **CO-III:**Identify the class and functions of secondary metabolites **CO-IV**: Understand Inorganic nitrogen and sulphur metabolism. **CO-V:** Understand the application of Biotechnology.	

UNIT I	**12 hrs**
Energetics of metabolic processes: Energy rich phosphate compounds, electron transport and	
phosphorylation, β-oxidation of lipids, Biological nitrogen fixation: Nitrogenase enzyme, substrates for nitrogenase, reaction mechanism, strategies to exclude oxygen and need to control hydrogen evolution	
UNIT II	**12 hrs**
Enzymology: General aspects, prosthetic groups and coenzymes, mechanism of catalysis, kinetics, Michaelis-Menten equation, bi-substrate reactions, active sites, factors contributing to the catalytic efficiency, enzyme inhibition, regulatory enzymes, ribozymes	
UNIT III	**12hrs**
Phytochrome and cryptochrome mediated plant responses, Phototropins . Introduction	
Classification and Biosynthesis of Tarpene, Alkaloid, Non Protein Amino Acid, Plant Phenolics, Flavonoids, Tannins, Lignin	
UNIT IV	**12hrs**
Inorganic nitrogen and sulphur metabolism: Introduction, nitrate transport, nitrate and nitrite reductase, inhibitors of nitrate and nitrite reductases, localization and regulation of nitrate and nitrite reductases, sulphate uptake, activation and transfer, assimilatory pathways of sulphate reduction	
UNIT V	**12 hrs**
Biotechnology: PCR and its applications; principles of DNA sequencing, recombinant DNA technology: Gene transfer. Vectors of plant transformation. Genetic manipulation for pest resistance, improvement of crop yield and quality. Biocontrol of insect pests using microbes. GM crops-development, merits and demerits and public acceptance. Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS, SCARS, AFLP etc.).Applications of Plant Biotechnology	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand Energetics of metabolic processes.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Describe the mechanism of enzyme action and identify the classes of enzymes and factors affecting action.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Identify the class and functions of secondary metabolites	Presentation/Animated Video lecture.	Quiz,Assignment, Class test.seminar.
IV	Understand Inorganic nitrogen and sulphur metabolism.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand the application of Biotechnology	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Classtest.

Suggested Readings/ Books

1. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.Molecular cell Biology (fourth edition). W.H. ,Freeman and Company, New York USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.
3. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
4. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
5. Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.Molecular cell Biology (fourth edition). W.H. ,Freeman and Company, New York

USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
9. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
10. Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
11. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida
12. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford
13. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.

Plant Biochemistry and Biotechnology Lab
(MBOT203P)

Lab Objective:The course aims to develop skills of performing basic biochemical tests.

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effect of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. Separation of chloroplast pigments by solvent method.
5. Determining the osmotic potential of vacuolar sap by plasmolytic method.
6. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
7. Protein estimation in a given sample
8. Carbohydrate estimation
9. Nitrogenase activity.
10. Acid and alkaline acid phosphatase activity.
11. Separation of amino acid through paper and column chromatography.
13. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer.

Lab Outcome:-

- ✓ Students able to perform biochemical tests.
- ✓ Separate plant pigments by column chromatography

MSc (BOTANY)	Total Marks: 100
Semester : II	External Marks: 70
Core Course IV: Ecology & Biodiversity Conservation	Internal Marks: 30
Paper Code: MBOT204	No. of Hours: 60hrs
Course Objective: The objective of this course is to provide a critical and conceptually sophisticated understanding of biodiversity science, and also acquaint the students with concepts of Globalization, Ecology and Environment	Total Credit: 4 Credit

Course Learning outcomes: After completion of these courses students will be able to understand-
CO-I: Know the biotic and abiotic components of ecosystem.
CO-II: Understand utilization and conservation of plant resources.
CO-III: Understand diversity among various groups of plant kingdom.
CO-IV: Understand plant community & ecological adaptation in plants.
CO-V: Scope , importance and management of biodiversity

UNIT I	12 hrs
The concept and scope of ecology	
Introduction, Plant interaction with abiotic factors such as climatic, edaphic and Topographic factors, Plant-plant interaction, concept of allelopathy Plant-animal interaction, herbivory, carnivorous plants ,Plant-microbes interaction: Mutualism, parasitism, Ecological modelling.	
UNIT II	**12 hrs**
Ecosystem ecology	
Organization of Ecosystem: biotic and abiotic components, Ecosystem types: Terrestrial, aquatic and artificial, Biomes of the world, Biomes of India – Case studies of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) ecosystems, Island biogeography.	
UNIT III	**12hrs**
Population and community ecology	
Habitat and niche, Characteristics of population: Distribution and size of the population, factors affecting population size, Ecological limits and the size of population, Life history strategies, r and k selection, C-S-R triangle, Concept of metapopulation, extinction events, population viability analysis	
Community structure and species diversity, Diversity types and levels (alpha, beta and gamma), ecotone and edge effect.	
UNIT IV	**10hrs**
Ecosystem dynamics	
Energy flow models and mineral cycling, Ecosystem productivity- primary and secondary production, Plant succession: seral communities, xeric, aquatic, concept of climax, secondary succession on disturbed land,Resistance and resilience of ecosystem, homeostasis and homeorhesis	
UNIT V	**14 hrs**
Pollution & climate change- Air water and soil pollution; kinds, sources,quality parameters. Effects on structure & function of ecosystems; Management of pollution, Bioremediation; Climate changes sources, Trends & role of greenhouse gases, Effect of global warming on climate, ecosystem processes and biodiversity. Ozone layer & Ozone hole. Resource monitoring- Remote sensing concepts & tools, satellite remote sensing, basics sensors, visual & digital interpretation EMR bands and their applications Indian remote sensing program (IRS); Thematic mapping of resources and application of remote sensing in ecology &	

forestry.

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Know the biotic and abiotic components of ecosystem.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand utilization and conservation of plant resources.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand diversity among various groups of plant kingdom.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Understand plant community & ecological adaptation in plants.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Scope , importance and management of biodiversity	Lecturing / Research Study/video lecture/Field study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Smith R.L. 1996; Ecology and Field Biology , Harper Collins New York.
2. Muller Dombois . D. and Ellenberg H. 1974 Aims and methods 01 Vegetation Ecology Wiley New York.
3. Begon M. Harper J. L. And Townsend C.R. 1996 . Ecology. Blackwell Science Cambridge ,Ludwig.J. and Reynolds J.F. 1988 Statistical Ecology John Wiley & Sons.
4. Odum E. P. 1971. Fundamentals of Ecology. Saunders Philadelphia.
5. Odum. E. P. 1983 . Basic Ecology Saunders Philadelphia.
6. Barbour M.G. Burk J.H. and pitts W.O. 1987 Terrestrial plant Ecology cummings publication company California.
7. Kormondy E.J. 1996 Concepts of Ecology ,Pentice Hall of India pvt Ltd. New Delhi .
8. Chapman J.L.and Reiss M.J. 1988 Ecology principles and Applications t::ambridge University press Cambridge U.K.
9. Moldan B. and Billharz S. 1997 . Sustainability Indicators John wiley& Sons New York.
10. Treshow M. 1985 Air pollution and plant fife wileyInterscience.
11. Heywood , V, H, and Watson R.T. 1995 Global Biodiversity Assessment. Cambridge

University Press.
12. Mason C.F. 1991 . Biology of freshwater pollution. Longman
13. Hill M.K. 1997 Understanding Environmental Pollution Cambridge University press.
14. Brady N.C. 1990 The Nature and Properties of Soils MacMillan.
15. Mohdan B. and Billharz S. 1997 Sustainbility Indicators John wiley& sons New Youk.
16. Treshow M. 1985 Air Pollution and plant Life Wiley Interscience.
17. Heywood V.H. and Watson R.T. 1995 Global Biodiversity Assessment Cambridge University press.
18. Mason C.F. 1991 Biology of freshwater pollution Longman.
19. Kothari A 1997 Understanding Biodiversity Life Sustainability and Wquity Orient Longmen.

