SYLLABUS

# Sant Gadge Baba Amravati University

## Faculty – Science and Technology

## Programme- M. Sc. (Botany) NEP-2020

2023

**Sant Gadge Baba Amravati University**
**Part A**
**Faculty – Science and Technology**
**Programme- M. Sc. (Botany)**
**NEP-2020**

## POs

1. To equip students with strong fundamentals in subject domain knowledge.
2. To train students in all the areas of plant science with unique combination of core, elective papers.
3. Students can explore the cutting-edge technologies and skills currently used in plant sciences.
4. They are made aware of social, environmental issues and plant significance in natural interest.
5. To create interest in nature conservation and save the natural resources.
6. Focus is equally given on labour work as well as field work.
7. To worth together as a team along with other branches of life sciences without any complex.
8. To develop scientific temperament and research attitude and much for society.

## PSOs 1

1. To equip the students with the fundamental concepts of plant sciences
2. To understand the basics of structure and functions of cells
3. To learn the process of growth and development of plants
4. To study the evolutionary process from lower to higher plants

## PSOs 2

1. To study the concepts of genetics, plant breeding and their applicability
2. To understand and correlate the various biochemical and physiological processes in plants
3. To study the evolutionary process in Bryophytes and Pteriodophytes
4. To study the bioactive principles in plants and their defense mechanisms

## Employability Potential:

Joseph Paxton Famous Botanist said that 'Botany the science of vegetable kingdom is one of the most attractive, useful and extensive department of human knowledge, the science of beauty. Any human activity without plant involvement is baseless. Botany is the scientific study of plants. Sant Gadge Baba Amravati University offers M.Sc. Botany a master's Program which deals with study of plants, their characteristics, classification and various related aspects in detail. The main aims and objectives of M.Sc. program are:

- To prepare students for a carrier as scientists, who can deal with current research lines in botany using modern techniques.
- To help them represent the discipline both in basic and applied research area.
- To encourage multidisciplinary collaboration.

- To equip and helpful students in all aspects of plant sciences with a view that they can take up teaching at different levels, researches in institute/university, doctoral work, EIA, Biodiversity studies entrepreneurship, Scientific writing in relevant topics have been included in curriculum.

The duration of this program is two years .There are 30 seats and admission on merit basis. Candidates who wish to opt M.Sc Botany should have Botany as one subject at graduate level and deep interest in plants and their life cycle.

The Syllabi of Botany is designed as per CBSC pattern and is very rich so that along with Botany students can opt for their choices and interest in allied field. The major focus is upon ability and skills other than core course subjects. The whole post-graduate program is of 4 semesters, where students are imparted deep knowledge about plant kingdom, Physiology, Genetics, Molecular Biology, Biotechnology, Genetics Engineering, Pharmacognosy, Ecology, Microbiology, Biosystematics, Tissue Culture, Bioprospecting etc. Botany also deals with various aspects related to Agriculture, Environment, Pharmacy, Forestry, Horticulture and Floriculture. Nursery, farms, Environmental consultancies Pharmaceuticals companies Forest sciences with job profile as Ecologist, Plant Taxonomist, Plant Biochemist, Researcher, Environmental Consultant, forest ranger, Botanists. Nursery or green house manager, Farming consultant, geneticist, Biotechnologists, Microbiologist etc. It would also provide highly skilled human resource for incubation centres and start-ups in the field of plant related industrial units as well as Research and Development sectors.

Study of plants is fundamental and vital as life is dependent on plant for well being of all living organism as plants produce energy, O2 ,C, water etc. Comparing with other forms of life, plants life can be studied at different levels molecular, genetical and biochemical through various cells, tissues, organ, individuals, plants population and communities. Botanists are concerned with identification classification, structure, function of plant life. Botany also covers the Protista group which include fungi, Lichens, bacteria, viruses and single cell algae. A good understanding of plants is essential to the future generation because

- Produce food for expanding population
- Understand fundamental life processes
- Produce medicine and materials to treat disease

Education is not only to gain knowledge and understand the things but it must be able to enhance one's ability and skills for better employability. Employability skills are those which help one to stand separately than others for the same jobs. These skills are vital in order to secure a role where employability, skill matches with your job profile. These skills come naturally or can be acquired through work experience, practice or education.

The employability means, teaching botany at various levels. Employability skills are transferable that students can use this at workplace. Teachers seek all these set of diverse skills in students in addition to academic qualification, in order to stay relevant and improve their efficiency. Teacher should focus on building the employability skills. Various skills can be developed after completion of this program. These are as follows.

1. **Communication Skills:** It is one of the important personality traits which is sought after employment. It generally consists of five elements sender, receiver, message, medium and feedback. It can be verbal, non verbal, visual or written. Good communication skills help any institution/organisation to avoid unnecessary misunderstanding, waste of time and increase the output. To be an effective communicator one has to understand colleagues through ideas and thoughts to achieve the goal. Practices like positive expression, body language, careful listening, think before you speak, debate, group discussion, elocution completion, seminars etc can improve the skills.
2. **Leadership Skills:** Flourishing of any organisation requires good leaders with excellent leadership skills. They look for such persons .Good leaders can manage people/ team well, convince them, motivate them and train them so as to improve the workplaces practices as per the set objectives. Students are given various responsibilities of organising and conduction of event, arrangements and coordination of various activities in team to develop these qualities.
3. **Problem Solving Skills:** This quality helps to remove the obstacles by resolving complex issues. They are asset to any organisation for increasing the efficiency. It is an act to determine the issue, identify the cause, select best possible solution and implement it. Complex problem can be broken into smaller parts and then the issue can be addressed. In other way it can be solved by research, analyses and then decision can be made. Undertaking research projects, Assignments, brain storming sessions, solving puzzle etc can enhance this skill.
4. **Team Work Skills:** To know role in team and work amicably with teammates. Healthy, cordial relationship with colleagues and better work environment increases job satisfaction. It has direct impact on organisation stability, innovation and output. In practical's, group of 4-5 students are made and they perform the experiment efficiently, group assignments, group activities etc develop these skills.
5. **Reliability Skills:** This is very important employability skill to build trust with the employer. Consistency is the key of reliability. Meetings, daily task, respond to queries, acknowledge mistakes and take lessons from it are the thing to develop reliability. Mentor –mentee meet often, counselling etc.
6. **Self Management Skills:** It is the ability to organise and manage own works without guide. It saves time and enhances efficiency. Students project work, Botanical Excursions and tours management, preparations for exams, perform experiments in 3hrs etc.
7. **Learning Skills:** It enables to improve the knowledge about the subject. Tend to change to adapt new concepts and methods. Such persons can acquire challenging positions and save time. It ensures quick implementations of new system, process and technology. Students are asked to refer good books of the subject, seminars on recent topics are given, standard protocols are used in practicals etc.

8. **Technology skills:** In present scenario it is must to know and how to use the updated technology. It is one of the leading skills for any institution. Helps to stay relevant and ahead of the competition. These skilled are valued as one can grasp the technology based concept and learn how to use them effectively. Students are using this technology for learning and research purpose.
9. **Planning and Organization skills:** Important to achieve goals, manage time, money and effort and increase efficiency. Should be resourceful, manage priorities, timely and take decisions.
10. **Technical and Analytical skills:** Make them skilled in practicals, laboratory equipment's and interpret the data on biological material.

The course is designed in such a way that after completion it is expected that they develop and nurture these employability skill for employment or entrepreneurship development.

**Scheme of Teaching, Learning & Examination leading to Two Years PG Degree Master of Science in the Programme Botany**
**following Three Years UG Programme wef 2023-24**
**Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option**
**(M.Sc. Part I) Semester I**

| S. N. | Subject | Type of Course | Subject Code | Teaching & Learning Scheme | | | | | | | Duration Of Exam Hours | Examination & Evaluation Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Teaching Period Per Week | | | | Credits | | | | Maximum Marks | | | | | Minimum Passing | | |
| | | | | | | | | | | | | Theory | | Practical | | Total Marks | | | |
| | | | | L | T | P | Total | L/T | Practical | Total | | Theory Internal | Theory +MCQ External | Internal | External | | Marks Internal | Marks External | Grade |
| 0 | *Pre-Requisite Course(s) if applicable/MOOC/Internship/Field Work cumulatively<br>If students wish to opt Minor Course of UG as Major for PG, **balance 12 Credits** Course will have to be completed<br>**(As and when applicable)** | **Th-Prq** | | **0** | **0** | **0** | **0** | **Additional Credits to be earned = (1) minus( 2)<br>(1). Credits from Major DSC Courses in UG (minus)<br>(2).The Credits already earned from the Course as Minor at UG, now to be opted as Major at PG** | | | **2** | **15** | **35** | | | **50** | **06** | **14** | **P** |
| **1** | Research Methodology and IPR | **Th-Major** | BOT 01 | **4** | | | **4** | **4** | | **4** | **3** | **30** | **70** | | | **100** | **12** | **28** | **P** |
| **2** | DSC-I.1 Cell and Molecular Biology | **Th-Major** | BOT 101 | **4** | | | **4** | **4** | | **4** | **3** | **30** | **70** | | | **100** | **12** | **28** | **P** |
| **3** | DSC-II.1 Evolution and Diversity of Algae and Fungi | **Th-Major** | BOT 102 | **4** | | | **4** | **4** | | **4** | **3** | **30** | **70** | | | **100** | **12** | **28** | **P** |
| | DSC-III.1 Plant Development, Economic Botany and Resource Utilization | **Th-Major** | BOT 103 | **3** | | | **3** | **3** | | **3** | **3** | **30** | **70** | | | **100** | **12** | **28** | **P** |
| **4** | DSE-I /MOOC (Elective Options) | **Th-Major Elective** | BOT 104 | **3** | | | **3** | **3** | | **3** | **3** | **30** | **70** | | | **100** | **12** | **28** | **P** |
| | DSE-I -Angiosperm Taxonomy, Phytochemistry and Pharmacognosy | | BOT 104-A | | | | | | | | | | | | | | **Minimum Passing Marks** | | **Grade** |
| | DSE-I -Molecular Systematics of Plants | | BOT 104-B | | | | | | | | | | | | | | | | |
| | DSE-I -Plant Tissue Culture | | BOT 104-C | | | | | | | | | | | | | | | | |
| | DSE-I -Advanced Plant Physiology | | BOT 104-D | | | | | | | | | | | | | | | | |
| | DSE-I -Basic and Applied Mycology | | BOT 104-E | | | | | | | | | | | | | | | | |
| | DSE-I -Molecular Biology, Biotechnology &Plant Breeding | | BOT 104-F | | | | | | | | | | | | | | | | |
| **5** | DSC-I.1 Lab | **Pr-Major** | | | | **2** | **2** | | **1** | **1** | **3** | | | **25** | **25** | **50** | **25** | | **P** |
| **6** | DSC-II.1 Lab | **Pr-Major** | | | | **2** | **2** | | **1** | **1** | **3** | | | **25** | **25** | **50** | **25** | | **P** |
| **6** | DSC-III.1 Lab | **Pr-Major** | | | | **2** | **2** | | **1** | **1** | **3** | | | **25** | **25** | **50** | **25** | | **P** |

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| **7** | DSE-I Laboratory/MOOC Lab | **Pr-Major Elective** | | | | **2** | **2** | | **1** | **1** | **3** | | | **25** | **25** | **50** | **25** | | **P** |
| **8** | # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively** | **Related to DSC** | | **120 Hours cumulatively during vacations of Semester I and Semester II** | | | | | | **4*** | | | | | | | | | **P*** |
| **9** | **Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV** | Generic **Optional** | | **90 Hours Cumulatively From Sem I to Sem IV** | | | | | | | | | | | | | | | |
| | **TOTAL** | | | | | | | | | **22** | | | | | | **600+50*** | | | |

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: Prq, Theory : Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Discipline Specific Core: DSC, Discipline Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research

Methodology; Research Project: RP, Co-curricular Courses: CC

Note : # On Job Training, Internship/ Apprenticeship; Field projects Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **BOT 01** | **Research Methodology and IPR** | **04** |

**Cos :**

1. The main objective of this course is to introduce the basic concepts in research methodology.
2. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.
3. To make them aware about the latest techniques used in plant sciences
4. To make friendly about the tools and techniques.
5. To know the principle and applications of these techniques.

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| **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.<br>Problem Identification & Formulation - Research Question – Investigation Question - Measurement Issues - Hypothesis - Qualities of a good Hypothesis Null Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance.<br>Measurement: Concept of measurement- what is measured? Problems in measurement in research- Validity and Reliability. Levels of measurement Nominal, Ordinal, Interval, Ratio. |
| **Unit-II** | 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.<br>Qualitative and Quantitative Research: Qualitative research – Quantitative research - Concept of measurement, causality, generalization, replication. Merging the two approaches. |
| **Unit-III** | Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample.<br>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.<br>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. |
| **Unit-IV** | Strategies for conservation of Biodiversity, causes of decline & Biodiversity.<br>Importance of sanctuaries, National parks, Biophere reserves (Tiger reserve with reference to Melghat Tiger Project). Wild Management.<br>Conservation of wild germplasm with reference to endangered & threatened species. Sacred groves & threatened species. |
| **Unit-V** | 5.1 Transition to flowering; morphological and histochemical changes in shoot apex, floral meristems and floral development; homeotic mutants in Arabidopsis and Antirrhinum, sex determination. Regulation of anther and ovule development, microsporogenesis; microgametogenesis, tapetum. |
| **Unit-VI** | Primer design, PCR: basic features and application, types – standard, hot start PCR, touch-down PCR, Nested PCR, RT-PCR, Real time PCR, overlap PCR, RACE, Inverse PCR.<br>Analysis at the level of gene transcription – Northern blot, In situ hybridization, RNase protection assay, |

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| | Analysis of DNA protein interactions: Electrophoretic mobility shift assay (EMSA), DNase I foot-printing, Chromatin immune-precipitation assay.<br>Analysis of protein-protein interactions , Co-immuno precipitation assay, Fluorescence resonance energy transfer (FRET). |

**Suggested Reading:**


1. Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions.
2. Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology- C. R. Kothari
4. Sriwastava, S. C. : Foundation of Social Research andEconomics Techniques, Himalaya Publishing House, 1990.
5. Chou, Ya-Lun : Statistical Analysis with Business and Economics Applications, 2nd Eds., New York, Hold Rinchart and Wrintston, 1974.
6. Clover, Vernon t and Balsely, Howerd L : Business Research Methods, Colombus O. Grid, Inc, 1974.
7. Emary C. Willima : Business Research Methods, Illinois : Richard D. Irwin Inc. Homewood, 1976.
8. Sharma H.D. and Mukherji S. P. : Research Methods in
9. Economics and Business, New York : The Macmillan Company, 1992.II
10. Gerber R. and Verdoom, P.J. : Research Methods in Economics and Business, New York, The Macmillan Company, 1992.
11. Courtis J.K. (ed.) Research and Methodology in Accounting & Financial Management, 1980.
12. Menden HYall and Varacity : Reinmuth J.E. : Statistics for Management and Economics (2nd Edition), 1982.
13. Krishnaswami O.R. : Methodology of Research in Social Sciences, Himalaya Publishing House, 1993.
14. Molecular Biology: A laboratory Manual, 4th edition, 2012: M. Green and J. Sambrook
15. An introduction to Molecular Biotechnology–Molecular fundamentals, methods and applications in Modern Biotechnology (2006): ed. Micheal Wink
16. Slater, A., Scott, N. W., & Fowler, M. R. (2003). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford: Oxford University Press.
17. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics.


**Course Outcomes**

1. Demonstrate the ability to choose methods appropriate to research aims and objectives.
2. Understand the limitations of particular research methods.
3. Develop skills in qualitative and quantitative data analysis and presentation

**Part B**

**Syllabus Prescribed for 2023 Year** — **PG. Programme**

**Programme** — **M.Sc. Botany**

**Semester I**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSC I BOT101** | **Cell and Molecular Biology** | **04** |

**Cos :**

1. To understand structural organization and functional role of cell and organelles and role of biomolecules.
2. To correlate the various life processes and their functioning.
3. To understand the process of chromosomal organization and its role in cellular metabolism.
4. To evaluate the various life processes and their regulations with special reference to regulation of gene expression.

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| **Unit-I** | Cell wall, composition and functions<br>Structural organization and functional aspects of membrane, transport, ion channels, active transport, membrane pumps. |

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| | Structural organization and functional aspects of cell organelles, Structure and function of cytoskeletons; microtubules, intermediate filaments, microfilaments and their role in motility, Plasmodesmata |
| **Unit-II** | Cell cycle; Steps in cell cycle, roles of Cyclins and Cyclin Dependent Kinases, checkpoints; regulation of mitosis and meiosis, chromosome congression, cell plate formation and cell division. |
| **Unit-III** | Genetics of cancer, tumor suppressor genes, oncogenes; their types and role Cell signaling; signal transduction; G-proteins, GPCRs, second messengers, regulation of signaling pathways, plant two- component systems, light signaling in plants, bacterial chemotaxis and quorum sensing. |
| **Unit-IV** | Chromosomal Organization, DNA packaging, histone modifications; chromatin structure, heterochromatin, euchromatin, Organization of Centromeres and Telomeres, Specialized Chromosomes: Polytene, Lampbrush, B Chromosomes.<br>Genome size, Organization; C-value paradox, cot curve, re-association kinetics, hypochromic effect. |
| **Unit-V** | Regulation of gene expression in Prokaryotes: Gene structure, *Lac* - Operon, *Trp*- Operon and Phage Operon,<br>Regulation of gene expression in Eukaryotes**:** *cis* and *trans* regulation; promoters, transcription factors, post-transcriptional regulation, role of chromatin remodeling. |
| **Unit- VI** | Protein synthesis**;** Ribosomes, formation of initiation complex, factors for initiation, elongation, termination and their regulation, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading and translational inhibitors, protein folding; post- translational modifications of proteins. Protein sorting and targeting to different organelles, secretary protein synthesis; Signal Recognition Particle (SRP). |

**Suggested Reading:**


1. De, D.N. 2000. Plant Cell Vacuoles: An introduction. CSIRO Publication, Collingwood, Australia
2. Rost, T. et al.. 1998. Plant Biology. Wadsworth Publishing Co, California, USA.
3. Krishnamurthy, K.V.2000. Methods in Cell wall Cytochemistry, CRC Press, Boca Raton, Florida
4. Atherly, A.G,, Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA
5. Burnham, C.R. 1962. Discussions in Cytogenetics. Burgess Publishing Co., Minnesota
6. Bush, H. and Rothblum, L. 1982. Volume X. The Cell Nucleus & DNA Part A. Academic Press.
7. Hartl, D.L. and Jones, E.W. 1998. Genetics: Principles and Analysis (4th Edition). Jones and Bartlett Publishers, Massachusetts, USA.
8. Khush, GS. 1973. Cytogenetics of Ancuploids. Academic Press, New York, London
9. Lewis R., 1997. Human Genetics: Concepts and Applications (2nd Edition). WCB McGraw Hill, USA
10. Russel, P.J. 1998. Genetics (5th Edition). The Benjamin/ cummings Publishing Company Inc., USA
11. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2nd Edition). John Wiley and Sons Inc., U.S.A
12. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function. Jones and Barlett Publishers, Boston, Massachusetts
13. Hall, J.L. and Moore, A.L. 1983. Isolation of Membranes and Organelles from Plant Cells. Academic Press, London, U.K.
14. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, Oxford, U.K
15. Fukui, K. and Nakayama, S.1996. Plant Chromosomes: Laboratory Methods. CRC Press, Boca Raton, Florida.
16. V. R. Dnyansagar (1986). Cytology and Genetics. Tata McGraw-Hill, ISBN 0074515721, 9780074515723.


**Reference book:**


1. Benjamin Lewin, . 1997. Genes VIII, Oxford University Press, New York.
2. Benjamin Lewin, 2008 Genes IX, Oxford University Press, New York.
3. Benjamin Lewin, Jones and Bartlett 2011Genes X, Oxford University Press, New York.

4. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia

**Course Outcomes**

4. Develop strong fundamental basics of cell dynamics.
5. They would be able to analyze and interpret the cell behavior, cell cycle andcell communication processes.
6. They would be able to predict disorders within the biological systems related to gene regulation.
7. They would be able to illustrate and justify the biological mechanisms
8. Able to explain the structure, synthesis and processing of Nucleic acids.

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSC II BOT102** | **Evolution and Diversity of Algae and Fungi** | **04** |

**Cos:**

On completion of this course, the students would be able to

1. Understand the phycology with special reference to Indian work.
2. Algae in diversified habitats (Terrestrial, fresh water, marine) Criteria used in classification of algae, Role of algae in human welfare
3. General account of thallus organization, reproduction and life history of algae.
4. Study of important groups of algae Cyanophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariopyta, Phaeophyta & Rhodophyta.
5. Fungi: General Characters, Classification., Economic importance of fungi in medicine,
6. Agriculture (Biopesticide an biofertilizer).
7. Fungi as plant pathogen.

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| **Unit I: Algae** | Occurrence, Range of Thallus organization, Pigments, reserve food, reproduction and types of life cycles in algae, origin and evolution of sex in algae.<br>Classification of algae proposed by F. E. Fritsch (1935,1948), G. M. Smith (1955), R. E. Lee (2008).<br>Cyanophyta: Affinities with Prokaryotes and algae, ultrastructure of cell, special Cells-Akinites, heterocyst and harmogonia, Range of thallus, reproduction and economic importance of cyanobacteria.<br>Chlorophyta –range of thallus organization, reproduction and life cycle patterns and economic importance of green algae.<br>Charophyta – Habitat and thallus diversity and reproduction |
| **Unit II: Algae** | Euglenophyta –Cell structure and reproduction<br>Xanthophyta – Occurrence, distribution, thallus structure and reproduction.<br>Bacillariophyta- General Characters, Occurrence Morphology Cell structure, Valve Morphology Reproduction and Economic importance of Diatoms<br>Pheophyta – General characters, geographical distribution, thallus diversity reproduction and economic importance<br>Rhodophyta – Occurrence, thallus structure and reproduction. |
| **Unit III: Fungi** | Mycelium structure and types, modified hyphal structures, mode of nutrition, mode of asexual reproduction, phases of sexual reproduction and fruiting bodies in different groups.<br>Classification as per Ainsworth (1971), outline of phylogenetic classification as per D.S.Hibbett (2007). General account of the following groups and study of representative genus.<br>Myxomycetes –General account and life cycles of typical myxomycete<br>Chytridiomycetes-, Vegetative structure and reproduction in *Allomyces.*<br>Oomycetes- life cycle in *Phytopthora* and *Albugo.* |

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| | 3.6 Zygomycetes- Vegetative structure and reproduction in *Mucor* and *Rhizopus* |
| **Unit IV: Fungi** | General account of the following groups and study of representative genus:<br>Plectomycetes – Vegetative structure and reproduction in *Aspergillus*<br>Discomycetes - Vegetative structure and reproduction in *Peziza*<br>Teliomycetes- life cycle of –*Ustilago*<br>Hymnomycetes- Life cycle of *Agaricus* |
| **Unit V: Fungi** | General account of the following groups and study of representative genus:<br>Hypomycetes- *Alternaria Fusarium,*<br>Coelomycetes- *Colletotricum*<br>Heterothalism and parasexuallity in fungi<br>Major fungal diseases - *Candidiasis, Aspergillosis*, *Mucormycosis*<br>Regional crop diseases (Fungal, Viral, Bacterial and Phytoplasmal diseases). |
| **Unit VI: Applied mycology** | Research work in the field of mycology and Phytopathology in India<br>Role of fungi in –Agriculture, Industry and as a food<br>Role of Fungi in antibiotic production.<br>Lichen- nature of association, Morphological types, reproduction and economic importance.<br>Mycorrhiza – Types and its applications. |
| **Suggested Reading: 5.1** | |

1. Fritsch, F.E. The structure and reproduction of algae volume 1 and 2
2. Robin South, G and Alan Whittick: Introduction to Phycology
3. Morris,I: An Introduction to Algae
4. Bold, H.C. and Wynne, M.D.: Introduction to the Algae structure and reproduction
5. John Webster and Roland W.S. Weber - Introduction to Fungi
6. Alexopoulos C.J., C.W. Mims and M. Blackwell – Introductory Mycology
7. Mehrotra R.S. and K.R. Aneja – An Introduction to Mycology
8. Smith, J.E. - The Filamentous Fungi
9. Introductory Phycology – H.D. Kumar, Affiliated East West Press Ltd., New Delhi. Phycotalk Vol. I and II - H. D. Kumar Rastogi Publ., Meerut.
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84. KR Aneja, R.S. Mehrotra 2015 An Introduction to Mycology,New Age International private Limited.
85. Introduction to Fungi, Bacteria and Viruses 2017 HC Dubey Agribios, India
86. Text Book Of Fungi 2010, R.C.Gupta ,O.M.Prakash Sharma Oxford publication.

**Learning outcomes:**

On completion of this course, the students will be able to

1. Develop understanding on the diversity of algae with reference to thallus organization, pigmentation and life cycles.
2. Classify the algae up to genus level and identify based on morphology and reproduction.
3. Identify true fungi and demonstrate the principles and applications of plant pathology and human pathology
4. Demonstrate skills in plant pathology or mycology for isolation, identification and classification of fungi.
5. Identify common local plant diseases according to symptoms and casual organisms.

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSC III BOT103** | **Plant Development Economic Botany and Resource Utilization** | **03** |

**Cos :**

1. Study the origin, divarication, utility and conservation strategies & natural resources
2. Study importance of food, fiber, medicines & oil yielding plant.
3. Study the plants and their value in the service & mankind.
4. Study the conservation of biodiversity.
5. Deals with regulation of growth and development of plants in relation to bio-molecular interaction.

| | |
|---|---|
| **Unit – I** | Introduction & levels of Biodiversity, species diversity, genetic diversity, ecosystem diversity<br>Biodiversity threats – habitat loss and over exploitation of resources.<br>Biodiversity conservation *in situ* & *ex situ*;<br>Biodiversity and agriculture; biodiversity and food diversity, commercial value of biodiversity. |
| **Unit-II** | Centers of origin & cultivated plants and gene diversity utilization & cereals, cultivation and improvement of wheat, rice, jowar, Bajra.<br>Pulses & forage legumes – general account Origin, evolution, botany, cultivation and uses of |

| | |
|---|---|
| | i. Regional Food, Forage and fodder crops such as *Sorghum*, *Cajanus*, Maize, Paddy, Pulses.<br>ii. Regional Fiber crops – Cotton, Jute & Coir.<br>iii. Regional Medicinal and aromatic plant such as *Withania somnifera, Vinca rosea, Aloe vera, Mentha piperita* and *Cymbopogon.*<br>iv. Regional Oil yielding plants & vegetables (*Arachis hypogaea, Gossypium, Brassica* sp., *Solanum*, and *Abelmoschus esculentus*.<br>v. Spices – Ginger, Turmeric, Cinnamon, Clove, Black paper & Chilies. |
| **Unit-III** | Plants and their value in the service of the mankind<br>General account and parts from which these are obtains, methods of extraction and uses, paper making Tannins, Dyes, Gum and Resins, Rubber & Latex.<br>Innovative approaches for meeting world food demands modern agricultural approach.<br>Plants used as Avenue trees for shade and asthetics.<br>Fire wood & Timber woods their identification properties and users, Teak, Shisam, Sal, Neem, Mango, Babul. |
| **Unit – IV** | Concepts of growth and development, zygote, embryonic development; stages; polarity and symmetry, developmental plasticity; Morphogenetic gradients, pluripotency;<br>Cell fate and cell lineages determination, Meristem development, types of meristem;<br>Anatomical features, vascular elements; differentiation of xylem, phloem, secretory tissues, Nectaries, laticifers, resin ducts**.** |
| **Unit-V** | Organization of Shoot and Root Apical Meristems (SAM & RAM), molecular regulation and mutant analysis in Arabidopsis and Antirrhinum,<br>Leaf development, determination of phyllotaxy and molecular regulation in Arabidopsis and Antirrhinum; leaf anatomy, development of epidermis, mesophyll, trichomes and stomata.<br>Secondary growth; cambium, structure and development of wood. |
| **Unit-VI** | Concept of lead Botanical gardens and Biodiversity parts field gene banks, seed banks.<br>Legal aspects of conservation of biodiversity in India.<br>General account and activities of national institutes like botanical survey of India (BSI), National Bureau of plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of scientific and Industrial Research (CSIR) Ministry of Environment & Forest and Climate change. |

**Suggested Reading:**


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31. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition) Wordsworth Publishing, Belmont, Calfornia.
32. Steeves, T.A. and Susses, I.M. 1989. Patterns in Plant Development (2nd edition), Cambridge University Press, Cambridge.
33. Waisel, Y., Eshel, A. and Kafkaki, V. (eds) 1996. Plant Roots: the Hidden Hall (2nd edition). Marcel Dekker, New York. Taiz, L. and Zeiger, F. (1998): The Plant Physiology. Second Edition, Sunderland: Sinauer Associates.
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**Learning Outcome:**

After completion of this course student would be able to –

1. Understand the pattern origin diversification and cultivation & plant in nature.
2. Know about origin and cultivation and various economically importance crop plants.
3. Student study the strategies for conservation of biodiversity.
4. They become well worst with the plants utilized by human race.
5. Know about plant anatomical structure, their developmental patterns.

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – I BOT-PR01 | Practical based on DSC I.1 & II.1 | 04 |

**DSC I Cell and Molecular Biology**

**Laboratory Exercises**

1. Differential Centrifugation for isolation of cell fractions.
2. Isolation and extraction of cell organelles like mitochondria/ chloroplast.
3. Isolation and observations on B Chromosome.
4. Preparation of cytological slides for chromosomal non-disjunction in *Rhoeo/ Tradescantia*.
5. Prepare slides of mitosis and meiosis in some monocots like *Allium, Aloe, Brassica* etc.
6. To determine mitotic index.
7. SDS PAGE separation of seed storage proteins and quantification of each fragment.
8. Isolation and purification of genomic DNA from plant materials by CTAB Method.
9. Isolation and purification of RNA from plants.
10. Quantitative estimation of genomic DNA and RNA using spectrophotometer.
11. Agarose gel electrophoresis of genomic DNA and RNA and detection using gel documentation system.
12. Digestions of DNA by restriction enzymes and size fractionation of fragments
13. Isolation of Plant DNA and prepare Cot curve.
14. Demonstration of western blotting.
15. Study of electron micrographs of cell organelles.
16. Study of permeability of living cell to acids and bases.
17. Restriction Digestion of lambda DNA / Plasmid DNA, its electrophoresis and molecular weight determination.
18. Visit to National Laboratory or Research Lab to study latest techniques or sophisticated equipment from technical person.