Ecology & Biodiversity Conservation Lab
(MBOT204P)

Practical

Lab Objective: The course aims to learn the approaches to the study of Ecology and biodiversity conservation.

1. To determine the minimum area of quadrate for phytosociological analysis of grassland.
2. To determine frequency, density and abundance of different species in the grassland.
3. To determine frequency, density and abundance of different species in the grassland by quadrate method.
4. To determine minimum number of frequency, density and abundance of different species in the grassland Transect for sampling of grassland.
5. To compare community structure of different forest.
6. To determine the pH & Dissolve Oxygen of water sample.
7. To determine the tropic state of alkalinity/ salinity of water body.
8. To determine the pH of soil samples.
9. To calculate Simpson's indices of diversity of grassland vegetation.
10. To calculate Shannon-Wiener indices of diversity of grassland vegetation.
11. To determine water holding capacity of the soil.

Lab Outcome: - Students are able to -

- ✓ Understand the population & Community Ecology.
- ✓ Ecological field study-Quadrats and Line transect methods of vegetation study

MSc (BOTANY)	Total Marks: 100
Semester : II	**External Marks: 70**
Elective Course V (A) : Entrepreneurship	**Internal Marks: 30**
Paper Code: MBOT205 (A)	**No. of Hours: 60hrs**
Course Objective: The goals of this programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. They will be introduced to key traits and the DNA of an entrepreneur, and be given an opportunity to assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur. The programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

At the end of the course, the students will:

- Develop awareness about entrepreneurship and successful entrepreneurs.
- Develop an entrepreneurial mind-set by learning key skills such as design, personal selling, and communication.
- Understand the DNA of an entrepreneur and assess their strengths and weaknesses from an entrepreneurial perspective.

Unit I **Contact Hours: 12**

Entrepreneurship: Concept of Entrepreneur, Entrepreneurship and Manager, Difference between Entrepreneur and Entrepreneur, Entrepreneurship, Attributes and Characteristics of successful entrepreneurs. Functions of an Entrepreneurs Function of an Entrepreneur, Classification of Entrepreneurs, Role of Entrepreneur in Indian Economy, Developing Entrepreneurial culture, Factors influencing Entrepreneurship Growth – Economic, Non-Economic Factors, For profit or Not for profit entrepreneurs, Constraints for the Growth of Entrepreneurial Culture, Entrepreneurship as a career, Entrepreneurship as a style of management, Emerging Models of Corporate Entrepreneurship, India's start up revolution-Trends, Imperatives, benefits: the players involved in the ecosystem, Business Incubators-Rural Entrepreneurship, social entrepreneurship, women entrepreneurs, Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India.Case study on related topics.

Unit II **Contact Hours: 12**

Theories of entrepreneurship: Innovation Theory by Schumpeter & Imitating, Theory of High Achievement by McClelland, X-Efficiency Theory by Leibenstein, Theory of Profit by Knight, Theory of Social change by Everett Hagen.Case study on related topics.

Unit III **Contact Hours: 12**

Entrepreneurship development: Entrepreneurial Competencies, Developing competencies, concept of entrepreneurship development, Entrepreneur Training and developing, Role of Entrepreneur development Programs (EDP), Role of DIC, EDII, NIESBUD, NEDB, EDP – Objectives – contents – methods – execution, Mudra Yojna: Shishu, Kishore and Tarun Scheme. Role of Mentors. Innovation and Entrepreneurship, Design Thinking Process, Role of consultancy organizations in promoting Entrepreneurs, Problems and difficulties of Entrepreneurs – Marketing Finance, Human Resource, Production; Research – external problems, Mobility of Entrepreneurs,Entrepreneurial change, occupational mobility – factors in mobility.Case study on related topics.

Unit IV **Contact Hours: 12**

Role of Central government and State Government in promoting Entrepreneurship:Introduction to various incentives, subsidies and grants, Export Oriented Units, Fiscal and Tax concessions available, Women Entrepreneurs – Role, Problems and Prospects, Reasons for low women Entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework – Role of SSI Sector in the Economy – SSI Units – Failure, Causes and Preventive Measures – Turnaround Strategies. Future of Entrepreneurship Development and Government, Start Up India, Make in India.Case study on related topics.

Unit V **Contact Hours: 12**

Enterprise Promotion: Creating Entrepreneurial Venture, Entrepreneurship Development Cycle, Business Planning Process The business plan as an entrepreneurial tool, Elements of Business Plan, Objectives, Market Analysis, Development of product/ idea –Resources, Capabilities, and strategies, identifying attributes of strategic resources, Opportunity Analysis, innovator or imitator, SWOT analysis, Internal and External Environment Analysis, Industry Analysis, Embryonic Companies and Spin off's, Porter's five forces model, Identifying the right Business Model Canvas, Seven Domains of John Mullins, Opportunities in Emerging/Transition/Decline industries, Opportunities at the bottom of the pyramid, Opportunities in social sector, Opportunities arising out of digitization, Marketing, Finance, Organization & Management, Ownership – Franchising, networking and alliances, Buying an existing business, Critical risk contingencies of the proposal, Scheduling and milestones.Case study on related topics.

Text Books:

1. Vasant Desai (2011), Dynamics of Entrepreneurship Development, Himalaya Publishing House.
2. David H. Holt, (1991) Entrepreneurship: New Venture Creation, Prentice Hall.
3. K. Nagarajan, (2017) Project Management, New Age International Pvt Ltd.

Reference book:

1. The Culture of Entrepreneurship, Brigitte Berger.
2. Entrepreneurship: Strategies and Resources, Marc J, Dollinger.

MSc (BOTANY)	Total Marks: 100
Semester : II	**External Marks: 70**
Elective Course V (B) : Intellectual Property Rights	**Internal Marks: 30**
Paper Code: MBOT205 (B)	**No. of Hours: 60hrs**
Course Objective: To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries and Research. **1.** To disseminate knowledge on patents, patent regime in India and abroad and registration aspects **2.** To disseminate knowledge on copyrights and its related rights and registration aspects **3.** To disseminate knowledge on trademarks and registration aspects **4.** To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects **5.** To aware about current trends in IPR and Govt. steps in fostering IPR and case studies .	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.

2. This course provide further way for developing their idea or innovations.

3. To Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Unit-1 **Overview and Introduction of Intellectual Property**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994, Phonograms or Geneva Convention, History of IPR.

Unit-2 **Patents and Drafting**

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed

Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board, Patent Filing and Drafting
Case studies, Patent Agents role in India.

Unit-3 Copyrights in IPR

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights, Filing and Drafting the Copyrights.

Unit-4 Trademarks and Trading licences

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board, Trading licence importance of exports and imports in trading.

Unit-5 IP transactions; Enforcement of IP, Commercialisation

Implications of Intellectual Property Rights in promoting innovations and their commercialization; technology transfer, Due diligence in patent transactions. Working of patents in India Compulsory licence and its implications; Enforcement of Patents against infringer.

Industrial Designs Registrations: Classification, Protection and Enforcement of Industrial Designs in Indian. Registration and protection of design in India and abroad.

Geographical Indications:Concept of Geographical Indications and GI registration in India; Global scenario of GI. Protection of Traditional Knowledge and development of balanced benefit sharing models; management of GI to enhance the economic returns from GIs. Enforcement of GI. GI registrations process in India Case studies.

Case Studies and Discussions related to IPR

Learning Outcomes

4. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.

5. This course provide further way for developing their idea or innovations.

6. To Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Assessment Tools: Written examinations, Case study discussions, Viva examinations.
REFERENCE BOOKS

Text book

1. Rimmer, M. (2008). *Intellectual property and biotechnology: biological inventions*. Edward Elgar Publishing.
2. Singh, H. B., Jha, A., &Keswani, C. (Eds.). (2016). *Intellectual property issues in biotechnology*. CABI.
3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

E-resources:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

Reference Journal: 1. Journal of Intellectual Property Rights (JIPR): NISCAIR http://nopr.niscair.res.in/handle/123456789/45 (Case Studies)

Useful Websites:

1. Cell for IPR Promotion and Management (http://cipam.gov.in/)
2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

SEMESTER III

MSc (BOTANY)	Total Marks: 100
Semester : III	External Marks: 70
Core Course I: Anatomy, Development, Reproduction and Embryology of Angiosperms	Internal Marks: 30
Paper Code:MBOT301	No. of Hours: 60hrs
Course Objective: This course aims to impart an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperm and Identifies role of anatomy in solving taxonomic and phylogenetic problems.	Total Credit: 4 Credit

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I: Understand the plant anatomy and embryology of angiospermic plant.
CO-II: Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information
CO-III: Understand anatomical and embryological features.
CO-IV: Understand the development of pollen and ovule.
CO-V: Understand the process of Embryology

Unit: I	12 hrs
Unique features of plant development differences between animal and plantdevelopment. Organization of shoot apical meristem (SAM) control of tissue differentiation especially xylem and phloem; secretary ducts and laticifers wood development in relation to environmental factors.	
Unit: II	**12 hrs**
Leaf Growth and differentiation. Organization of root apical meristem(RAM) cell fates and lineages vascular tissue differentiation lateral roots root hairs microbe interaction. Vegetative options and sexual reproduction flower development genetics of flower development genetics of floral organ differentiation homeotic mutants in *Arabidiopsis* and *Antirrhinum* sex determination .	
Unit: III	**12 hrs**
Structure of anthers microsporogenesis role of tapetum pollen development and gene expression. Male sterility pollen germination pollen tube greet and guidance. pollen storage, pollen allergy and pollen embryos	
UNIT IV	**12hrs**
Ovule development, megasporogenesis organization of embryo sac. Structure of embryo sac cells. Flora characterisitics; pollination mechanisms and vectors breeding system structure of pistil pollen stigma interactions sporophytic and gametophytic	
Unit V	**12 hrs**
self incompatibility. Double fertilization, Endosperm development during early maturation and desiccation stages. Embryogenesis; storage proteins of endosperms and embryo. Polyembryonic, apomixes. Dynamics of fruit growth biochemistry and molecular biology of fruit maturati	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand the plant anatomy and embryology of angiospermic plant.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand anatomical and embryological features.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Understand the development of pollen and ovule.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand the process of Embryology	Lecturing / Research Study/video lecture/Field study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Johri BM (1982) Experimental Embryology of Angiosperms. Springer, Berlin
2. Rost . T et al 1998 plant Biology wadsworth publishing con California USA
3. Krishanmurthy K.V. 2000 Methods in cell wall cytochemistry CRC press Boca Roton Florida USA
4. Buchanan B.B. Groissem w. And jones RL 2000 Biochemistry And molecular biology of plants American society of plant physiologisits Maryland USA.
5. De. D.N. 2000 Plant cell vacuoles An Introduction CSIRO Publication Collij18W Australia.
6. Bhojwani S.S. and Bhathagar S.P. 2000 . The Embryology of Angiosperms (4th revised and enlarged edition) vikas publishing House New Delhi.
7. Burgess J. 1985 : An Introduction to plant cell Development Cambridge University press Cambridge.
8. Fageri K. and Van der Piji L 1979 . The Principles of Pollination Ecology .Pergamon Press Oxford.
9. Fahn . A 1982 Plant Anatomy (3rd edition) pergamon press Oxford.
10. Fosket D.E. 1994 Plant Growth and Development . A Molecular Approach . Academic Press san Diego .

11. Howell S.H. 1998 Molecular Genetics of Plant Development Cambridge . J Cramer Germany.
12. Lyndon R.F. 1990 Plant Development . The Cellular Basis UninHyman . London
13. Murphy . T. M. and Thompson W.E. 1988 Molecular plant Development . Prentice Hall New Jersey.
14. Proctor M. And Yeo P. 1973. The Pollination of Flowers . William Collins Sons London .
15. Raghvan V. 1997 Molecular Embryology of Flowering Plant Cambridge University Press Cambridge.
16. Raghvan V. 1999 Development Biology of Flowering P. Jants Springer Verlag.

Anatomy, Development, Reproduction and Embryology of Angiosperms (MBOT301P)

Lab Objectives:-

- Learn the main anatomical characters to recognize reproduction and embryology of angiosperms.

Practical

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedling.
2. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
3. Study of monocot and dicot stem.
4. Examinations of shoot apices in monocotyledons in both T.S. and L.S. to show the origin and arrangement of leaf primordial.
5. Microscopic examination of vertical section of leaves such as Cannabis, Tobacco, Nerium, Maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc.
6. Study the C3 and C4 leaf anatomy of plants.
7. Study of whole roots in monocots and dicots.
8. Study of microsporogenesis and gametogenesis in sections of anthers.
9. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination
10. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
11. Estimating percentage and average pollen tube length in vitro.
12. Study of ovule in cleared preparations, study of monosporic, bisporic and terrasporic types of embryo sac development through examination of permanent, stained serial sections.
13. Field study of several types of flower with different pollination mechanisms (wind pollination thrips pollination bee/butterfly pollination, bird pollination.
14. Study of seed dormancy and methods to break dormancy.

Lab Outcomes:-

- Explain the root and shoot anatomy
- Discuss anatomical difference of monocot and dicot leaves.
- Understand the development of pollen and ovule.