**Evolution and Diversity of Algae and Fungi:**

| | |
|---|---|
| **1** | Morphological study and monographs of Algae :(Any 12 of the following) *Oscillatoria, Nostoc, Anabaena, Spirullina, Gleotricha, Chlamydomonas, Eudorina, Volvox, Closterium, Hydrodictyon, Pediastrum, Cladophora, Ulva, Pithophora, Draparnaldia, Cosmarium, Chlorella, Acetabularia, Chara, Nitella, Laminaria, Voucharia, Sargassum, Padina, Ectocarpus, Batrachospermum, Gracillaria, Gellidium, Polysiphonia***,** Diatoms. |
| 2 | Morphological Studies and monograph of Fungi (any 15 of the following) |

| | |
|---|---|
| | *Stemonities, Perenospora, Phytopthora, Albugo, Mucor, Rhizopus, Yeast, Aspergillus, Penicillium, Chaetomium, Taphrina, Peziza, Erisyphe, Phyllactenia, Uncinula, Melampsora, Uromyces, Drechslera, Ravenallia, Ustilago, Polyporus, Morchella, Cyathus, , Alternaria, Helminthosporium, Curvularia, Colletotrichum, Phoma, Plasmodiophora, Cercospora, Fusarium, Claviceps.* |
| 3 | Permeant Slides or Culture of following fungal forms<br>*Rhizopus, Mucor, Aspergillus, Penicillum, Drechslera, Curvularia. Phoma, Colletotrichum, Alternaria, Helminthosporium Trichoderma.* |
| 4 | Symptomology of some diseased plants (any 10 of the following).<br>White rust of Crucifers, Downy mildew, powdery mildew, Rusts, Smuts, Ergot, Groundnut leaf spot (Tikka disease), False smut of paddy, red rot of Sugarcane, Wilt disease, Citrus canker, Angular leaf spot of cotton, Leaf mosaic of bhindi/ papaya, Leaf curl of tomato/Potato/Papaya, Little leaf of Brinjal, Types of Lichens. |
| 5 | Field study: i) Collection of Algal material from water reservoirs<br>(ii) Photography of Diseased plant parts<br>(iii) Microphotography of fungal isolates |
| | **Learning Outcome:**<br>1. **Create** monographs of algal isolates.<br>2. **Classify** and identify algal genus<br>3. **Demonstrate** the application of algae in different fields<br>4. **Create** monographs of fungal isolates<br>5. **Classify** and **identify** algal genus.<br>6. **Diagnosis** of plant diseases<br>7. **Create** compendium of plant diseases |

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc . I (Botany) , SEMESTER – I (NEP-20)**

**PRACTICAL I: CELL AND MOLECULAR BIOLOGY AND EVOLUTION AND DIVERSITY OF ALGAE AND FUNGI**

**PRACTICAL SCHEDULE**

**Time: 6 hrs.** **Marks – 50+50=100**

| | |
|---|---|
| Preparation of Mitosis slides and calculation of Mitotic Index of any cytological material. | 05 |
| Extraction and Estimation of Plant Genomic DNA using UV-VIS Spectrophotometer | 05 |
| Q.3. Isolation and Identification of any two algal forms from the given material. | 10 |
| Q.4. Isolation and Identification of any two fungal forms from the given material. | 10 |
| Q.5. Comment on the given experiment from CMB | 05 |
| Q 6. Comment on the given experiment from EDAF | 05 |
| Q.7. Spotting | 10 |

**Practical Internal**

| | |
|---|---|
| Q.8. Record/ Assignments | 20 |
| Q.9.Viva Voce | 20 |
| Q.10. Attendance, | 10 |

*** List of Practical/Laboratory Experiments/Activities etc.**

**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 2022 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I**<br>**Code of the Course/Subject** | **Title of the Course/Subject**<br>(Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| **Practical II BOT PR-02** | Practical based on DSC III.1 | **02** |

*** List of Practical/Laboratory Experiments/Activities etc (Economic Botany and Resource Utilization).**

**Practical Course is divided into three units**

1) Laboratory work
2) Field Survey
3) Scientific visits

**laboratory work.**

1) Morphology, Anatomy, uses, micro chemical tests for stored food material for following food crops. Wheat, Rice Jowar, Maize, Chickpea (Bengal gram), Potato, Sugarcane.
2) Study of any three important forage/fodder crops of the locality ex. *Sorghum*, Bajra, Wheat, Maize.
3) Plant fibres. Morphology, anatomy, microscopic study of following fibres.
4) Study of textile fibre:
    a. Cotton, Jute, Coir, Linen, Sun hemp, *Cannabis*.
    b. Study of cordage fibre – Coir.
    c. Fibbers for stuffing - Cotton, Silk Cotton or Kapok
5) Study of Medicinal and aromatic plants: Depending on the geographical location of the college/ University select five medicinal and aromatic plants from a garden crop field or from the wild only if they are abundantly available.
   *Catharanthus roseus, Adhatoda zeylamica* (Syn. A. *vasica*), *Allium sativum, Withania somnifera, Tinospora cordifolia, Centella asiatica, Phyllanthus niruri, Aloe barbadense, Commiphora mukul, Asparagus racemosus, Mentha piperata, Ocimum sanctum, Vetiveria zizanoides, Rauvolfia serpentina, Cymbopogon Sp., Cissus quadrangularis, Tribulus terrestris, Vitex negundo, Abrus precatorius*. Study of live or herbarium specimens for other visual materials to become familiar with these sources. (Morphology, identification, uses, products & conservation studies.
6) Vegetable oils : Mustard, Ground nut, Soyabean, Coconut, Sunflower and Castor. Morphology, microscopic studies of the oil-yielding tissues, test for oil and iodine number
7) Study of Gums, Resins tannis & Dyes – Perform simple test for gums and resins prepare a water extract of vegetable tannins (*Acacia, Terminalia*, Tea, *Cassia* sp. *Myrobalans*) and dyes (Turmeric, *Bixa orellana, Butea monosperma, Indigo, Lawsonia inermis*) and perform test to understand chemical nature.
8) To prepare ombrothermic diagram for different sites based on given data and comment on climate

**Course Outcomes – Students would be able to**

1. Importance cultivation & uses of economically important plants.
2. Identification morphology & uses of medicinal plants which are locally available.
3. Extramural, sources of various non-wood forest products.
4. Conservation strategies of rare & threatened plant species
5. Important plants & their value in the service of the mankind

**Plant Development**

**Laboratory and Field Exercises**

1. Study of vegetative and reproductive apical meristems.
2. Anatomical studies on secondary growth (wood)
3. Study development of epidermal structures (trichomes, glands and lenticels) and
4. Study of secretory structures (nectaries and laticifers)
5. Histochemical comparison between vegetative SA and reproductively induced SA
6. Observations on:
    - Microsporogenesis and development of male gametophyte (pollen)
    - Megasporogenesis and development of female gametophyte
7. Study on types of endosperm, dissection and isolation of endosperm
8. Observations on stages of embryo development, dissection and isolation of developing embryo (3 stages)
9. *In vitro* germination of spore/pollen, correlation between fertility (stainability), viability

10. Germination study and (TTC and FDA staining) and germinability (*in vitro*) of pollen grains.
11. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
12. Induction of somatic embryos using a suitable plant material.
13. Demonstration of the effect of ABA on stomatal closure.
14. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
15. Study the organization of root and shoots with different sections.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I (Botany), SEMESTER – I (NEP-20)**

**PRACTICAL-II: ECONOMIC BOTANY, RESOURCE UTILIZATION AND PLANT DEVELOPMENT**

**Time: 3 Hrs.** **Marks: 25+25=50**

| | |
|---|---|
| Q.1: Morphology, Botanical identification and Economic importance of food/fiber crop (Any one) | 10 |
| Q.2: Any two phytochemical test | 05 |
| Q.3:Setting and working of any major experiment based on Plant Development | 10 |

**Practical Internal**

| | |
|---|---|
| Q.4: Viva-Voce | 10 |
| Q.5: Practical Record, Attendance and Assignments | 15 |

## ELECTIVE OPTIONS UNDER NEP-20

**Part B**
**Syllabus Prescribed for 2023 Year** **P.G. Programme**
**Programme :** **M.Sc. Botany**
**Semester: I**

| Code of the Course | Subject Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSE I BOT104-A** | **Angiosperm Taxonomy, Phytochemistry and Pharmacognosy** | **03** |

**COs:**

1) Study plant morphology, Description of a plant specimen, Study of locally available families of flowering plants, Identification of genus and species of locally available wild plants.
2) Appreciate the need to conserve floristic and cultural diversity of the region.
3) Preparation of botanical keys at generic level by locating key characters.
4) To develop laboratory skill like isolation, extraction & evaluation of phytochemicals from medicinal plants.
5) To develop knowledge of herbal drugs and new commercial plant products.
6) Rescue and document Ethnobotanicals for sustainable use of plant resources.

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|---|---|
| **UNIT I :** | Scope, Aims, Principles of Taxonomy, Historical Development of Plant Taxonomy; Study of Basic Principles and Recent Angiosperm Phylogeny Group (APG) System of Classification. Taxonomic Literature: Checklist, Catalogue, Floras, Monographs, Indices and Journals, Taxonomic Keys and DNA Barcoading |

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|---|---|
| **UNIT II :** | International code of Botanical Nomenclature Type method, valid publication, Rule of priority, Author citation, conservation of names and rejection ofnames, Herbarium Preparation and use, Digital Herbarium, Role of Botanical Garden . Different theories of origin of angiosperms. |
| **UNIT III :** | Modern concepts and trends in plant taxonomy: Elementary treatment of Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, Molecular Taxonomy, Cladistics |
| **UNIT IV :** | Taxonomic evidence: Wood anatomy, Floral Anatomy, Embryology, Palynology, Cytotaxonomy, Biosystematics, Chemotaxonomy and Numerical Taxonomy. A brief account of major contribution made by the following Taxonomists: Carl Linnaeus, Joseph Dalton, Hooker, William Roxburgh, John Friminger and Duthie. |
| **UNIT V :** | Basic principles of phytochemical techniques, Classification of Phytochemicals. Extraction and Isolation of Phytochemicals, Spectrophotometry- Principle and application, UV Visible and Infra-Red Spectroscopy. |
| **UNIT VI :** | Chromatographic techniques- Paper chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC). |

| **Semester I**<br>**Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| **Practical III** | Practical based on DSE I | **02** |

**List of laboratory experiments:**

1) Identification of families mentioned in the syllabus with the help of salient features
2) Preparation of dichotomous key
3) ICN problems
4) Name of the plant using Gamble
5) Submission of 30 herbarium sheets
6) Field trip for minimum of 3 days for collection of plants and preparation of herbarium
7) Study of local flora
8) Spotters related to Theory

**Sant Gadge Baba Amravati University, Amravati**
**Practical Examination Botany Semester- I (NEP-20)**
**Practical III**
**Angiosperm Taxonomy, Phytochemistry and Pharmacognosy**
**Practical Schedule**

Time 6hrs Marks-25+25=50

**Practical External**

Q.1: Systematic description of two Angiospermic plants (one from Dicotyledons and one from Monocotyledons) 20 Marks

Q.2: Preparation of artificial key 05 Marks

**Practical Internal**

Q.3: Viva-Voce 10
Q.4: Practical Record, Attendance and Assignments 15

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE-I BOT104-B** | **Molecular Systematics of Plants- Elective-I** | **03** |

**Cos:** On completion of the course, the student should be able to

1. Discuss and apply principles of delimitation and identification of species and other taxa
2. Account for the central concepts of the field and principles of phylogenetic analysis, especially based on the parsimony criterion
3. Discuss and apply methods to generate relevant molecular data, mainly sequence data.
4. Choose and apply existing software in the included course parts, from generating relevant molecular data to phylogenetic analysis
5. Critically analyse, evaluate, compile, and present the results of phylogenetic analyses.

| | |
|---|---|
| **Unit-I** | Taxonomy; concept of taxa; family, genes and species Systematics- Concepts, components, methods and relevance of plant systematics. |
| **Unit-II** | Taxonomic evidences: morphological, palynological, chromosomal and phytochemical data in plant systematics. Taxonomic hierarchy; taxonomic categories (supra-specific, species, and intra-specific); taxonomic characters (kinds and criteria). |
| **Unit-III** | 3.1 Systems of classification; artificial (Carl Linaeus), natural (Bentham and Hooker) and, phylogenetic systems (Takhtajan-Cronquist).<br>3.1. Phenetic taxonomy: Objectives, selection of Operational Taxonomic Units (OTU), taxon matrix, similarity matrix and cluster analysis. |
| **Unit-IV** | Evolution of populations and Speciation. Estimation of evolutionary trees in relation to Biogeography, Divergence times, Character evolution, Ecology. Fossil angiosperms and phylogeny; flower structure and evolution of flower. |
| **Unit-V** | 5.1 Study of the following Polypetalae families with special reference to their phylogeny, geographical distribution and plants of economic importance, common examples - Rananculaceae, Nymphaeceae, Violaceae, Papaveraceae, Polygalaceae. |
| **Unit-VI** | 6.1. Concepts and Techniques in Systematics: Three Domain Concept in Systematics, two, five and six kingdom classification.<br>6.2 Methods of estimating genetic diversity – isozymes, RFLP, RAPD and its modifications. Applications of molecular systematics. |

**Suggested Reading:**


1. Felsenstein, J. 2004. Inferring phylogenies. Sunderland, Mass., Sinauer Associates, Inc. Hall, B. G. 2011. Phylogenetic trees made easy: a how-to manual (4th edition). Sunderland: Sinauer Associates. Hillis, D. M., C. Moritz and B. K. Mable, eds. 1996.
2. Molecular systematics. Sunderland, Mass.: Sinauer Associates. Kitching, I. J., P. L. Forey, C. J. Humphries and D. M. Williams. 1998. Cladistics: the theory and practice of parsimony analysis. Oxford: Oxford University Press.
3. Li, W.-H. 1997. Molecular evolution. Sunderland, Mass.: Sinauer Associates. Schuh, R. T. 2000. Biological systematics. Comstock Publishing Associates, Ithaca. Soltis, P. S., D. E. Soltis and J. J. Doyle, eds. 1992. Molecular

systematics of plants. New York: Chapman and Hall. Soltis, D. E., P. S. Soltis and J. J. Doyle, eds. 1998.
4. Molecular systematics of plants II DNA sequencing. Boston: Kluwer Academic Publishers. Williams, D. M. and M. C. Ebach. 2008. Foundations of systematics and biogeography. New York, Springer. Yang, Z. 2006. Computational molecular evolution. Oxford, Oxford University Press.
5. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
6. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 2. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
7. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

**Learning Outcome:**

After successful completion of this course, students will be able to:

1. Understand historical development of taxonomy.
2. Explain concept of species. Order sub and super categories of species according to Linne hierarchy.