MSc (BOTANY)	Total Marks: 100
Semester : III	External Marks: 70
Core Course II: Plant Physiology & Metabolism	Internal Marks: 30
Paper Code:MBOT302	No. of Hours: 60hrs
Course Objective: This course objective is to llustrates knowledge of photosynthesis, Respiration and phytohormone.	Total Credit: 4 Credit
Course Learning Outcomes: After completion of these courses students will be able to understand- **CO-I**: Know scope and importance of plant physiology. **CO-II:** Understand process of photosynthesis, C3, C4, CAM pathways. **CO-III:** Understand the process of respiration, growth and developmental process in plant. **CO-IV:** Understand the Physiology of Floral Induction. **CO-V:** Understand the Plant Growth Regulators	

Unit –I	**12 Hrs**
Plant-water relation, mechanism of water transport through xylem, root microbe interaction in facilitating nutrient uptake. Comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport system.	
Unit –II	**12 Hrs**
Photosynthesis: Properties of light and absorption of light by photosynthetic pigments, Composition and characterization of photo systems I and II, Photo-oxidation of Water, mechanism of electron & proton transport, Photo-phosphorylation. A brief description of C3, C4 and CAM plants, photorespiration.	
Unit –III	**12Hrs**
Respiration: General aspects, Glycolysis, TCA Cycle, Electron transport and ATP synthesis and alternate Oxidase system. Pentose Phosphate pathway and its significance. Glyoxylate cycle.	
Unit –IV	**12Hrs**
Physiology of Floral Induction: Photoperiodism and its significance, role of Vernalization, Phytochrome – structure and function. Physiology and biochemistry of seed dormancy and germination: Causes of dormancy and methods of breaking dormancy, Biochemical changes accompanying seed germination.	
Unit –V	**12 Hrs**
Plant Growth Regulators: Structure, metabolism and physiology effect of auxins, gibberellins, cytokinins, ethylene and abscisic acid. Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, oxidative stress**.**	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Know scope and importance of plant physiology.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand process of photosynthesis, C3, C4, CAM pathways.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand the process of respiration, growth and developmental process in plant.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Understand the Physiology of Floral Induction.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand the Plant Growth Regulators	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.
2. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.
3. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
4. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
5. Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & ,Sons, Inc., New York, USA.
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.Molecular cell Biology (fourth edition). W.H. ,Freeman and Company, New York USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second

edition). Springer -Verlag, New York. USA.
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
9. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
10. Taiz l and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.

Plant Physiology & Metabolism lab
(MBOT302-P)

Practical

Lab Objective:-

- To know about the separation technique (Column and Paper Chromatography).
- Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer.

1. To study the effect of temperature on permeability of plasma membrane.
2. To prepare the standard curve of protein and determine the protein content in unknown samples.
3. Separation of chloroplast pigments by solvent method.
4. Determining the osmotic potential of vacuolar sap by plasmolytic method.
5. Determining the water potential of any tuber.
6. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
7. Study of Salt stress, acid stress, drought stress.
8. Isolation and identification and interaction of rhizospheric microorganism.
9. Comparison of the rate of respiration of various plant parts
10. Isolation and identification of Rhizobium from different plants.
11. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer.

Lab outcome-

- Students are able to isolate rhizobium from plant.
- Able to determine the effect of temperature on plasma membrane, know the technique of paper chromatography.
- Able to estimate various chemicals and substrate.

MSc (BOTANY)	Total Marks: 100
Semester : III	**External Marks: 70**
Discipline specific Course: Plant Pathology (DSE-1)	**Internal Marks: 30**
Paper Code:MBOT303A	**No. of Hours: 60hrs**
Course Objective: To acquaint the students with the science of phytopathology; its objectives, general concepts and classification of plant diseases.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I: Know the concept, scope and importance of Plant pathology.
CO-II: Understand causes of disease development.
CO-III: Account of Plant disease classification.
CO-IV: Know the prevention and control measures of plant diseases.
CO-V: Knowledge of Bio-control and Integrated Pest management.

Unit-I	**12 hrs**
Historical development and present status of phytophathology,Concept of plant disease, Classification of plant diseases, Pathogenesis and disease development; role of enzymes and toxins in pathogenesis, Host-pathogen interaction,Pathogenesis and disease development; role of enzymes and toxins in pathogenesis	
Unit-II	**10hrs**
Viral disease of plant, Life cycle of TMV, Gemini Virus, viral diseases symptoms, transmission, Isolation and puricification of virus, Multiplication.Basic control measures and production of virus-free plants. Yellow vein mosaic of bhindi	
Unit-III	**12 hrs**
Bacterial diseases of plant symptoms and transmission, Plant responses against bacterial Infection, Study of citrus canker,Bacterial leaf blight on wheat, Crown gall diseases caused by Agrobacterium, bacterial blight of rice, Ear cockle of wheat-Anguinatritici, Root knot of vegetables-Meloidogyne incognita, M. javanica, M.arenaria ; little leaf of brinjal	
Unit-IV	**14 hrs**
Fungal diseases- Symptoms and transmission-; Rusts, Smuts and powdery mildews; damping-off of seedlings, late blight of potato, red rot of sugarcane. Integrated pest disease management	
The effect of weather on pathogenic agents- Insect pest, fungi, bacteria and viruses, combating plant diseases, natural and artificial methods, the integrated campaign (IPM), insect against insects, Bacteria and Bacilli against insect, Virus against Insects, effect of weather on the host.	
Unit-V	**12 hrs**
Host-pathogen interaction.Plant disease diagnosis; Koch's postulates with special reference to parasitism. Defense mechanism in host, effect of infection on host physiology, Dissemination of plant disease; disease forecasting and management plant disease. Post harvest diseases and mycotoxins.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Know the concept, scope and importance of Plant pathology.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand causes of disease development.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Account of Plant disease classification.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Know the prevention and control measures of plant diseases.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Knowledge of Bio-control and Integrated Pest management	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Agrios G. Plant Pathology (5th edition). Academic Press.
2. Mehrotra RS Plant Pathology. Tata McGraw Hill.
3. Bonnie H. Ownley, Robert N. Trigiano (2016) Plant Pathology Concepts and Laboratory Exercises. CRC Press
4. Singh RS Introduction To Principles Of Plant Pathology, 5th edition. MedTech
5. Stephen Burchett and Sarah Burchett. Plant Pathology. CRC Press
6. Sharma PD (2013) Plant Pathology. Deep and Deep Publications
7. Cooke, B. Michael, Jones, D. Gareth, Kaye, Bernard (2006) The Epidemiology of Plant Diseases. Springer, Netherland

Plant Pathology Lab
(MBOT403A-P)

Practical

Lab Objective:-

- Learn culture media preparation.
- Isolate disease causing microbes from diseased plants.

1. Isolation of fungal Pathogen from leaves
2. Extraction of Cellulase enzyme from diseased plant (*In vivo*)
3. Demonstration of Koch's Postulates for a Fungal Pathogen
4. Isolation of Plant Pathogen Bacteria
5. Identification and study of Citrus canker and other bacterial diseases,
6. Identification of fungal diseases- *Fusarium*, White blister, late blight of Potato.
7. Study of infected plant material for rust and smut disease.
8. Study of plant material infected with powdery mildew disease.
12. Effect of antifungal agents on selected fungi

Lab Outcomes-

- Students are able to recognize different plant diseases present in plants and their casual organism, studied about different life cycle of different fungi.
- Students will get the knowledge of diseases in plants in their local area.

MSc (BOTANY)	Total Marks: 100
Semester : III	External Marks: 70
Discipline Elective Course II (B): Cytogenetics and Plant Breeding	Internal Marks: 30
Paper Code:MBOT303 (B)	No. of Hours: 60hrs
Course Objective: This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problemsolving skills from classical to molecular genetics. To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement..	Total Credit: 4 Credit
Course Learning Outcomes: After completion of these courses students will be able to understand- **CO-I:** Understand the Mendelian and neo Mendelian genetics. **CO-II:** Know about interaction of genes, multiple alleles and linkage and crossing over. **CO-III:** Know about molecular cytogenetics. **CO-IV:** Know the gene structure and expression. **CO-V:** Understand objectives and scope of plant breeding.	