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – III | Practical based on DSC I | 02 |

## DSE Molecular Systematics of Plants- Elective-I

**Laboratory Exercises**

**Major Experiments**

1. Live plants/ Herbarium specimens of the following families will be provided in the class for description and identification (classification based on APG II, 2003):
2. Basal Angiosperm and Magnoliids: Nymphaeaceae, Magnoliaceae
3. Basal Monocots: Araceae, Alismataceae
4. Petaloid monocots: Liliaceae, Smilacaceae, Alliaceae, Orchidaceae
5. Preparation of identification keys for at least 10 specimens based on morphological features.
6. Use of palynological, chemical methods in taxonomy

## Minor Experiments

7. Writing exercise
8. Nomenclature exercise
9. Classification exercise
10. Cladogram construction and analysis
11.

**Sant Gadge Baba Amravati University, Amravati**

**Practical Examination Botany Semester- I (NEP-20)**

**Practical III**

**Molecular Systematics of Plants- Elective-I**

**Practical Schedule**

Time 6hrs Marks-25+25=50

Q.1: Systematic description of Basal Monocot and Dicot. 20 Marks

Q.2: Preparation of artificial key 05 Marks

**Practical Internal**

Q.3: Viva-Voce 10

Q.4: Practical Record, Attendance and Assignments 15

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE-I BOT104-C** | **Plant Tissue Culture Elective-I** | **03** |

**Cos:** On completion of the course, the student should be able to

6. To lean the basic principles of plant tissue culture
7. To demonstrate the methods in Plant Tissue Culture
8. Understand the applicability of Plant Tissue culture in relation to present day problems.
9. To gain the Knowledge about laboratory organization for plant tissue culture.
10. Understand various Aseptic techniques for plant tissue culture.

| | |
|---|---|
| **Unit-I** | History of plant tissue culture research - basic principles of plant tissue culture.<br>Laboratory organization, design and layout, equipment's (Laminar air flow, autoclave, distillation unit, pH meter, orbital shaker, microscope, deep freezer, growth chamber) and their working principles, laboratory ethics and practices. |
| **Unit-II** | 2.1. Nutrient media and their types, importance, Preparation of stocks, pH and Buffers and their significance in media.<br>2.2 Media Constituents: Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, hormones, Activate charcoal) |
| **Unit-III** | Concept of totipotency, cells differentiation and dedifferentiation. Factors affecting vascular tissue differentiation<br>Callus culture: induction of callus, transfer, subcultures, morphological features and growth kinetics. |
| **Unit-IV** | Micropropagation: steps, advantages, applications and challenges.<br>Meristem culture, organ culture, axillary bud proliferation technique and applications<br>Synthetic seed- technique, advantages, applications. Aseptic seed germination |
| **Unit-V** | Concepts of Morphogenesis, organogenesis, acclimatization their steps, needs, packaging, exportations and quality maintenance.<br>Pathogen (Virus) indexing-significance, methods, advantages, applications. |
| **Unit-VI** | Somatic embryogenesis: steps, induction, direct and indirect somatic embryogenesis, factors affecting somatic embryogenesis, Comparative account with zygotic embryogenesis and applications. |

**Suggested Reading:**

8. Bhojwani, S.S. 1990. Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.

9. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers, New York, USA.
10. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.
11. Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Glick, B.R. and Thomson, J. E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
13. A Text Book of Biotechnology, R. C. Dubey, S. Chand Publication

**Learning Outcome:**

After successful completion of this course, students will be able to:

3. List out, identify and handle various equipments in plant tissue culture lab.
4. Demonstrate the procedures of preparation of media.
5. Exhibit skills on inoculation, establishing callus culture and micropropagation.
6. Acquire skills in observing and measuring callus growth

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – III | Practical based on DSC I | 02 |

**DSE Plant Tissue Culture- Elective-I**

**Laboratory Exercises**

1. Principals and applications of- Autoclave, Laminar Airflow, Hot Air Oven.
2. Sterilization techniques for glass ware, tools etc.,
3. MS medium - Preparation of different stock solutions; media preparation
4. Explant preparation, inoculation and initiation of callus from carrot.
5. Callus formation, growth measurements.
6. In vitro meristem culture
7. Synthesis of artificial seeds

**Model Question Paper for Practical Examination**

**Semester – I**

**Elective-I Plant Tissue Culture-I**

**Max. Time: 3 Hrs.** **Max. Marks: 50**

| | |
|---|---|
| 1. Demonstration of a sterilization technique 'A' | 05 |
| 2. Preparation of MS medium 'B' | 10 |
| 3. Demonstration of callus culture technique/growth measurements 'C' | 10 |
| **Internal** | |
| Viva Voce | 10 |
| Record | 05 |
| Assignment/lab visit | 10 |

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester I**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSE-I BOT104-D** | **Advanced Plant Physiology Elective** | **03** |

**Cos :** On completion of the course, the student should be able to
The course will deal with various advanced plant physiological fundamental aspects, evolutionary physiology, secondary metabolites and defence system

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|---|---|
| **Unit-I** | **Water, minerals uptake and transport**<br>Physiological regulation of mineral homeostasis, absorption and adaptive strategies under different environmental conditions; Soil–Plant–Atmosphere Continuum. Hydraulic conductance, Aquaporins. |
| **Unit-II** | Mineral uptakes through Plant–microbe interactions (rhizoplane, rhizosphere, endosphere, and phyllosphere), their role in providing nutrients, vitamins, energy minerals, and protection them from pathogens; plant holobionts; regulation of nutrient transport, homeostasis (iron and phosphorus uptake). Micronutrient acquisition. |
| **Unit-III** | **Evolutionary dynamics of photosynthesis**<br>Evolution and diversity of photosynthesis from bacteria to higher plants, Carbon-concentrating mechanisms in bacteria, algae and plants.<br>Damage avoidance and repair; photoprotectant in cyanobacteria and higher plants.<br>Stoichiometry of electron transport yields. |
| **Unit-IV** | Path of carbon: Light Reaction, Involvement of reaction centre, Kelvin cycle, Sources ribulose and Sedoheptulose. Electron Pathways. |
| **Unit-V** | **Evolutionary dynamics of photosynthesis**<br>Role of light in the activation of dark phase enzymes, regulation of RUBISCO, PEPcase, light effect, modulators and coordination of light , dark phase. C4 Photosynthesis: inter and intra-cellular transport of metabolites, carbonic anhydrase, PEPcase, NADP-MDH and PPDK. Regulation of CAM through transport of metabolites. |
| **Unit-V** | **Evolutionary dynamics of photosynthesis**<br>Evolutionary timeline and phylogenetic distribution of Rubisco; Photorespiratory bypasses and energy cost, facultative CAM, Economically important $C_4$ and CAM species, Turbocharging rice, Artificial photosynthesis, Photosynthetic fungi and animals |
| **Unit-VI** | **Translocation of Photosynthates**<br>Regulation of translocation of photosynthates, signaling mechanism for transport of photo assimilates flow; factors affecting translocation, sieve elements sealing, P-proteins; companion cells as reservoir; comparative account of source to sink transport in symplastic and apoplastic phloem leaders<br>Role of Sucrose–H+ symporter; polymer-trapping model; Phloem Unloading; sink-to-source transition. |

**Suggested Reading:**


1. Davies, P.J. (2004). Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
2. Jordan, B.R. (2006). The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
3. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry (5thed.). New York
4. Buchanan, Gruissem and Jones. 2002. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
5. Annual Review of Plant Biology (formerly Annual Review of Plant Physiology and Plant Molecular Biology).

6. **BASIC REFERENCES:** Alberts et al., Molecular Biology of the Cell (parts related to plants); Salisbury and Ross, Plant Physiology; Taiz and Zeiger, Plant Physiology; Hopkins and Huner, Introduction to Plant Physiology.
7. **CURRENT LITERATURE** (JOURNAL ARTICLES): Plant Physiology, The Plant Cell, Journal of Plant Physiology, Physiologia Plantarum, Plant Physiology and Biochemistry, Postharvest Biology and Technology, Hortscience, Journal of the American Society for Horticultural Science, Science, Nature, Scientific American etc.
8. Many plant physiology journals can be viewed via the net. The URL of one of the sites listing these journals is: http://www.e-journals.org/botany/

**Learning Outcome:**

After successful completion of this course, students will be able to:

1. The students will learn and demonstrate the physiological mechanisms of Water, minerals uptake and transport; they can correlates with present day's challenges for plant growth, development and survival.
2. The students will understand the evolutionary history of photosynthetic organisms and their adaptability in changing environmental conditions; they can interpret the photosynthetic productivity in relation to changing climatic conditions and food security
3. They will acquire the knowledge and demonstrate the various mechanisms of translocation of photosynthetic products to different sink
4. The students will learn various plant responses against environmental changes and challenges; they can understand unique strategies of plants to resolve the various stresses

| **Semester I**<br>**Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| **Practical III** | Practical based on DSE I | **02** |

**List of Experiments:**

1. Assay of catalase, peroxidase and ascorbic acid oxidase activity; determination of Km value of Urease.
2. Complexometric assay of Calcium and Magnesium
3. Colorimetric estimation of IAA.
4. Isolation of chloroplast and assay of Hill activity
5. Tetrazolium test of seed viability
6. Estimation of total phenolic content from seeds.
7. Colorimetric estimation of amino groups by Ninhydrin reaction.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I (Botany), SEMESTER – I (NEP-20)**

**PRACTICAL-III: Advanced Plant Physiology Elective (DSE-I)**

| **Time: 3 Hrs.** | **Marks: 25+25=50** |
|---|---|
| Q.1: Setting and working on any major experiment | 20 |
| Q.2: Setting and working on any Minor experiment | 15 |
| Q.3: Estimation of biological compounds | 15 |
| **Practical Internal** | |
| Q.4: Viva-Voce | 10 |
| Q.5: Practical Record, Attendance and Assignments | 15 |

**Part B**

**Syllabus Prescribed for 2023 Year** **PG.Programme**

**Programme** **M.Sc.**

**Botany**

**Semester I**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSE-I BOT104-E** | **Title of Subject Basic and Applied Mycology** | **03** |

**Cos:**

Upon completion of this course successfully, students would be able to

1. To identify the distribution of fungi in nature.
2. To study positive and the negative roles of fungi in life.
3. Discuss the systematic classification of fungi.
4. Describe the general characters of fungi.

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|---|---|
| **Unit-I Diversity of Fungi** | Fungi: Status of fungi in the living world, Physiology and growth of fungi, Recent trends in the classification of fungi, Molecular fungal taxonomy. The structure and composition of fungal cell, The growth and form of fungal cell Thallus organization, Nutrition (Saprotrophs, Biotrophs, Necrotrophs, Symbiotrophs) and reproduction (Asexual and Sexual) and evolution of fructifications in fungi Fungal Cytology and Genetics: Heterothallism, Heterokaryosis and Parasexuality Global contributions of important mycologists including Indian mycologists. |
| **Unit-II Myxomycota** | 1.1 Fungal diversity, Major taxonomic groups, Structure, Reproduction, Life cycle and Significance of the following representative: Gymnomycota – Cellular slime moulds (Dictyostelium), Plasmodial slime molds. |
| **Unit-III Mastigomycota** | a. Mastigomycota- Coelomomyces, Langenidium, Achlya, Phytophthora, Peronospra, Plasmodiophora.<br>b. Amastigomycota – Zygomycotina – Mucor, Synephalastrum, Blakeslea, Cunninghamella, Entomorphthora |

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|---|---|
| **Unit-IV Fungi in Agriculture** | Mycorrhizae Ectotrophic, endotrophic and Ectendotrophic mycorrhizae.<br>Role and importance of AM fungi in agriculture.<br>Fungi as Biological control of pest.<br>Entomogenous fungi<br>Nematophagous fungi<br>Mycoherbicides<br>Fungi as bio fertilizers |
| **Unit-V Fungi as Food** | Mushroom definitions, Characteristics of mushrooms<br>Edible mushrooms and their cultivation practices<br>General account and importance of Oyster, white button, paddy straw, Morels, Truffles & Poisonous mushrooms<br>Cultivation and economics of Agaricus bisporus, Pleurotus and Volvoriella<br>Medicinal and nutritional value of edible and poisonous mushrooms<br>General techniques and their application in improving mushroom production |
| **Unit-VI Fungi in Industry** | Production of alcohol, antibiotic, and organic acids.<br>Fermentation methods and biomass production of fungi<br>General account of production and application of Industrial fungal enzymes<br>General account of production and application of primary metabolites (vitamins and proteins).<br>General account of production and application of secondary metabolites (pigments and alkaloids) |
| **Suggested Reading:** | |
| 1. Illustrated Generic names of Fungi Miguel Ulloa, E. Aguirre-Acosta APS PRESS 2019<br>2. Illustrated Dictionary of Mycology Miguel Uloa, Richard T. Hanlin Amer Phytopathological Society; 2000 ISBN-10: 0890542570; ISBN-13: 978-0890542576 | |

3. Introductory Mycology, 4ed C.J. Alexopoulos, C.W. Mims, M. Blackwell Wiley; Fourth edition, 2007 ISBN-10: 8126511087; ISBN-13: 978-8126511082
4. K. R. Aneja An Introduction to Mycology New Age International Private Limited; Second edition; 2015 ISBN-10: 8122437966; ISBN-13: 978-8122437966
5. Alexopoulos, Mims and Blackwell. Introductory Mycology, Fourth Edition. John Wiley & Sons, New York, 1996
6. Arora, David, Shepherd, Glenn, Economic Botany, Vol. 62, #3, The New York Botanical Garden Press, Bronx, NY, 2008
7. Ainsworth, G.C. and A.S.Sussman (eds). The Fungi, An advance Treatise Vol.I, II, III & IV Academic Press, New York. 48. Alexopoulos, C.J. and Mims C.W. (1979).
8. Introductory Mycology 3rd Edition, John Wiley and Sons, Inc. Wiley, New York.
9. Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York.
10. Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
11. Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
12. Bilgrami, K.S. and H.C.Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
13. Butler E.J. and S. J. Jones (1949) Plant Pathology, Macmillan & Co. New York.
14. Dube, R.C. and D. K. Maheshwari (2000) Practical Microbiology - S. Chand & Co. Ltd.
15. Gupta, V.K. and M. K. Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rejinder Nagar, Ludhiana.
16. Jha, D.K. (1993) A Text Book of Seed Pathology, Vikas Publication House.
17. Manibhushan Rao, K. and A. Mahadevan - Recent Development in biocontrol of plant pathogenes. Today and Tomorrow publishers, New Delhi.
18. Mehrotra, R.S. and K. R. Aneja (1998) An Introduction to Mycology, New Age Intermediate Press. . Mukadam, D.S. and L.V. Gangawane (1978) Experimental Plant Pathology (edited) Marathwada University Aurangabad.
19. Pande, P.B. (1997) Plant Pathology, S. Chand & Co. New Delhi. 61. Preece and Dickeson. Ecology of leaf surface microorganism Academic Press, New York.
20. Rangaswamy, G. and A.Mahadevan (1999) Diseases of Crop Plant in India, Prentice Hall of India. 63. Sing, R.S. (1994) Plant Pathology, Oxford and IBH Publication Co. New Delhi.
21. Thind, T.S. (1998) Diseases of field crops and their management, National Agricultural Technology, Information Centre Ludhiana.
22. C. Manoharachary , K. V. B. R. Tilak, K. V. Mallaiah and I. K. Kunwar 2016,Mycology and Microbilogy, Scietific Publishers, Jodhapur Rajasthan.
23. KR Aneja, R.S. Mehrotra 2015 An Introduction to Mycology, New Age International private Limited. 67. Introduction to Fungi, Bacteria and Viruses 2017 HC Dubey Agribios, India
24. Text Book Of Fungi 2010, R.C.Gupta ,O.M.Prakash Sharma Oxford publication.

25. Text Book Of Fungi O.M.Prakash Sharma, Tata McGraw-Hill Publishing Company, 1989.

- www.drfungus.org
- www.mycobank.org
- www.mycologyonline.org
- www.aspergillus.org.uk
- www.fungusfocus.com
- www.mycology.adelaide.edu.au

**Learning Outcome:**

After successful completion of this course, studentswill be able to:

1. know the structural, physiological, genetic, and growth characteristics of fungi.
2. understand the principles and schemes used to classify fungi.
3. appreciate the beneficial roles fungi play in biotechnology, food production, and the environment
4. learn the basic techniques used to collect, grow, observe, and identify fungi.

| **Semester IV Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical –III | Practical Based on DSE-I Basic and Applied Mycology | **02** |

**Laboratory Exercises**

1. Study of the following genera
   a. Myxomycotina – *Gymnomycota* ( Dictyostelium)
   b. Mastigomycotina- Coelomycetes- (*Langenidium, Achlya, Phytopthora, Perenospora, Plasmodiophora*),
   c. Zygomycotina- (*Mucor, Synephalastrum, Blakesla, Cunninghamella, Entomorphthora*)
2. Mushroom cultivation
3. Isolation and identification of mycorrhizae.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

**PRACTICAL EXAMINATION (Botany) , SEMESTER III –(CBCS New)**

**Practical – I - Basic and Applied Mycology**

| **Practical – I (Internal Practical Examination)** | **Marks-25** |
|---|---|
| 1. Attendance | 05 |
| 2. Performance (any three fungal material ) | 09 |
| 3. Activity<br>Botanical Excursion/Short/Long- Report Submission.<br>Visit to any Biodiversity Area to study the plant diversity in natural habitat Report submission. | 03 |
| 4. Record Book | 05 |
| 5. Internal Viva-Voce | 03 |

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**NT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

**PRACTICAL EXAMINATION (Botany) , SEMESTER III –(CBCS New)**

**Practical-II- Basic and Applied Mycology**

**Practical – II (External Practical Examination)**
**Time – 4 Hours** **Max Marks-25**

| | | |
|---|---|---|
| Q.1. Salient features and identification of Fungal material (Any two) | | 10 |
| Q.2. Cultivation of Mushroom or isolation and identification of Mycorhhiza(Any one) | | 05 |
| Q.4. Spotting | | |
| (fungal material/slide) | (Any Five) | 05 |
| Q.5. External Viva voce | | 05 |

**PartB**

**Syllabus for 2023 Year** **P.G. Programme**

**Programme** **M.Sc. Botany**

**Semester-I**

| **Code of the Course Subject** | **Title of the Course/Subject** | **No. of periods/week** |
|---|---|---|
| **DSE-I- BOT104-F** | **Molecular Biology, Biotechnology &Plant Breeding- Elective-I** | **03** |

Cos: On completion of the course, the student should be able to

1.Tolearnthebasicprinciplesofmolecular biology & plant breeding

2.Todemonstratethemethodsin molecular biology & plant breeding

3. Understand the applicability of molecular biology & plant breeding in Relation to present day problems.

4. To gain the Knowledge about laboratory organization for molbio.

5. Understand various Aseptic techniques for plant tissue culture.

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|---|---|
| **Unit-I** | **Nucleic Acids** :<br>1.1Importance of nucleic acid in living systems, general composition of nucleic acids, purine and pyrimidine bases,<br>1.2**Tautomer forms of bases,** reactions of purines and pyrimidines,<br>1.3 **Structure of nucleosides** and nucleotides, deoxynucleotides, cyclic nucleotides and polynucleotides.<br>1.4 **Watson and Crick model for** DNA. Different types of DNA and RNA |
| **Unit-II** | **DNA Replication:**<br>2.1Introduction to molecular biology and genetics. Basic concept ofmolecular biology and genetics.<br>2.2**DNA Replication** in Prokaryotic and eukaryotic replication. Models of replication, theta mode of replication, rolling circle model of replication,<br>Bi directional replication, replication of linear DNA. unidirectional replication<br>2.3**Functions of various proteins** involved in prokaryotic replication of DNA and eukaryotic replication.Properties of various replication enzymes.<br>2.4**Replication of telomere**s and enzymes involved in telomere replication. |
| **Unit-III** | 3.1 **Introduction to celland tissue culture** as a technique toproduce novel plants and hybrids; Tissue culture media (composition and preparation).<br>3.2**Initiation and maintanace** of callus and suspension culture,single cell clones.Organogenesis, somatic embryo genesis, transfer andestablishment of cut whole plant in soil Shoot tip culture<br>3.3 **Rapid clonal propagation** and productionof virus free plants; Embryo culture and embryo rescue;Protoplast isolation, culture and fusion selection of hybridcells and regeneration of hybrid plants, symetric andasymetric hybrids, cybrids;<br>3.4 **Anther, pollen and ovary culture**for production of haploids plants and homozygous line;Cryopreservation , slow growth and DNA banking for germplasm |

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| | conservation; Green house and green hometechnology |
| **Unit-IV** | 4.1 **Milestones of inventions in Genetic Engineering**; DNA chemical synthesis, separation by electropherosis, various types of agarose used in electropherosis and PAGE,<br>4.2 **Denaturating agents** used in gel electropherosis, cloning, control of expression of cloned genes, cloning and patenting of life forms.<br>4.**3Guidelines on experimentation** in genetic engineering. Guidelines of bio- safety according to WHO (Geneva Convention) and DBT India. |
| **Unit-V** | 5.1**Molecular tools:** Polymerase enzymes, Nucleic acidmodifying enzymes, nucleic acid ligases, proteases,<br>5.2 **Typesof restriction enzymes** and their sub types and application,various types of DNA and RNA markers and methods ofcalculation of molecular weight of nucleic acids. |
| **Unit-VI** | 6.1 **History of Plant Breeding** (Pre and post-Mendelian era); Objectives of plant breeding,characteristics improved by plant breeding;<br>6.2**Patterns of Evolution** in Crop Plants- Centres ofOrigin-biodiversity and its significance. Genetic basis of breeding self- and crosspollinatedcrops including mating systems and response to selection - nature of variability, |

**SuggestedReading:**


1.Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000

2. DNA Cloning: a Practical Approach, D.M. Glover and B.D. Hames, IRL Press, Oxford, 1995

3. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu, D. Kim and L.J: Cseke, CRC Press, Florida, 1995

4. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc.San Diego, 1998

5. Methods in Enzymology Vol 185, Gene Expression Technology,D.V. Goeddel, Academic Press, Inc., San Diego, 1990

6.DNA Science. A First Course in Recombinant Technology, D.A. Mickloss and G.A. Freyer, Cold Spring Harbor Laboratory Press, New YorK, 1990

7 Molecular Biotechnology (2"d Edn.), S.S. Primrose, BlackwellScientific Publishers, Oxford, 1994

8. Milestones in Biotechnology. Classic papers on GeneticEngineering, J.A. Davies and W.S. Reznikoff, Butterworth-Heinemann, Boston, 1992

9. Route Maps in Gene Technology, M.R. Walker and R. Rapley,Blackwell Science Ltd., Oxford, 1997

10. Genetic Engineering. An Introduction to gene analysis andexploitation in eukaryotes, S.M. Kingsman and A.J. Kingsman,Blackwell Scientific Publications, Oxford, 1998

11. Molecular Biotechnology - Glick.

12 Recombinanat DNA and Biotechnology: Guide to teachers byHelen Kreuzer

13. Academia to biotechnology By Jeffery M Gimble

14. Biotechnology and safety assessment by Jhon A Thomas
15. Methods in biotechnology by Michel Schweizer
16. Bioethics an introduction for the Bioscience By Mepham.Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
17. Breeding Field Crops. Oxford & IBH. Chopra VL. 2001.
18 Plant Breeding. Oxford & IBH. Chopra VL. 2004
18. Practical Plant Breeding. Agribios. Gupta SK. 2005.
19.Breeding Asian Field Crops. Oxford & IBH. Pohlman JM & Bothakur DN. 1972
20. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ. House. Roy D. 2003.
21.Principles and Practice of Plant Breeding. Tata McGraw-Hill. Sharma JR. 2001.
22.Principles of Crop Improvement. English Language Book Society Simmonds NW. 1990..
23 Plant Breeding. Kalyani. Singh BD. 2006.
24 .Objective Genetics and Plant Breeding. Kalyani. Singh P. 2002.
25 Essentials of Plant Breeding. Kalyani. Singh P. 2006
26. Genetic Bases and Methods of Plant Breeding. Singh S & Pawar IS. 2006.
27.Quantitative Genetics and Selection in PlantBreeding. Walter de Gruyter Wricke G & Weber WE. 1986.
28.Singh P & Narayanan SS. 1993. Biometrical Techniques in Plant Breeding.Kalyani
29.Biometrical Genetics. Chapman & Hall. Mather K & Jinks JL. 1971.
30 .Watson J.D, Baker T.A, Bell S.P, Gann A, Levine M and LosickR.Molecular Biology of the Gene. . Benjamin-Cummins Publishing Co.,

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**Learning Outcome:**

**After successful completion of this course, students will be able to:**

1.To make acquainted with various latest genetic engineering

2. Explain the basics, methodology and applications of plant tissue culture.

3. Design experiments for functional characterization of plant genes and to identify those suitable for creating agronomically important traits.

4 Conceptualize plant transformation, selection of desirable genes for crop improvement, design binary vector and procedure for generating GM crops.

| **Semester I** | **Code of the Course/Subject** | **(No. of Periods/Week)** |
|---|---|---|
| Title of the Course/Subject | (Laboratory/Practical/practicum/ hands-on/Activity) | 02 |

**List of Experiments:**

1.Quantitation of nucleic acids.
2 Isolation of plasmid DNA.
3.Isolation of RNA
4. SDS – PAGE.
5. To extract genomic DNA from leaves and to analyse the extracted DNA by Agarose Gel Electrophoresis.
6.Mechanical isolation of mesophyll protoplasts.
7. Protoplast fusion using polyethylene glycol solution.
8. Emasculation and bagging of flowers of Brasicaceae, Malvaceae, and liliaceae,
9.Principles of spectrophotometry,

10.Preparation of stocks - macronutrients, micronutrients, vitamins and hormones, filter sterilization of hormones and antibiotics. Preparation of Murashige and Skoogmedium.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I (Botany), SEMESTER – I (NEP-20)**
**PRACTICAL-III: Molecular Biology, Biotechnology, and Plant Breeding-**
**Elective-I DSE-I**

| **Time: 3 Hrs.** | **Marks: 25+25=50** |
|---|---|
| Q.1: Setting and working on any major experiment | 15 |
| Q.2: Setting and working on any Minor experiment | 05 |
| Q.3 Comment on principle and working of analytical instrument. | 05 |
| **Practical Internal** | |
| 1. Attendance | 05 |
| 2. Visit to any Molecular/Biotechnology & Report Submission. | 10 |
| 3. Activity- Botanical Excursion/Short/Long- to study the plant diversity in natural habitat Report Submission. | 05 |
| 4. Record Book | 05 |

**Other Stream/ Faculty Course**

| | | |
|---|---|---|
| **Part B** | | |
| **Syllabus Prescribed for 2023 Year** | | **PG. Programme** |
| **Programme** | | **M.Sc. Botany** |
| **Semester I** | | |
| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
| **BOEC I** | **Medicinal Plant Diversity** | **04** |
| **Cos:**<br>1. To study the Ethnic tribes in ethnobotany<br>2. To study the significance and cultivation of medicinal plants<br>3. To make students aware about IPR.<br>4. To know the organizations' working in these lines. | | |
| **Unit-I** | History of Medicinal and Aromatic Plants, terms used in herbal medicine Ayurveda, Siddha, Unani, Homeopathy, Aroma Therapy. | |
| **Unit-II** | Importance of Medicinal Plants, Databases Organization, Natural Sweeteners, Herbal Products and Preparation. | |
| **Unit-III** | Cultivation practices of some medicinal plants like: *Asparagus, Chlorophytum, Tinospora cordifolia, Dioscorea*, *Aloe* sp. Conservation, Rate data book, CBD, FAO Mandate. | |
| **Unit-IV** | Ethno Botany: History, significance, scope and objective, branches , Tribes of India, Ethno-Medicine, | |
| **Unit-V** | Intellectual property rights: IPR, Patents, Trade secrets, Trademarks, TRIPS, PGR, Copyrights, GATT & International Trade. | |
| **Suggested Reading:** | | |

1. V.V. Sivarajan & I. Balachandran, (1994). Ayurvedic Drugs and their Plant. Oxford & IBH.
2. Cultivation of Medicinal and Aromatic Plants by A.A. Farooqi (2004).
3. Ethnomedicine and Human Welfare by Irfan Ali Khan and AtiyaKhatun (Vol- I, II, III, IV & V)
4. Handbook of Ayurvedic Medicinal Plants by L.D. Kapoor (2005).
5. Handbook of MAPs by S.K. Bhattacharjee (2009).
6. Handbook of Medicinal and Aromatic Plants by S.K. Bhattacharjee (2004).
7. Indian Medicinal Plants (Vol 1- 4) by K.R. Kirtikar and B.D. Basu (2006).
8. Indian Medicinal Plants by P.C. Trivedi (2009).
9. Indigenous Medicinal Plants Social Forestry & Tribals by M.P. Singh et al. (2003).
10. IPR, Biosafety and Bioethics by Goel and Parashar (2013)
11. IUCN Red List Categories by IUCN (1993).
12. Medicinal and Aromatic Plants by H. C. Srivastava, ICAR (2014)
13. Medicinal and Poisonous plants of India, by C. Algesi Boopathi (2021)
14. Medicinal Plants Cultivation: A Scientific Approach by S.S. Purohit (2004).

15. Medicinal Plants: Chemistry and Properties by M. Daniel, Oxford & IBH Publishing Co. Pvt. Ltd.
16. Medicinal Plants: Conservation Cultivation & Utilization by A.K. Chopra, Daya publishing house, Trinagar, Delhi (2007).
17. Psychoactive Medicinal Plants: Hallucinogenic and Narcotic Drugs by Rita Singh; Global Vision Publishing House (2017)
18. Recent Progress in Medicinal Plants Vol.12, Globalization of Herbal Health by A.K. Sharma (2006).
19. Text Book of Medicinal and Aromatic Plants, ICAR (2018)
20. Tribal India, by Nadeem Hasnain (2021)
21. Tribes of India (Vol- I & II) by A. Ashok and P. V. Lakshmaiah (2018)
22. Medicinal Plants of Uttarakhand by C.P. Kala (2010).
23. Handbook of Ayurvedic Medicinal Plants by L.D. Kapoor (2005). Medicinal Plants: Biodiversity and Drugs - M. K. Rai, G A. Cordell, J L. Martinez, M Marinoff, L Rastrelli
24. Modern Phytomedicine – Ahmad Iqbal, Aqil Farrukh, Owais Mohammad
25. Herbal medicine: bimolecular & clinical aspects - FF Benzie & SW Galor
26. Quality Control of Herbal Drugs – PK Mukherjee

**Learning Outcome:**

The students will be able to

1. Explain and elaborate the history, scope and significance of medicinal plants.
2. Apply this knowledge in cultivation of medicinal plants that are rare and endangered.
3. Practically use some of these plants in minor ailments.
4. Know *ex-situ* and *in-situ* conservation of some rare medicinal plants.
5. Patenting and preservation of Traditional knowledge.