UNIT-I	12 hrs
Mendelian and Non-Mendelian Inheritance: Meiosis; Chromosome theory of inheritance; Mendelian laws; Gene interactions; Organelle inheritance.	
UNIT-II	**12 hrs**
Molecular Cytogenetics: Nuclear DNA content, C-value paradox, Cot curve and its Significance, restriction mapping - concept and techniques, multigene families and their evolution, in situ hybridization and techniques, chromosomes micro dissection and micro cloning, flow cytometry and confocal microscopy and karyotype analysis.	
UNIT-III	**12 hrs**
Gene structure and expression: fine structure of gene, Cis-trans test, fine structure analysis of eukaryotes, introns and their significance. RNA splicing, regulation of gene expression in prokaryotes and eukaryotes. • Protein sorting: Targeting proteins to organelles.	
UNIT-IV	**12 hrs**
Mutation: Spontaneous and induced mutation, physical and chemical mutagens molecular basis of gene, transposable elements in prokaryotes and eukaryotes, mutation induced by transposones, site directed mutagenesis, inherited human diseases and defects in DNA repair, translocation, intersect Robertsonian translocation.	
UNIT- V	**12 hrs**

Plant breeding and crop improvement: Objectives and scope of plant breeding, hybridization in self- and cross-pollinated crops, genetic basis of inbreeding depression and heterosis, breeding for disease and insect resistance, transgenes and transgenic plants. Physical and genetic mapping using molecular markers

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand the Mendelian and neo Mendelian genetics.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Know about interaction of genes, multiple alleles and linkage and crossing over.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Know about molecular cytogenetics.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Know the gene structure and expression.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand objectives and scope of plant breeding..	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Alberts, B. Bray, D. Lewis, J. Raff: M. Roberts, K. and Watson,J. D. 1989 Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York. U. S. A.
2. Atherly, AG. Girton, J.R and Mc Donald, J.E. 1999. The Science of Genetics: Saunders College Publishing, Fort Worth, U.S.A.
3. Burnham, C.R 1962. Discussions in Cytogenetics, Burgess Publishing Co. Minnesota.
4. Busch. H. and Rothblum. L. 1982. Volume X. The Cell Nucleus rDNA Part A. Academic Press.
5. Hartl, D.L. and Jones, E. W. 1998. Genetics: Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA
6. Khush, G.S. 1973. Cytogenetics of Aneuploids. Acedemic Press, New York, London.
7. Karp, G. 1999 Cells and Molecular Biology: Concepts and Experiments John Wiley &Sons,U SA
8. Lewin: B. 2000 Gene VII. Oxford University Press, New York, U.S.A
9. Lewis, R. 1997. Human Genetics: Concepts and Applications. (2nd edition). McGraw Hill,

U.S.A
10. Malacinski, G. M. and Freifelder, D. 1998. Essentials of Molecular Biology *(3M* edition). Jones and Barlett Publishers, Inc. London.
11. Russel, P.J. 1998. Genetics (5th edition). The Benjamin / Cummings Publishing Company Inc., U. S. A
12. Snustead, D. P. and Simmons, M. J. 2000. Principles of Genetics (2nd edition). John Wiley & Sons, U.S.A
13. Lewin, B. 2000, Genes Vll, Oxford University Press, New York.
14. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA
15. Pollard, T. S. and EaJ-nshaw, W. C. 2002 Cell Biology. Saunders,Philadelphia, U.S.A Twyman, R. M. 2003. Advanced Molecular Biology. Viva Books Private Ltd. New Delhi.
16. Gardner, M. J. Simmons, D. P. Snustad (2006) Principles of Genetics.John Wiley and Sons.
17. Sybenga J Cytogenetics and Plant Breeding. Springer Verlag.

Cytogenetics and Plant Breeding
(MBOT303B-P)

Lab Objective:-

- To know about Mendel's Law.
- To provide insight into structure and function of chromosomes.

Practical

1. Preparation of mitotic and meiotic spreads and analysis of various stages of cell division (*Phlox, Allium* and *Rhoeo*).
2. Extraction of genomic DNA from plants by CTAB method.
3. Analysis of molecular polymorphism in parental lines and derived mapping population using different types of molecular markers.
4. Mutagenesis experiments in *E. coli*.
5. Studying pea plant as tool for investigating Laws of Inheritance.
6. Demonstration of Mendel's Law of segregation.
7. Demonstration of Mendel's Law of Independent Assortment.
8. Studying deviations from Mendels laws and applying statics.
9. Studying Drosophila as a model organism.
10. Familiarizing students with lab equipments
11. Study of different type of chromosomes
12. Preparation of karyograms using camera lucida
13. Induction of polyploidy using colchicines
14. Induction of polyploidy using colchicines.

Lab Outcome-

- Students can isolate DNA from plants, studied about Mendel's law, got knowledge about various lab instruments used in botany practical, got knowledge about special types of chromosome.

MSc (BOTANY)	Total Marks: 100
Semester : III	External Marks: 70
Discipline Specific Elective Course IV(A): Herbal Medicine	Internal Marks: 30
Paper Code:MBOT304 A (DSE)	No. of Hours: 60hrs
Course Objective: The **objective** of the **course** is to teach students basic phytopharmacology, counseling skills on **herbal medicine**, evidence-based resources, manufacturing practices, and dietary regulations. A review of over 50 **herbs** touches on clinical use, efficacy, safety, and **drug** interactions..	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I: Understand the basic phytopharmacology, counseling skills on herbal medicine.
CO-II: Understand the medicinal plant research scenario in India.
CO-III: Know commercial cultivation of medicinal plants conservation of medicinal plants.
CO-IV: Be able to advise and educate effectively to create a comprehensive wellness plan incorporating herbal, dietary and lifestyle recommendations integrating self-awareness and lessons of nature
CO-V: Know about Ethnomedicine.

Unit-1	10 hrs
Medicinal plant research scenario in India . Diagnostic features, bioactive molecules and therapeutic value of some common medicinal plants	
Unit-2	**8 hrs**
Standardization of herbal drugs, Commercial cultivation of medicinal plants conservation of medicinal plants	
Unit-3	**10hrs**
Neutraceuticals and medicinal food . Bioprospecting, biopiracy and protection of traditional medicinal knowledge (IPR) Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.	
Unit-4	**10 hrs**
Use of pesticides and plant growth regulators.Methods of harvesting and storing plant drugs.Basics of commerce of herbal drugs, Methods of cultivating plants.	
Unit5-	**12 hrs**
Ethnomedicine: Definition, history and scope. Collection of ethnic information.Importance of medicinal plants: Role in human health care.Introduction to basic concepts of folk medicine and Ayurveda, Naturopathy and Yoga: methods of disease diagnosis and treatment. Important ethnomedicines of Madhya Pradesh and Chhattisgarh	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand the basic phytopharmacology, counseling skills on herbal medicine.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand the medicinal plant research scenario in India.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Know commercial cultivation of medicinal plants conservation of medicinal plants.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Be able to advise and educate effectively to create a comprehensive wellness plan incorporating herbal, dietary and lifestyle recommendations integrating self-awareness and lessons of nature	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Know about Ethnomedicine	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. A Class Book of Botany. A.C. Dutta. Oxford University Press.
2. Pharmacognosy -G. E. Trease and W.C. Evans. Saunders Edinburgh, New York
3. Textbook of Pharmacognosy by T.E. Wallis.
4. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
5. Aniszewski T, (2015) Alkaloids (2nd Edition) Chemistry, Biology, Ecology and Application< Elsevier Science.
6. Cooper R and Nicola G (2014) Natural Products Chemistry. CRC Press, Taylor & Francis Group, USA.