**Scheme of Teaching, Learning & Examination leading to Two Years PG Degree Master of Science in the Programme Botany**
**following Three Years UG Programme wef 2023-24**
**Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option**
**(M.Sc. Part I) Semester II**

| S. N. | Subject | Type of Course | Subject Code | Teaching & Learning Scheme | | | | | | | Duration Of Exam Hours | Examination & Evaluation Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Teaching Period Per Week | | | | Credits | | | | Maximum Marks | | | | | Minimum Passing | | |
| | | | | | | | | | | | | Theory | | Practical | | Total Marks | | | |
| | | | | L | T | P | Total | L/T | Practical | Total | | Theory Internal | Theory +MCQ External | Internal | External | | Marks Internal | Marks External | Grade |
| 1 | DSC-I.2 Plant Physiology | **Th-Major** | BOT 201 | 4 | | | 4 | 4 | | 4 | 3 | 30 | 70 | | | 100 | 12 | 28 | P |
| 2 | DSC-II.2 Evolution and Diversity of Bryophytes and Pteridophytes | **Th-Major** | BOT 202 | 4 | | | 4 | 4 | | 4 | 3 | 30 | 70 | | | 100 | 12 | 28 | P |
| 3 | DSC-III.2 Plant Biochemistry, Genetics and Plant Breeding | **Th-Major** | BOT 203 | 3 | | | 3 | 3 | | 3 | 3 | 30 | 70 | | | 100 | 12 | 28 | P |
| 4 | DSE-II/MOOC (Elective Option) | **Th-Major Elective** | BOT 204 | 3 | | | 3 | 3 | | 3 | 3 | 30 | 70 | | | 100 | 12 | 28 | P |
| | DSE-II -Angiosperm Taxonomy, Phytochemistry and Pharmacognosy | | BOT204-A | | | | | | | | | | | | | | | | |
| | DSE-II -Molecular Systematics of Plants | | BOT 204-B | | | | | | | | | | | | | | | | |
| | DSE-II -Plant Tissue Culture | | BOT 204-C | | | | | | | | | | | | | | | | |
| | DSE-I I-Advanced Plant Physiology | | BOT204-D | | | | | | | | | | | | | | | | |
| | DSE-II -Basic and Applied Mycology | | BOT 204-E | | | | | | | | | | | | | | | | |
| | DSE-I -Molecular Biology, Biotechnology &Plant Breeding | | BOT 204-F | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | **Minimum Passing Marks** | | |
| 5 | DSC-I.2 Lab | **Pr-Major** | | | | 2 | 2 | | 1 | 1 | 3 | | | 25 | 25 | 50 | 25 | | P |
| 6 | DSC-II.2 Lab | **Pr-Major** | | | | 2 | 2 | | 1 | 1 | 3 | | | 25 | 25 | 50 | 25 | | P |
| 7 | DSC-III.2 Lab | **Pr-Major** | | | | 2 | 2 | | 1 | 1 | 3 | | | 25 | 25 | 50 | 25 | | P |
| 8 | DSE-II Laboratory/MOOC Lab | **Pr-Major Elective** | | | | 2 | 2 | | 1 | 1 | 3 | | | 25 | 25 | 50 | 25 | | P |
| 9 | # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively** | **Related to Major** | | **120 Hours cumulatively during vacations of Semester I and Semester II** | | | | | | 4* | | | | | | | | | P* |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8** | **Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV** | Generic **Optional** | | **90 Hours Cumulatively From Sem I to Sem IV** | | | | | | | | | | | | | | |
| | | | | **Exit Option with a PG Diploma with 4 Credits On-the-job training/internship in the respective Major subject**<br>• **Student has to earn Total minimum 4 Credits cumulatively during Vacations of Semester I and Semester II from internship in order to exit after First Year with PG Diploma (42-44 Credits) after Three Year UG Degree** | | | | | | | | | | | | | | |
| | **TOTAL** | | | | | | | | | **18+4*** | | | | | | **550** | | | | |

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: Prq, Theory : Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Discipline Specific Core: DSC, Discipline Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research Methodology; Research Project: RP, Co-curricular Courses: CC

Note : # On Job Training, Internship/ Apprenticeship; Field projects Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II.

This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSC I- BOT-201** | **Plant Physiology** | **04** |

**Cos :**

1. This course aims to educate student on concepts of proteins, enzymes, basic plant signaling mechanisms, sensory photobiology. The course further deals with physiology of nutrient uptake, photosynthesis and nitrogen metabolism.
2. To make them aware about the latest techniques used in plant sciences
3. To make friendly about the tools and techniques.
4. To know the principle and applications of these techniques.

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|---|---|
| **Unit-I** | **Bioenergetics, enzyme kinetics:**<br>Thermodynamics, entropy, enthalpy; Bioenergetics; Gibbs's free energy, concept of catalysis and mechanism, types of enzymes, enzyme kinetics, enzyme regulation and inhibition; isozymes |
| **Unit-II** | **Photosynthesis:**<br>Light-harvesting complexes and their evolution; energy funneling, antenna pigment system, photoprotective mechanisms; mechanisms of electron transport; photosynthesis inhibitors, carbon fixation; C3, C4, and CAM pathways and their evolutionary relationship, adaptability and crop productivity; photorespiratory pathways; C2 cycle and its significance. |
| **Unit-III** | **Respiration and secondary metabolites:**<br>Regulation of glycolysis; citric acid cycle, alternate oxidase; plant mitochondrial electron transport and ATP synthesis; PPP, Glyoxylate pathway and its significance.<br>Stress Physiology: responses to biotic and abiotic stresses. |
| **Unit-IV** | **Plant hormones and photomorphogenesis:**<br>Biosynthesis, storage, breakdown, and transport; physiological effects and mechanisms of action. Auxins Gibberellins, Cytokinins, Ethylene, Abscissic acid, Brassinosteriods, Jasmonic acids, Polyamines, salicylic acid.<br>Structure, function and photomorphogenic responses, of phytochromes, cryptochromes and phototropin, photoperiodism and floral induction, Biological Clocks; Stomata movements. |
| **Unit-V** | **Solute transport and photo assimilate translocation:**<br>Uptake and transport of water, minerals, ions, solutes and macromolecules from soil through cells, xylem and phloem; membrane transport proteins; active, passive transport, mechanisms of loading and unloading of photo assimilates.<br>Assimilation of nitrate, ammonia, sulphur and phosphate. |
| **Unit-VI** | Electrophoresis: Principle, types, separation of proteins and nucleic acids, buffer, detection assay, storage, safety of application. Western blotting, Northern blotting, southern blotting<br>Fundamentals of chromatographic separation methods – Definition, Principles of chromatography, sorption mechanisms - differential migration, partition and adsorption phenomena; Classification of different chromatographic methods; Methods of development- Elution development, Gradient elution development, displacement development and frontal analysis. Dynamics of chromatography-efficiency of chromatographic column, zone spreading, Height Equivalent to Theoretical plate (HETP).<br>Thin Layer Chromatography: Principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromatoplate, types of development, visualization methods, documentation, applications in the separation, HPTLC principle, technique, applications. |

**Suggested Reading:**

5. Buchanan B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
6. Galston, A.W. 1989. Life Processes in Plants. Scientific American Libray, Springer-Verlag, New York,USA.
7. Hooykaas, P.J.J., Hall, M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amesterdam, The Netherilands.
8. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
9. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D., and Darnell, J. 2000. Molecular Cell Biology (fourth edition).
10. W.H. Freeman and Company, New York, USA.
11. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
12. Nobel, P.S., 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
13. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
14. Singhal, G.S., Renger, G., Sopory. S.K., Irrgang, K.D. and Govindejee 1999. Concepts in Photobiology. Photosynthesis and Photomorphogenesis, Narosa Publishing House, New Delhi.
15. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Academic Press, San Diego, U.S.A. Westhoff, P. (1998) Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford, UK.
16. Plummer, D.T. 1988. An Introduction to practical Biochemistry. Tata McGraw Hill Publishing Co.Ltd.New Delhi.
17. Wilson,K. and Goulding, K.H. (Eds), 1992. A Biologist Guide to Principles and Techniques
18. Practical Biochemistry (3rd Edition). Manas Saikia for Foundation Books, New Delhi.
19. Sadasivam, S. and Manickam A., 1996. Biochemical methods (2nd Edition). New Age International Publishers New Delhi.
20. Schewer M.A. and Zeclinskin.1989. Methods in plant Molecular biology. Academic Press New York.
21. Wilson E and Walker J. 2000. Practical Biochemistry Principles and Techniques. Cambridge publications.
22. Ream W and Field K.G.1999. Molecular Biology Techniques Academic Press London.
23. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill
24. Publishing Co. Ltd. New Delhi. 3rd edition.
25. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
26. Douglas A. Skoog, Donald M. West and F. James Holler, analytical chemistry an introduction, Saunders college publishing, New york, 1990.
27. J. Bassett, R.C. Denny, G. Jeffery and J. Mendham. Vogel's text book of inorganic Quantitative analysis, 4th edition, Longman group Ltd, Harlow, 1985.
28. Pietrazyk and Frank. Analytical chemistry, 1990.
29. KVSG Muralikrishna, An Introduction to ISO 14000, Environmental Management, 1998.
30. Y.Anjaneyulu, Quality Assurance and GLP – IGNOU Pub., New Delhi, 1999.
31. Omachonu V.K.and Ross J.E. Principles of Total quality , S.Chand & Co.Ltd., New Delhi, 1997.
32. Werner Funk, Vera Damman, Gerhild Donnervert. Quality Assurance in Analytical Chemistry,VCH Publishers, New York, NY (USA), 1997.
33. Bertamd L.Hanser and Prabhakar Ghani. Quality Control and Applications, Prentice-Hall

**Learning Outcome:**

1. Students would be able to demonstrate a depth of knowledge of physiological processes together with a better understanding of interaction and regulation of growth, metabolism and development and influence of environment on plant and further will be able to communicate scientific ideas in both written and oral forms to diverse audiences.
2. The students would be able to showcase knowledge of various signal transduction mechanisms in plants. The concept of second messengers, calcium signaling, kinases/phosphatases in plant signaling would be delineated to

enhance their grasping power for understanding of different signaling pathways operative in plants. Two component signaling concept would be introduced and extended to plant hormone signaling. Quorum sensing and its potential biotechnological applications should be clear to students after these classes.

3. During the course students would gain knowledge about various mechanisms such as channel or transport proteins involved in nutrient uptake in plants. Further the course will deal with various phytohormones and their role in physiology of growth and development. This course will introduce students to physiological advances in sensory photobiology.

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSC II BOT-202** | **Evolution and Diversity of Bryophytes and Pteridophytes** | **04** |

**Cos :**

1. To understand evolutionary diversification of early land plants and morphology and reproduction in bryophytes, pteridophytes.
2. To know the Ecological and Economic Importance of bryophytes, pteridophytes.
3. To classify Bryophytes into various groups, study their importance
4. To classify Pteridophytes into various groups, study their importance and multiplication of important ferns
5. To know the applied aspects of Bryophytes and Pteridophytes.

| | |
|---|---|
| **Unit I: Bryophyta** | 1. Evolutionary trends in Bryophytes with special emphasis on thallus organization and sporophyte evolution, fossil Bryophytes, Bryology in India.<br>2. G. M. Smith (1955) Classification of Bryophyta<br>3. Thallus Organization; Internal structure and reproduction, Comparative account and distinguished adoptive feature of: -<br>**Hepaticae:**<br>i. Sphaerocarples<br>ii. Marchantiales<br>iii. Anthocerotales<br>iv. Jungermanniales<br>v. Metzgeriales<br>vi. Calobryales |
| **Unit II: Bryophyta** | 1. Alternation of generation in Bryophytes.<br>2. Thallus Organization; Internal structure and reproduction with special reference to key distinguishing characters in: -<br>**Musci:**<br>i. Sphagnales<br>ii. Andreales<br>iii. Eubryales<br>iv. Takakiales<br>3. Contribution of Shiv Ram Kashyap, Ram Udar and S. C. Srivastava in Bryology.<br>4. Endemism and endemic liverwort genera of India and conservation of bryophytes. |
| **Unit III: Pteridophyta** | 1. A brief account of origin of pteridophytes, heterospory and seed habit, evolution of steler system, telome theory, evolution of sorus, apogamy, apospory and apomixis.<br>2. G.M. Smith (1955) Classification of Pteridophyta.<br>3. A brief account of the following classes with emphasis on evolution:<br>*i.* Psilophytopsida: *Rhynia, Horneophyton*<br>ii. Psilotopsida: *Psilotum*. |

| | |
|---|---|
| | iii. Lycopsida: *Lycopodium, Lepidodendron, Lepidocarpon, Selaginella, Isoetes*.<br>*iv.* Sphenopsida: *Hyenia, Sphenophyllum, Calamites, Equisetum.* |
| **Unit IV: Pteridophyta** | 1. The fertile sporophyte: sporangia: position, ontogeny types, structure.<br>2. Comparative study of Pteropsida: Eusporangiate (Ophioglossales and Marattiales) with special reference to phylogeny of Ophioglossales. |
| **Unit V: 1. Protoleptosporongiate** | 1. Protoleptosporongiate (*Osmunda, Leptopteris*)<br>Leptosporongiate:<br>a. Filicales (*Hymenophyllum, Adiantum, Pteris, Dryopteris*)<br>b. Marsileales (*Marsilea*)<br>c. Salvineales (*Salvinia, Azolla*).<br>2. Endangered and endemic pteridophytes and their conservation |
| **Unit VI: Role and Applications** | 1. Emerging source for herbal remedies and usability of bryophytic material in forensic studies.<br>2. Economic importance of Bryophytes, Bryophytes as monitors of mineral deposition, Air Pollution Indicators.<br>3. Diversity of Ferns - an ecological perspective, Cultivation and maintenance of ornamental ferns.<br>4. Ethnomedicinal uses of Pteridophytes. |

**Suggested Reading:**


1. Cavers, F. (1976). The inter relationships of the bryophyte. S.R. Technic, Ashok Rajpath, Patna.
2. Chopra, R. N. and Kumar, P. K. (1988). Biology of bryophytes. John Wiley& Sons, New York, NY.
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4. Kashyap, S. R. (1929). Liverworts Of The Western Himalayas And The Panjab Plain Part 1 Chronica Botanica New Delhi.
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9. Watson, E. V. (1971). Structure and life of bryophytes 3rd, Hutchinson University Library London.
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11. Vanderpoorten, A. and Goffinet, B. (2009). Introduction to bryophytes. Cambridge University Press, Cambridge ISBN 978-0-521-70073-3.
12. Goffinet, B. and Shaw, A. J. (Edited) (2008). Bryophyte biology. 2nd ed. – XIV + 565 pp., Cambridge University Press, Cambridge. ISBN 978-0-521-69322-6.
13. Dyer, A.F. (1979). Experimental biology of ferns. Academic Press
14. Ranker, T.A. and Haufler, C.H. (2008). Biology and Evolution of Ferns and Lycophytes. Cambridge University Press, Cambridge
15. Mehlereter, K., Walker, L.A. and Sharpe, J.M. (2010). Fern Ecology. Cambridge University Press, Cambridge
16. Parihar, N.S. 1991, Bryophyta, Central Book Depot, Allahabad.
17. Parihar, N.S. 1996, Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
18. Puri, P. 1980, Bryophytes. Atma Ram and Sons, Delhi.
19. Stewart, W.N. and Rothwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
20. Campbell, D.H. (1961) The evolution of Land Plants. Central Book Depot, Allahabad.
21. Smith G.M (1955) Cryptogamic Botany Vol-II. Bryophyta and Pteridophyta McGraw Hill.Book Co., New York

22. Ram Udar (1970) An introduction to Bryophyta , Sadashiv Malviya Prakashan, Lucknow.
23. B.R.Vashishta (Revised by A.K.Sinha), Reprint Edition 2005
24. Sporne, K.R.(1976) : Morphology of Pteridophytes.
25. Smith, G.M. (1976): Cryptogamic Botany Vol.II, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi.
26. Rashid,A (1976): An introduction to Pteridophyta, Vikas Publishing House, New Delhi.
27. Parihar N.S. (1976): The biology and morphology of the Pteridophyta, Central Book Depot, Allahabad.
28. Eames, A.J.(1974): Morphology of Vascular Plants- lower groups,Tata Mc-Graw Hill publishing Co., New Delhi.

**Learning Outcome:**

Upon successful completion of this course, the student would be able to:

1. Classify Bryophytes into various groups, study their importance
2. Classify Pteridophytes into various groups, study their importance and multiplication of important ferns
3. Create awareness on the threats to biodiversity and sensitize towards the Biodiversity Conservation for sustainable development.

**Part B**

**Syllabus Prescribed for 2022 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

| Code of the Course Subject | Title of the Couse/ Subject | No. of periods/ week |
|---|---|---|
| **DSC III BOT-203** | **Plant Biochemistry, Genetics and Plant Breeding** | **03** |

**Cos:**

1 To understand the concept of classical and modern genetics clearly.
2 To study the inheritance pattern.
3 To know the role of chromosomes in evolution and the factors leading to changes in them.
4 To study mutations and breeding and their significance in crop improvement.
5 To study the variation in populations.
6 To study the plant biochemistry and its various aspects.
7 To study the metabolism and regulation of bio molecules

| | |
|---|---|
| **Unit-I** | **Carbohydrates**:<br>Structure and physico-chemical properties of carbohydrates, biological significance, important glycoprotein, Lipids: Classification, structure and properties of important lipids, biological significance of glycolipids, fatty acid biosynthesis and storage. |
| **Unit-II** | **Amino acids:**<br>• Uptake, Assimilation and Reduction of Nitrogen<br>• Amino acid classification, properties, functions<br>• Biosynthesis of Amino acid<br>**Lipids:**<br>• Classification, Structure and properties, functions,<br>• Biosynthesis of Fatty acids,<br>• Membrane lipids, Structural lipids, Storage lipids,<br>• Catabolism of lipids,<br>• Phospholipids, Sphingolipids, derived lipids, |
| **Unit-III** | Gene Concept, Mendelian vs. neo mendelian inheritance; codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance, expressivity and phenocopy. Mitochondria and chloroplast Genome, its inheritance and effect, |
| **Unit-IV** | Chromosome structural aberrations; deletion, duplication, inversion, translocation, complex translocation. |

| | |
|---|---|
| | Chromosomal Numerical aberrations, Euploidy and aneuploidy and their genetic implications.<br>Polyploidy: Types, origin and meiotic behaviour,<br>Karyotype analysis; method and evolution; banding patterns, applications |
| **Unit-V** | Plant Breeding; history, Breeding methods; self-pollinated crops; mass selection, pureline selection, pedigree selection, bulk method, backcross method, Clonal selection, Hybridization<br>Mutational breeding; methods, types, treatments, selections of mutants<br>Role of polyploids in plant breeding, heterosis and inbreeding depression |
| **Unit-VI** | Population genetics: Allele frequencies and genotype frequencies, random mating and Hardy-Weinberg principle, Implications of Hardy-Weinberg principle, rate of change in gene, frequency through natural selection, mutation, migration and random genetic drift.<br>Biostatistics: samples, data, graphs, frequency distribution, mean, variance and deviation, Binomial and Poisson distribution and Chi-Square test. |

**Suggested Reading:**


1. Atherly, A.G., Girton, J.R. and Mc Donald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, New York
2. Benjamin A. Pierce. 2003. Genetics: A Conceptual Approach. W.H, Freeman and Company, New York, NY.
3. Gardner E.J., Simmons, M.J., and Snustad, D.P. 1991. Principles of Genetics, ($8^{th}$ edition) John Wiley & Sons Inc., New York.
4. Griffith A.F. J., Miller, J.H, Suzuki, D.T., Lewontin, R.C., Geibart.,W.M, 1993. An Introduction to Genetic analysis (7th edition). W.H Freeman & Company, New York.
5. HartI D. L., Jones E.W. 2001. Genetics an analysis of Genes and Genomes ($5^{th}$ edition). Jones & Bartlett Publishers, Boston
6. Klung, W. and Cummings, M. R 2003. Concepts of Genetics. ($7^{th}$ edition) Pearson Education, Singapore.
7. Russell, P.J. 2005. Genetics A Molecular Approach ($2^{nd}$ edition). Pearson/Benjamin Cummings, San Francisco.
8. Stansfield 1991. Genetics ($3^{rd}$ edition), Schaum's outline series, McGraw Hill, New York.
9. Weaver, R.F and Hedrick P.W. 1997. Genetics (3rd edition), Wm. C Brown Publishers.
10. Toronto. Fukui, K. and Nakayama, S.1996. Plant Chromosomes: Laboratory Methods. CRC Press, Boca Raton, Florida.
11. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia,
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18. Sen, S. Kar, D.K. 2005. Cytology and Genetics – Narosa Publishing House, New Delhi.
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20. Backcock., E.B. 2001 Genetics and Plant breeding. Agrobios (India), Jodhpur
21. Basra, A. S.2000. Heterosis and hybrid seed production In Agronomic Crops (Basra, A.S. Ed.). M.S. Swaminathan Research Foundation, Taraman Industrial Area, Chennai.
22. Bose, T.K., Mitra S.K. & Sadhu, M.K.1986. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prakash, Calcutta.

23. Briggs, F.N & Knowles, P.F 1967. Introduction to Plant Breeding. Reinhold Publ. Co., New York/ Amsterdam/ London.
24. Chopra,V. L. 2000. Plant Breeding. Theory and Practicals (2nd edition),Oxford & IBH Publ. Co. Pvt.. Ltd., New Delhi.
25. Frankel, R & Galum, E.1977. Pollination Mechanisms, Reproduction and Plant Breeding. Springer-Verlag, Berlin/ Heidelberg/ NewYork.
26. Jain H.K. & Kharkwal, M.C..(Eds.) 2004. Plant Breeding: Mendelian to Molecular Approaches.-. Narosa Publishing. House, New Delhi, Chennai, Mumbai, Calcutta.
27. Poehlman, J.M & David.A.S.1995. Field Crops (4th edition). Panima Publ. Co., New Delhi/ Bangalore.
28. Poehlman, J.M. & Borthakur, D. 1959. Breeding Asian Field Crops with Special Reference to Crops of India. Oxford & IBH Publishing Co. New Delhi, Bombay, Calcutta.
29. Russel, G.E. 1985. Progress in Plant Breeding In Russel G E (Ed.) Butter Worth & Co. Publ. Ltd., Calcutta.
30. Sharma, J R. 1994 Principles and Practice of Plant Breeding, Tata-McGraw-Hill Publ. Co. Ltd, New Delhi.
31. Simmond, N.W.1976. Evolution of Crop Plants. N.W Simmond (Ed.) Edinburgh School of Agriculture & Longman Group Ltd.
32. Bajracharya D. (1998). Experiments in Plant Physiology, Narosa Publishing House, New Delhi.
33. Bhattacharya A and Vijay Laxmi (2015). Methods and techniques in plant physiology, New India Publishing Agency, New Delhi
34. Mandal S.C., Mandal V and Das A. K. (2015), Essentials of Botanical Extraction, Academic Press, London
35. Evans W. C. (2009). Trease and Evans Pharmacognosy, Saunders Elsevier, Edinburgh
36. Wilson, E. & Goulding, K.H. 2000 A Biologists' Guide to Principles and Techniques of Practical Biochemistry ELBS.
37. Jayaraman, J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.
38. Modern Experimental Biochemistry, (3rd Edn.) R.Boyer, Benjamin Cumming, 2000.
39. Practical Biochemistry, Principle and Technique (5th Edn.) K. Wilsen and J. Walker, Cambridge University press. 2000.
40. Plant Biochemistry, P.M dey and J.B. Harborne, Harcourt Asia Ltd. Academic press, 1997.
41. Horborne. J.B. 1983. Phyto chemical methods. Chapman and Hall. London.
42. Trease. G.E. and Evanes W.C.Pharmacognosy. 12 Edition. Bailliere, Tindall, East Bourne, U.K. 1983.
43. Kokate. C.K.Purohit A.P. and S.B. Gokhale. Pharmacognosy Nivali Prakashan Publication.
44. Miller. L.P. Phyto chemistry. 1-3 volumes Van Nostrand, Reinhold Co. 1973.
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47. Sinha, R.K 2004. Modern Plant Physiology, Narosa Publishing House, New Delhi.
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49. Dewick P.M., 2002. Medicinal Natural Products: A biosynthetic approach, John Wiley & Sons Ltd.
50. Evans W.C., 2002, Trease and Evan's Pharmacognosy, W.B. Saunders.
51. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall.
52. Houghton P.J. and A. Raman, 1998. Laboratory handbook for fractionation of natural extracts, Chapman and Hall.
53. Kokate C.K., 1991. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
54. Samuelsson G., 1999. Drugs of naural origin: A text book of Pharmacognosy, Swedish Pharmaceutical Society, Swedish Pharmaceutical Press, Stockholm, Sweden.

55. Tyler V.E., L.R. Brady and J.E.. Robbers, 1988. Pharmacognosy, Indian Edition, K.M. Varghese Company, Bombay.
56. Vickery M.L. and B. Vickery, 1981. Secondary Plant Metabolism, The MacMillan Press Ltd.
57. Wallis T. 1967. Text Book of Pharmacognosy, J & A Churchill, London.24
58. Wagner H., S. Bladt and E.M. Zgainski (Translated by A. Scott) 1984, Plant Drug Analysis, Springer-Verlag.
59. Vermerris Wilfred & Nicholson Ralph, 2006, Phenolic compound Biochemistry

**Learning outcome:**

**After completion of the course student would be able to-**

1. Differentiate the genetics changes and can justify the reasons.
2. signify the maternal inheritance can be very well elaborated.
3. Explain how mutations can lead to variation and lethality.
4. Can apply their knowledge to the changes in population genetics.
5. Classify Carbohydrates, Lipids, fatty Acids and their importance

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester II Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical IV | Practical based on DSC I.2 & DSC-II.2 | **04** |

*** List of Practical/Laboratory Experiments/Activities etc.**

**Plant Physiology: (Only 12 Experiment should be perform to which 8 Major and 6 Minor).**
**Laboratory Exercises:**

**Major:**

1. Extraction of chloroplast pigments from leaves and preparation of absorption spectrum of chlorophylls and carotenoid.
2. To determine chlorophyll a, chlorophyll b and total chlorophyll ratio in C3 & C4 plants.
3. Estimation of sodium and potassium in plant material by flame photometry.
4. Determination of Ca: Mg ratio by spectrophotometry in plant tissue.
5. Preparation of the standard curve of proteins (BSA) by Biurette method.
6. Determination of Isoelectric point of Legumin.
7. Effect of GA/IAA on plant growth.
8. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.
9. To demonstrate photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE & performs Western blotting.
10. Estimation of protein content in extracts of plant material by Lowry's or Bradford's method.

**Minor:**

1. Principles of colorimetry, spectrophotometry and fluorimetry.
2. Demonstration of an electron transport system.
3. Estimation of carbon dioxide liberated during respiration.
4. To demonstrate the process of antagonism.
5. To demonstrate the process of tissue tension.
6. Detection of amino acids by chromatography.
7. Effect of various salts on the permeability of the plasma membrane.
8. Estimation of Ascorbic Acid in the given material.
9. Estimation of reducing, Non-reducing and total sugars.
10. To determine the Osmotic pressure of vacuolar sap of *Rheo discolar* or *Tradescantia* leaves by Plasmolytic method (50% plasmolysis)
11. To determine the diffusion pressure deficit (water potential) of potato tuber tissue by weighing method
12. To determine the structure, size and frequency of stomata in mesophytic and xerophytic leaves
13. To determine the rate of transpiration of plant i. Weight ii. Potometer method
14. To determine the rate of transpiration by Cobalt Chloride paper method and to calculate transpiration index (TI), Transpiration efficiency (TE) of various leaves
15. To measure the rate of photosynthesis in aquatic plants by Willmotts bubble counting method
16. To study the effect of-i. CO2; ii. Light quality and intensity; iii. Injury; iv. Temperature on the rate of photosynthesis in leaves of an aquatic / terrestrial plant
17. To extract the major plant pigments from leaves by different solubility method.
18. Demonstration of polyphenoloxidase in plant tissue.
19. Action of invertase on sucrose.
20. Effect of temperature on enzyme activity.

21. Action of salivary enzyme on starch.

**Evolution and Diversity of Bryophytes and Pteridophytes:**

1. Morphological, anatomical and reproductive studies of following members: *Targonia, Cyathodium Marchantia, Plagiochasma, Deumortiera, Anthoceros, Notothylus; Polytrichum, Pogonatum, Sphagnum*, *Funaria*.
2. Study of morphology, anatomy and reproductive structure of Pteridophytic forms *Psilotum, Lycopodium, Marsilea, Selaginella. Isoetes, Equisetum, Gleichenia, Pteris, Ophioglossum, Azolla, Salvinia, Adiantum, Angiospteris.*
3. Study of fossil forms: *Rhynia, Calamites, Calamostachys, Lepidodendron, Zygopteris.*
4. Field study
   i. Visits to the field to study distribution of Bryophytic and Pteridophytic forms.
   ii. Monographic and photographic presentation of Bryophytic and Pteridophytic material.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I Botany, Semester- II (NEP-20)**

**PRACTICAL IV:- (PLANT PHYSIOLOGY + EVOLUTION AND DIVERSITY OF BRYOPHYTES AND PTERIDOPHYTES)**

**TIME: -6 Hrs.** **Maximum Marks: -50 + 50 = 100**

| | | |
|---|---|---|
| **Q.1.** | Perform Major Experiment in Plant Physiology. | **10** |
| **Q.2.** | Perform Minor Experiment in Plant Physiology. | **05** |
| **Q.3.** | Identification of given Bryophytic form on basis of Morphology, Anatomy, and Reproductive organs from given material (One double stained slide preparation). | **10** |
| **Q.4.** | Identification of given Pteridophytic material on basis of morphology, Anatomy and Reproductive organs (one double stained slide preparation). | **10** |
| **Q.5.** | Comment on one Plant Physiology experiment set up. | **05** |
| **Q.6.** | Spotting Bryophytes (03), Pteridophytes (03) and Fossil specimen (04) | **10** |
| **Q.7.** | **Internal marks:** Practical Record (20); Viva voce (20); Student overall performance and Activity – Botanical Excursion with field study report /Monograph and Attendance (10) | **50** |

**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 2022 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester II Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – IV | Practical based on Paper DSC-III.2 | **02** |

*** List of Practical/Laboratory Experiments/Activities etc.**

**Genetics and Plant Breeding (Practical's)**
**Laboratory Exercises**

1. Preparations of Stains, Dyes, Preservatives, Fixatives and pre-treatment for the material
2. Karyomorphological studies from slides/photograph.
3. Banding studies using Giemsa, Orcein, Florescent dyes.
4. Induction of mitotic abnormalities through mutagens.
5. To determine pollen viability and germination using fluorescent dyes and cell wall staining with Calcoflour.
6. Problem on Mendelian inheritance and interaction of genes, linkage and crossing over.
7. Demonstration of SEM.
8. Feulgen staining.
9. To study polygenic inheritance
10. Study of quality traits in some local crops cotton, soybeans, Wheat , *Brassica* etc.
11. Study the Meiotic configurations in maize, Alliums', *Rheo, Tradescantia, Aloe* etc.
12. Study of chromosomal aberrations in irradiated material.
13. Use of Colchicines in induction of polyploids in suitable plant material.
14. Karyotype analysis.
15. Study of Floral Biology of some crops.