Herbal Medicine Lab(MBOT304A-P)

Lab Objective:

- To teach basic of phytopharmocology.
- Counseling skills on herbal medicine.

Practical

1. To prepare crude drug from plant parts.
2. Isolation, purification of crude drug from plant parts.
3. To perform antibiotic assay using extracted drug.
4. Estimation of Alkaloid and Phenolics content from plant parts.
5. To perform antifungal assay using plant extracts.
6. To perform antibacterial assay using plant extracts.
7. Determination of phytochemicals in crude plant extracts.

Lab Outcome:

- Studied about the herbal drugs.
- Know about the product knowledge and their use in disease management.

MSc (BOTANY)	Total Marks: 100
Semester : III	**External Marks: 70**
Discipline Specific Course IV B : Applied Microbiology	**Internal Marks: 30**
Paper Code:MBOT304B (DSE-1)	**No. of Hours: 60hrs**
Course Objective: The main **objective** of the **course** is to provide students with the basis to face the study of the major fundamentals of **microbiology** including **bacteriology**, virology and immunology. basic knowledge of the main **microbiological** techniques to be **applied** in the laboratory.	**Total Credit: 4 Credit**

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: Understand Microbes as tools for understanding the biological processes

CO-II: Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.

CO-III: Microbial enzymes of industrial interest, microbial metabolites, wine production, single cell proteins, microbial transformation of steroids, food spoilage and preservation, production of dairy products (fermented milks and cheese), role of microbes in agriculture (biofertilizers, biopesticides), Waste water treatment.

CO-IV: Know various Culture media and their applications and also understand various physical and chemical means of sterilization.

CO-V: Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi

Unit 1-	**14 hrs**
Microbes as tools for understanding the biological processes: Physiology, biochemistry, genetics, molecular biology, genomics, proteomics. Microbes and environment: Pollution abatement, bio indicators, restoration of degraded ecosystems, biodegradation, bioremediation, biogenic gases, microbes in biological warfare	
Unit2-	**12 hrs**
Application of microbes in fermentation processes: Types, design and maintenance of bioreactors, application of fermentation technology in industry. Medical microbiology: Microbes as causal agents of human and animal diseases; Immunology: basic concepts, vaccines, immunotherapy	
Unit 3-	10 **hrs**
Role of microbes in relation to agriculture: Nitrogen economy, plant health, biological control.	
Unit4-	12 **hrs**
Symbiotic associations: Concepts, types and applications . Microbes in food and dairy industry: Mushrooms, fermented foods, microbial spoilage of food and dairy products, toxins	
Unit-5	12 **hrs**
Extremophiles and their biotechnological applications, Microbial technology: Biosensors, bio molecules, enzymes	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand Microbes as tools for understanding the biological processes	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Microbial enzymes of industrial interest, microbial metabolites, wine production, single cell proteins, microbial transformation of steroids, food spoilage and preservation, production of dairy products (fermented milks and cheese), role of microbes in agriculture (biofertilizers, biopesticides), Waste water treatment.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Know various Culture media and their applications and also understand various physical and chemical means of sterilization.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Reading and Books

1. A Textbook of Basic and Applied Microbiology" by K R Aneja published by New Age International, 2008
2. Applied Microbiology" by J P Simon and A Durieux by springer
3. Advances in Applied Microbiology" by Allen I Laskin and Geoffrey M Gadd
4. Applied Microbiology and Biotechnology" by Dean Watson *Publisher*: Syrawood*Publishing* House (May 23, 2016);
5. Baltz R.H., Demain A.L. and Davies J.E. (2010) Manual of Industrial Microbiology and Biotechnology, ASM Press.
6. Flickinger M.C. and Drew S.W. (1999) Encyclopedia of Bioprocess Technology: Fermentation,Biocatalysis and Bioseparation, (Vol 1-5), Wiley publishers
7. StanburyP.T.,Whitaker A. and Hall S. (2016) Principles of Fermentation Technology, Butterworth-Heinemann.

8. Waites M.J. Morgan N.L.,Rockey J.S. and Higton G. (2011) Industrial Microbiology.An Introduction, Paperback, WB Publishers.
9. Patel A.H. (2016) Industrial Microbiology, 2ndEdn. Laxmi Publications.

Applied Microbiology Lab
(MBOT304B-P)

Lab Objectives:-

- **To learn basic technique of applied microbiology.**

Practical

1. Basic techniques in microbiology.
2. Cultivation of Different type of mushroom.
3. Isolation of Lipolytic microorganism from butter.
4. Isolation of Antibiotic producing microorganism from soil.
5. Detection of number of bacteria in mil by breed count.
6. Enzyme production and assay –cellulase, protease and amylase.
7. Alcohol production.
8. Visit and observe an industry unit pertaining to microbiological products manufacturing.

Lab Outcome:-

- Students are able to isolate and characterize various types of microbes.

SEMESTER IV

MSc (BOTANY)	Total Marks: 100
Semester : IV	External Marks: 70
Core Course : Plant Cell, Organ & Tissue Culture	Internal Marks: 30
Paper Code:MBOT401	No. of Hours: 60hrs
Course Objective: The course aims to acquaint the students with technological aspects of plant tissue culture which have direct applications in agriculture, crop improvement and industrial processes.	Total Credit: 4 Credit

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I:Understand tissue culture techniques.
CO-II: Know the application of plant tissue culture.
CO-III: Understand the fundamental of recombinant DNA technology.
CO-IV: Understand technical germplasm & cryopreservation.
CO-V: Understand the concept of microbial genetic manipulation, genomics & proteomics and fermentation technology

UNIT-I	**12 hrs**
Plant cell and tissue culture: general introduction, history, scope, concept of cellular differentiation and totipotency. Tissue culture media, Techniques of tissue culture. Callus culture, Cell suspension culture, Organ culture .meristem, anther and embryo culture. Clonal propagation, Organogenesis and embryogenesis.	
UNIT-II	**12 hrs**
Somatic embryogenesis and androgenesis, Protoplast isolation, fusion and culture, Somatic Hybridization and cybrids, Somaclonal variation and its significance, Production of Secondary metabolites.	
UNIT-III	**12 hrs**
Cryopreservation and Germplasm storage: Raising sterile tissue cultures, Addition of cryoprotectants and pretreatment, freezing, storage, thawing, determination of survival viability. Plant growth and generation, verification, encapsulation and dehydration. Slow growth method, Applications. Intellectual Property Rights: Possible ecological risks and ethical concerns.	
UNIT- IV	**12 hrs**
Transgenic Plants-Genetic engineering of plants, aims, strategies for development of transgenics (with suitable examples); *Agrobacterium* .the natural genetic engineer; T-DNA and transposon mediated gene tagging .Plant cloning vectors:Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer.	
UNIT- V	**12 hrs**
Biological nitrogen fixation and biofertilizer, molecular mechanism of nitrogen fixation, genetics of *nif*gene. Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS , SCARS , AFLP etc.)Application of Plant Biotechnology.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand tissue culture techniques.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Know the application of plant tissue culture.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand the fundamental of recombinant DNA technology.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Understand technical germplasm & cryopreservation.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand the concept of microbial genetic manipulation, genomics & proteomics and fermentation technology	Lecturing / Research Study/video lecture	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Butenko, R.G. 2000. Plant Cell Culture. University Press of Pacific.
2. Collin, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
3. Dixon, R.A. (Ed.) 1987. Plant Cell Culture: A Practical Approach. IRL Press, Oxford.
4. Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
5. George, E.F. 1993. Plant Propagation by Tissue Culture. Part 1. The Technology, 2nd edition.Exeg.etics Ltd., Edington, UK.
6. George, E.F. 1993. Plant Propagation by Tissue Culture. Part 2. In Practice, 2nd edition. Exegetics Ltd., Edington UK.
7. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.
8. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
9. Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
10. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.
11. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core

Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
12. Brown, T.A. 1999. Genomes. John Wiley & sons, Singapore
13. Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.
14. Jolles, O. and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. BirkhauserVerlag, Basel, Switzerland.
15. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK

Plant Cell, Organ & Tissue Culture Lab
(MBOT401P)

Lab Objective:-

- To learn tissue culture techniques.
- Propagation of large quantity of good quality planting material from elite mother **plants.**

Practical

1. Introduction and awareness of lab safety measures.
2. Study of sterilization of explants and working place.
3. Demonstration of androgenesis in Datura.
4. Study of Organogenesis.
5. Somatic embryogenesis using appropriate explants.
6. Preparation of artificial seed.
7. Familiarizing students with lab set up and instrumentation.
8. Growth characteristics of E. coli using plating and turbidimetric methods.
9. Isolation of plasmid from E. Coli by alkaline lysis method and its quantification spectrophotometrically
10. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
11. Cloning of a DNA fragments in a plasmid vector, transformation of the given bacterial
12. population and selection of recombinants.
13. Demonstration of siderophore production by microbes.
14. Demonstration of Phosphate solubilizing activity of microbes.
15. Isolation, culture of Rhizobia and demonstration of their nodulation and nitrogen fixing potential.

Lab outcome –

- Students are able to handle spectrophotometer, get to know about how to culture various plant parts and develop new plant from it, able to isolate protoplast from plant tissue.

MSc (BOTANY)	Total Marks: 100
Semester : IV	External Marks: 70
Discipline Elective Course: Biochemical, Molecular Techniques and Bioinformatics	Internal Marks: 30
Paper Code:MBOT402A	No. of Hours: 60hrs
Course Objective: The course aims to acquaint the students with Biochemical, Molecular Techniques and Bioinformatics	Total Credit: 4 Credit

Course Learning Outcomes: After completion of these courses students will be able to understand-
CO-I: Understand Electrophoresis techniques.
CO-II: Know the Isoelectric focusing and Immobilized pH gradients, blotting techniques.
CO-III: Understand the fundamental of DNA amplification and genome mapping.
CO-IV: Understand technical Chromatography and microscopy.
CO-V: Understand the concept of Bioinformatics

UNIT I	12 hrs
Electrophoresis: Polyacrylamide gel electrophoresis (PAGE), agarose gel electrophoresis, native	
PAGE, SDS-PAGE, 2D electrophoresis, mass spectrometry, Isolation and purification: Genomic and plasmid DNA; RNA; proteins.	
UNIT II	**12 hrs**
Isoelectric focusing (IEF): Principles, kinds of pH gradients used in IEF- free carrier ampholytes,	
Immobilized pH gradients, blotting: Principles, types of blotting, immunoblotting - Southern, Northern, Western and Dot blots	
UNIT III	**12 hrs**
DNA amplification and genome mapping: PCR, RT-PCR, RFLPs, RAPD, FISH; Genome expression analysis: Microarray, EST, SAGE, DNA sequencing: Various methods of DNA sequencing, Gene silencing: RNA interference (RNAi)	
UNIT IV	**12hrs**
Chromatography: Gel filtration, ion exchange & affinity chromatography, TLC, HPLC, GC- basic	
Concept, Spectroscopy: basic concept, NMR & ESR spectroscopy, Microscopy: Phase contrast, confocal, fluorescence, Scanning Electron Microscopy & Transmission Electron Microscopy (TEM).	
UNIT V	**12 hrs**
Bioinformatics: Database (NCBI, EMBL, DDBJ, Genbank, Pubmed), sequence analysis using online tools- BLAST, Methods of phylogeny analysis (Neighbour Joining, Maximum Parsimony and Maximum Likelihood), Phylogenetic inference packages, sites and centres.	

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Understand Electrophoresis techniques.	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Know the Isoelectric focusing and Immobilized pH gradients, blotting techniques.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	Understand the fundamental of DNA amplification and genome mapping.	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Understand technical Chromatography and microscopy.	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	Understand the concept of Bioinformatics.	Lecturing / Research Study/video lecture/ computer lab	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1. Anna Tramontano Introduction to Bioinformatics The Ten Most Wanted Solutions in Protein Bioinformatics, CRC Press
2. HoomanRashidi, Lukas K. Bioinformatics Basics: Applications in Biological Science and Medicine Buehler Publisher: CRC Press/Taylor & Francis Group
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By: Andreas D. Baxevanis (Ed), B. F. Francis Ouellette (Ed)
4. Bioinformatics in the Post-Genomic Era: Genome, Transcriptome, Proteome, and Information-Based Medicine By: Jeffrey Augen Publisher: Addison-Wesley
5. Bioinformatics: Genes, Proteins and Computers C. A. Orengo, D. T. Jones, J. M. Thornton (Ed), D. T. Jones (Ed) Edition: 1st edition, May 2003, Publisher: Roultledge
6. Introduction to Bioinformatics: A Theoretical and Practical Approach, By: Stephen A. Krawetz, David D. Womble Edition: 1st, Book & CD-ROM edition, May 2003, Publisher: Humana Press
7. Discovering Genomics, Proteomics, and Bioinformatics By: A. Malcolm Campbell, Laurie J. HeyerEdition: Book and CD-ROM edition, September 2002 Publisher: Benjamin/Cummings
8. Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, and Michael M. Cox Seventh Edition Published by Macmillan Learning, 2017
9. RajanKatoch (2011) Analytical Techniques in Biochemistry and Molecular Biology, Springer

10. K. Wilson and J. Walker Principles and Techniques in Biochemistry and Molecular Biology. 7th edition. Cambridge University Press.
11. RC Gupta and S Bhargava Practical Biochemistry 5th edition. CBS Publisher and Distributers.
12. D Rickwood and BD Hames Gel Electrophoresis of Nucleic Acids- A Practical Approach. IRL Press
13. D Rickwood and BD Hames Gel Electrophoresis of Proteins- A Practical Approach. IRL Press
14. Suzanne Bell, Keith Morris (2009) Introduction to Microscopy. CRC Press.
15. Baxenavis AD and Ouellette BFF. Bioinformatics- A Practical guide to analysis of Genes and Proteins (Student edition). Wiley Publication.

Biochemical, Molecular Techniques and Bioinformatics (MBOT402P)

Practical

Lab Objectives:-

- The aim is to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and Bioinformatics.

1. Extraction of total proteins from soybean seeds.
2. To perform SDS-PAGE of proteins isolated from soybean seeds.
3. To isolate DNA from spinach leaves and quantify using spectrophotometer.
4. To perform agarose (0.8%) gel electrophoresis of DNA sample.
5. To perform PCR of ITS region.
6. To perform agarose (1.2) gel elcetrophoresis of PCR product
7. To perform thin layer chromatography of amino acids.
8. To study protozoan diversity in a water sample using a light and phase contrast microscope.
9. To carry out BLAST (NCBI) analysis of the given DNA sequence.
10. To download DNA sequences (ITS region) from Genbank and align them using MEGA software and manual editing.
11. To construct phylogenetic tree of the aligned sequences using various phylogenetic methods given in MEGA software.

Lab Outcome:-

- Students are able to perform –Extraction of protein,DNAIsolation.PCR techniques etc.

MSc (BOTANY)	Total Marks: 100
Semester : IV	External Marks: 70
Discipline Elective Course: Plant resource utilization and Ethnobotany	Internal Marks: 30
Paper Code:MBOT402B	No. of Hours: 60hrs
Course Objective: This course would provide students the economic importance and current research paradigms in various categories of commercially cultivated plants.	Total Credit: 4 Credit

Course Learning Outcomes: After completion of these courses students will be able to understand-

CO-I: Uses and current research paradigms in various plants of economic value..

CO-II: Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems Develop critical understanding on the evolution of concept of organization of apex•

CO-III: new crops/varieties, importance of germplasm diversity, issues related to access and ownership

CO-IV: Develop a basic knowledge of taxonomic diversity and important families of useful.plants Increase the awareness and appreciation of plants & plant products encountered in everyday life Appreciate the diversity of plants and the plant products in human use.

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CO-V: Understand the concept of Ethanobotany

UNIT I. **12 hrs**
Plant biodiversity for Man and their importance; History, Botany, cultivation and processing of: Cereals (Wheat, Rice, Maize), Legumes and Pulses, Forage crops, Fiber plants and their products
UNIT II **12 hrs**
Medicinal plants, Drugs and narcotics, Fumitories and mastigatories, Beverage yielding plants, Important wood and timber yielding plants, Sugar and sugar yielding plants, Tropical and subtropical fruits.
UNIT III
Spices and flavoring materials, Vegetables, Gum and dye yielding plants, Latex yielding plants, teal coffee, rubber and Insecticide yielding plants. Origin of cultivated plants: center of origin, criteria and Vavilov's center of origin. Origin and cultivation of wheat, rice, maize, sugarcane, mustard and potato. **12 hrs**
UNIT IV
Plants and Civilization: Centres of origin and gene diversity; Botany, utilization, cultivation and improvement of food plants, drug, fibre and industrial values; Unexploited plants of potential economic value; Plants as a source of renewable energy; Genetic resources and their conservation, cryopreservation **12hrs**
UNIT V **12 hrs**
ETHNONBOTANY : History, Scope, Objectives and Interdisciplinary nature of Ethnobotany. Ethnobotany: The concept and its role in modern medicine. Ethnic tribes of Chhattisgarh, Shifting Cultivation. Prior Informed Content (PIC), Traditional Knowledge and it's Importance,
Ethnomedicine, Ethnic Foods and Magico-religious beliefs.

FACILITATING THE ACHIEVEMENT OF COURSE LEARNING OUTCOME

UNIT NO.	COURSE LEARNING OUTCOME	TEACHING AND LEARNING ACTIVITY	ASSESSMENT TASK
I	Uses and current research paradigms in various plants of economic value..	Discussion &Presentation/Lecture.	Evaluation of Students on the basis of Presentation, Assignment Evaluation, Quiz.
II	Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems Develop critical understanding on the evolution of concept of organization of apex.	Application Based learning activity/ animated Video Lecture.	Evaluation of Students on the basis of Application-Based Activity, Evaluation, Assignment, Class test.
III	new crops/varieties, importance of germplasm diversity, issues related to access and ownership	Presentation/Animated Video lecture.	Quiz,Assignment, Class Test, seminar.
IV	Develop a basic knowledge of taxonomic diversity and important families of useful.plants Increase the awareness and appreciation of plants & plant products encountered in everyday life Appreciate the diversity of plants and the plant products in human use. .	Presentation/Video/ Research Study	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.
V	. Understand the concept of Ethanobotany	Lecturing / Research Study/video lecture/ computer lab	Evaluation of Students based on Research Study Presentation, Assignment Evaluation, Class test.

Suggested Readings/ Books

1.Chandel K. P. S. Shukla G. and Sharma Neelam.1996. Biodiversity in Medicinal and Aromatic Plants in India – Conservation and Utilization, Indian Bureau of Plant GeneticResources, New Delhi,

2. Kaufman Peter B. et al. 1999. Natural Products from Plants, CRC Press. UK.

3.Primack R.B. 2000. A Primer of Conservation Biology, SinauerAsso. Publ., Massachusetts. USA.

4.Sahoo S. 2002. Plant Resource Utilization. Allied Publishers. Nagpur.

5.Singh J.S. Singh S.P. and Gupta S.R., 2006, Ecology, Environment and Resource Conservation, Anamya Publication, New Delhi,

6.Trivedi P.C. and Sharma N. 2010. Plant Resource Utilization and Conservation, Pointer Publishers. Jaipur.

Plant resource utilization and Ethnobotany Lab
(MBOT402B-P)

Practical

1.Study of fodder, food, fire, oil, fibre and oil of plants (fiveeach)
2. Study of locally available medicinal and aromaticplants.
3. Study of Gums, resins, tannins, dyes yielding plants of Raipur,(CG).
4. Local Field study tour for plant wealth survey and reportwriting.
5. Fibers: Jute, Sun-hemp, Flax-Morphology , anatomy, microscopic study of whole fibers appropriate staining procedure
6. Oil seeds: Groundnut, Sunflower, Castor –morphology, microscopic structure of oil yielding tissues, test for oil and iodine number.
7.Medicinal Plants: Sarpagandha, Ashwagandha, Datura, Periwinkle (Study of atleast two from each category)
8. Cereals: Rice, Wheat, Maize, Jowar
10) Pulses: Red gram, Bengal gram, Black gram
11. Fruits: Mango, Banana, Grapes
12. Nuts: Beetle-nut, Cashew-nut
13. Vegetables: Brinjal, Tomato, Potato, Chilli, Spinach, Cluster-bean
14. Rubber: Hevea,Timber: Teak, Rose-wood ,Biofuels: Pongamia, Castor

MBOT 403P

External Term: 200
Internal Marks: 100

Project Work

Course Objective:-

- Selection of research topic.
- Collection and Compilation of literature.
- Designing of experiment with objectivity.
- Compilation and interpretation of results.
- Presentation of research data in different forms.
- . Highlighting results interpretation and discussion.

Project based on any of the above subject courses.
Viva-vice, Presentation,
Submit two copy of project report in the department.

Course		Outcomes After completion of these courses students should be able to-
MBOT404	**Project Work**	**CO-I:** Use and develop written and oral presentation skills **CO-II:** Identify key research questions within the field of Demography on which you will carry out independent research. **CO-III**: Identify, analyse and interpret suitable data to enable the research question to be answered **CO-IV:** Understand and apply theoretical frameworks to the chosen area of study. **CO-V:**Analyse and synthesise research findings.