**Plant Biochemistry and Pharmacognosy:**

1. Study of powdered drugs – physical, chemical and microscopic examinations.
2. Quantitative microscopy of leaf drug – stomatal frequency and stomatal index,
3. .Determination of palisade ratio and vein islet number.
4. Qualitative determination of alkaloids, tannins, steroids and saponins from medicinal plants
5. Determination of water soluble and water insoluble ash from crude drugs.
6. Determination of foaming index from crude drugs
7. Determination of titratable organic acid from leaves and fruits
8. Estimation of phytic acid
9. Determination of total phenol content from powdered drugs.
10. Determination of free radical scavenging activity of methanolic extracts of powdered drugs.
11. Effect of pH on enzyme activity.
12. Estimation of PPO oxidase from plant sample.
13. Estimation of Riboflavin
14. Estimation of Tannins [Folin – Denis / Vanillin hydrochloride]
15. Separation of proteins by SDS-PAGE
16. Determination of Nitrate reductase activity
17. Estimation of ascorbate peroxidase enzyme from plants
18. Estimation of carbohydrate by Anthrone reagent
19. Pharmacological screening of Anti-diabetic Agents.
20. Determination of anti-oxidant activity from local plants.
21. Screening of Crude Drugs for Anti-microbial activity.
22. Phytochemical screening methods: Paper Chromatography, TLC, HPLC, Spectrometry.
23. Identification and Estimation of Lipids
24. Determination of adulteration in crude drugs.
25. Determination of extractive value of crude drugs.
26. Identification of organized and unorganized plant drugs
27. Separation of anthocyanin from flower petals using TLC
28. Extraction and estimation of lycopene.
29. Determination of pH of fresh and dry material of the following plants (Ocimum, Adhatoda leaves, Terminalia arjuna fruit,)
30. Estimation of curcumin in given sample.
31. Evaluation of natural products – estimation of the ash value and determination of water soluble and acid soluble ash (Muffle furnace);
32. Determination of moisture content of sample using moisture balance method; Determination of microscopic characters
33. Estimation of Rutin

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I Botany, Semester- II (NEP-20)**

**PRACTICAL V: - (Plant Biochemistry, Genetics and Plant Breeding)**

**TIME: -6 Hrs.** **Maximum Marks: -25 + 25 = 50**

| | |
|---|---|
| To perform Karyomorphological studies of the given material. | **05** |
| To perform given experiment on Plant breeding. | **05** |
| Spotting's on Genetics and Plant breeding | **05** |
| Perform one major Plant Biochemistry experiment. | **05** |
| Perform qualitative analysis of any two secondary metabolites from given material. | **05** |
| **Internal marks :** Practical Record (10); Viva voce (10); Student overall performance and Activity – Field visit report (Agriculture University,Nursery, Research Institute) / Monograph and Attendance (05) | **25** |

ELECTIVE OPTIONS UNDER NEP-20

**Part B**
**Syllabus Prescribed for 2023 Year** **P.G. Programme**
**Programme :** **M.Sc. Botany**
**Semester: II**

| **Code of the Course** | **Subject Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE II BOT204-A** | **Angiosperm Taxonomy, Phytochemistry and Pharmacognosy** | **03** |

**COs:**

1) Study plant morphology, Description of a plant specimen, Study of locally available families of flowering plants, Identification of genus and species of locally available wild plants.
2) Appreciate the need to conserve floristic and cultural diversity of the region.
3) Preparation of botanical keys at generic level by locating key characters.
4) To develop laboratory skill like isolation, extraction & evaluation of phytochemicals from medicinal plants.
5) To develop knowledge of herbal drugs and new commercial plant products.
6) Rescue and document Ethnobotanicals for sustainable use of plant resources.

| | |
|---|---|
| **UNIT I :** | Data sources in Taxonomy: Embryology, Palynology, Anatomy, Molecular taxonomy–DNA barcoding. Tools of Taxonomy: Application of GIS and GNSS (Remote Sensing) in Botany. |
| **UNIT II :** | Some Important Families: Magnoliaceae, Nymphaeceae, Myrtaceae, Asclepiadaceae, Poaceae, Scrophulariaceae, Verbanaceae, Loranthaceae, Cannabinaceae, Sallicaceae, Cucurbitaceae, Primulaceae, Fagaceae, Araceae, Alisimaticeae, Orchidaceae |
| **UNIT III :** | Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs. (a) Laxatives: *Aloes*. Rhuburb. Castor Oil. *Ispaghula*. (b)Cardiotonic- *Digitalis Arjuna*. (c) Carminatives and G.I. regulators. Umbelliferous fruits, *Coriander*, Cardamom, Ginger, Black pepper, *Asafoetida*, Nutmeg and Clove. (d) Astringents: Catechu (e) Drugs acting on nervous systems - Belladonna, Aconite, *Withania somnifera*, Ephedra and Opium.(f) Anti diabetics- *Pterocarpus*, *Gymnema sylvestre*. |
| **UNIT IV :** | Study of Following Secondary Metabolites With Respect To Their Chemistry, Biological Activity And Role- Terpenes, Flavonoids, Simple Phenolics, Phenolic Glycosides, Tannins, Anthraquinone, Saponins, Steroids And Alkaloids, Pigments (anthocyanin and betacyanin),,Resins, Gums And Volatile Compound. |
| **UNIT V :** | Definition, history, scope and objectives, development and applications of Pharmacognosy ,Medicinal plants cultivation and its benefits Pharmacognostic studies of following drug plants:(Nomenclature, Morphology, Anatomy, Chemistry, Uses and Adultrants)*Tinospora cordifolia, Boerhavia diffusa, Plumbago zeylanica, Cissus quadraungaris Withania somnifera,Adhatoda zeylanica* Ethnobotany: Defination, scope and significance. |

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|---|---|
| **UNIT VI :** | Definition, history, scope and objectives, development and applications of Pharmacognosy ,Medicinal plants cultivation and its benefits Pharmacognostic studies of following drug plants:(Nomenclature, Morphology, Anatomy, Chemistry, Uses and Adultrants) *Datura metel, Solanum surattense, Zingiber officinale,Ocimum sanctum, Centella asiatica , Asparagus racemosus,Commiphora weightii* |
| | 1) Trease. G.E. and Evanes W.C. 2009. Pharmacognosy. 16th Edn. Elsevier<br>2) Wallis T. E. 2005. Textbook of Pharmacognosy, 5th Edn. CBS publishers.<br>3) S. B. Gokhale. 2008. Pharmacognosy, Pragati Books Pvt. Ltd. 4. C. K. Kokate 2008. Pharmacognosy 53rd Edn. Nirali publisher.<br>4) Mohammed Ali. 2019. Textbook of Pharmacognosy 2Edn. CBS Publisher. |
| | **Course Outcome:**<br>The students are able to identify drug from natural origin and their supply, cultivation, collection, storage along with their special conditions and also define drugs from natural origin. identify the cultivation and collection conditions. identify the storage of drugs. Recall the knowledge about modern concept and scope of Pharmacognosy. To learn the fundamental principles on cultivation, collection processing and evaluation of medicinal plants. Discuss the phyto-chemical screening techniques and able to identify the Phyto-constitutes of plants. |

**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester II Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – VI | Practical based on Paper DSE-II **Angiosperm Taxonomy, Phytochemistry and Pharmacognosy** | **02** |

1) Workout of plant specimens and description of vegetative and reproductive characters from representative families locally available.
2) Training in identification of specimens described in classes using relevant literatures and herbaria.
3) Study of various taxa of a genus, determining key characters and preparation of keys at species level.

**Sant Gadge Baba Amravati University, Amravati**

**Practical Examination Botany Semester- II (NEP)**

**Practical VI**

**Angiosperm Taxonomy, Phytochemistry and Pharmacognosy**

**Practical Schedule**

Time 6hrs Marks-25+25=50

Q.1: Systematic description of two Angiospermic plants (one from Dicotyledons and one from Monocotyledons) 20 Marks

Q.2: Preparation of artificial key 05 Marks

**Practical Internal**

Q.3: Viva-Voce 10

Q.4: Practical Record, Attendance and Assignments 15

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

**Code of the Course Subject** **Title of the Couse/ Subject** **No. of periods/ week**

**DSE-II BOT204-B** **Molecular Systematics of Plants- Elective-II 03**

**Cos :** On completion of the course, the student should be able to

11. Discuss and apply principles of delimitation and identification of species and other taxa
12. Account for the central concepts of the field and principles of phylogenetic analysis, especially based on the parsimony criterion
13. Discuss and apply methods to generate relevant molecular data, mainly sequence data
14. Choose and apply existing software in the included course parts, from generating relevant molecular data to phylogenetic analysis
15. Critically analyse, evaluate, compile, and present the results of phylogenetic analyses.

| | |
|---|---|
| **Unit-I** | Molecular markers in systematics: selection of suitable markers.<br>Comparative account and suitability of single gene markers over multigene markers in phylogenetic analysis. |
| **Unit-II** | Types of molecular data, analysis of molecular data alignment of sequences, homoplasy.<br>Phylogeny reconstruction, gene trees and species trees; molecular characters- chloroplast and mitochondria DNA structure and their role in systematics. |
| **Unit-III** | 2.1 Models of evolution: concept, and their applicability, long branch attraction, bootstapping,<br>2.2.Heuristic solutions and statistical approaches. Optimality criteria – distance, polymorphism analysis. |
| **Unit-IV** | Taxonomic data bases; their need, taxonomic Databases working Group, the Tree of life.<br>Taxonomic information systems- Database at the Royal Botanical Garden, online herbaria, ETI database, Taxonomic softwares |
| **Unit-V** | 5.1 Description of Phylogenetic trees, clustering algorithms and various method for tree building. |

| | |
|---|---|
| | 5.2 Phylogenetic Analysis softwares: Phylip, PAUP, MEGA, RxAML etc. Clustering method -UPGMA Cladistic method – Parsimony |
| **Unit-VI** | Molecular evolution: nucleotide substitution models, molecular clocks.<br>The evolutionary origin of the chloroplast and evolution of plastid genome. |

**Suggested Reading:**


14. Felsenstein, J. 2004. Inferring phylogenies. Sunderland, Mass., Sinauer Associates, Inc. Hall, B. G. 2011. Phylogenetic trees made easy: a how-to manual (4th edition). Sunderland: Sinauer Associates. Hillis, D. M., C. Moritz and B. K. Mable, eds. 1996.
15. Molecular systematics. Sunderland, Mass.: Sinauer Associates. Kitching, I. J., P. L. Forey, C. J. Humphries and D. M. Williams. 1998. Cladistics: the theory and practice of parsimony analysis. Oxford: Oxford University Press.
16. Li, W.-H. 1997. Molecular evolution. Sunderland, Mass.: Sinauer Associates. Schuh, R. T. 2000. Biological systematics. Comstock Publishing Associates, Ithaca. Soltis, P. S., D. E. Soltis and J. J. Doyle, eds. 1992. Molecular systematics of plants. New York: Chapman and Hall. Soltis, D. E., P. S. Soltis and J. J. Doyle, eds. 1998.
17. Molecular systematics of plants II DNA sequencing. Boston: Kluwer Academic Publishers. Williams, D. M. and M. C. Ebach. 2008. Foundations of systematics and biogeography. New York, Springer. Yang, Z. 2006. Computational molecular evolution. Oxford, Oxford University Press.
18. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
19. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 2. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
20. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.


**Learning Outcome:**

After successful completion of this course, students will be able to:

7. Understand historical development of taxonomy.
8. Explain concept of species. Order sub and super categories of species according to Linne hierarchy.

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – VI | Practical based on DSC- II | 02 |

## DSE Molecular Systematics of Plants- Elective-II

**Laboratory Exercises**

**Major Experiments**

1. Use of molecular markers to determine genetic relatedness between species
2. Construction of dendrograms using appropriate software
3. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients.
4. Commelinids: Commelinaceae, Poaceae, Cyperaceae
5. Basal Eudicots and Caryophyllids: Ranunculaceae, Caryophyllaceae
6. Rosids: Euphorbiaceae, Rosaceae, Fabaceae, Cucurbitaceae
7. Asterids: Solanaceae, Lamiaceae, Apiaceae, Asteraceae

**Minor Experiments**

8. PCR Based amplification of genes.
9. Sequencing protocol.
10. Method of gene Annotation.
11. Blast analysis of DNA sequence.

**Sant Gadge Baba Amravati University, Amravati**
**Practical Examination Botany Semester- II (NEP-20)**
**Practical VI**
**Molecular Systematics of Plants- Elective-I**
**Practical Schedule**

Time 6hrs Marks-25+25=50

Q.1: Systematic description of any two plant. 20 Marks

Q.2: Any one minor experiment on molecular systematics 05 Marks

**Practical Internal**
Q.3: Viva-Voce 10
Q.4: Practical Record, Attendance and Assignments 15

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE-II BOT204-C** | **Plant Tissue Culture- Elective-II** | **03** |

**Cos:** On completion of the course, the student should be able to

16. Acquire a critical knowledge on applications of plant tissue culture.
17. Demonstrate skills related to haploid culture through hands on experience
18. Understand the cell culture technique for production of secondary metabolites.
19. Comprehend the applications of plant hormones in plant tissue culture.

| | |
|---|---|
| **Unit-I** | Somaclonal variations: explant source, effect of genotypes, and media components, causes, advantages and applications.<br>Genetic basis of somaclonal variation.<br>Meristem culture – methods, advantages, applications |
| **Unit-II** | Haploid production : steps, culture requirments, signifiance.<br>Androgenesis : Anther culture : culture requirments, steps, screening of haploids and applications<br>Gynogenesis : Ovule and ovary culture and applications<br>In-*vitro* pollination and fertilisation |
| **Unit-III** | Distant hybridization : concept and applicability in haploid production.<br>Pollen Culture technique, *In-vitro* Monoploid and Polyploid Culture. Screening methods for selection of haploid cells. Triploid production (Endosperm culture).<br>Role of haploid and polyploids in plant improvement. |

| | |
|---|---|
| **Unit-IV** | Cell culture: Isolation of Single cell, different techniques for Single Cell Culture (SCC), advantages of SCC.<br>Suspension culture: types of suspension culture<br>Cell growth measurement, viability tests, synchronization of cultures, applications, factors affecting single cell culture. |
| **Unit-V** | Endosperm culture: culture requirements, steps and applications<br>Embryo culture, culture requirements, steps applications, Embryo rescue technique, steps and its applications.<br>Production of pathogen free plants; virus- elimination through *in-vitro* technique. |
| **Unit-VI** | Role of Plant hormones (auxins, cytokinins, abscissic acid, ethylene and Gibberellins) in In-vitro cultures.<br>The journey and new breakthroughs of plant growth regulators in tissue culture. |

**Suggested Reading:**


1. Pullaiah. T. and M.V.Subba Rao. 2009. Plant Tissue culture. Scientific Publishers, New Delhi.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. VikasPublicationHouse Pvt. Ltd., New Delhi. 5th edition.
5. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
6. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.


**Learning Outcome:**

After successful completion of this course, students will be able to:

9. Understand the invitro culture techniques and their applicability.
10. Acquire the necessary skills for establishment of in vitro culture.

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester I Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – VI | Practical based on DSC- II | 02 |

## DSE Plant Tissue Culture- Elective-II

**Laboratory Exercises**

1. Preparation of media and stack solutions
2. Selection and preparation of explants
3. In vitro study of pollen culture
4. In vitro study of anther culture androgenesis
5. In vitro study of ovary culture

6. In vitro study embryo culture
7. In vitro study of triploid production
8. To study the technique of Embryo rescue
9. To study single cell culture and cell suspension culture
10. To study the endosperm culture
11. Visit of tissue culture laboratory

**Model Question Paper for Practical Examination**

**Semester – II**

**Elective-II Plant Tissue Culture-II**

| **Max. Time: 3 Hrs.** | **Max. Marks: 50** |
|---|---|
| 1. Demonstration of any *In vitro* culture 'A' | 08 |
| 2. Preparation of Media for given culture 'B' | 09 |
| 3. Demonstration of any *In vitro* culture 'C' | 08 |
| Internal: | |
| Viva voce: | 10 |
| Record: | 05 |
| Assignment/field visit: | 10 |

**Part B**

**Syllabus Prescribed for 2023 Year** **PG. Programme**

**Programme** **M.Sc. Botany**

**Semester II**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE-II BOT204-D** | **Advanced Plant Physiology -Elective** | **03** |

**Cos :** On completion of the course, the student should be able to
The course will deal with various advanced plant physiological fundamental aspects, evolutionary physiology, secondary metabolites and defence system

| | |
|---|---|
| **Unit-I** | **Respiration:**<br>Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. |
| **Unit-II** | **Photoperiodism:**<br>Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization. Practical applications of vernalization and photoperiodism |
| **Unit-III** | **Plant responses against environmental challenges:**<br>Signal perception, transduction and responses against different environmental changes and challenges (water, light, temperature, elevated CO2, mineral toxicity and salt). |
| **Unit-IV** | **Plant responses against environmental challenges:**<br>Osmoprotectants, stress proteins, Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase etc.). Functions of HSPs chilling stress.<br>Phytochelatins, role of membrane lipids in high temperance tolerance. Molecular regulation and crosstalk among different signalling pathways. |

| | |
|---|---|
| **Unit-V** | **Photomorphogenesis**<br>Regulation of Photomorphogenesis and skotomorphogenesis<br>Wavelength-specific photoreceptors (Phytochromes, Cryptochromes, Phototropins etc), E3 ubiquitin ligases and TFs crosstalk; signal cascade for morphogenic responses. Synergic effect of BRs and Auxins and other growth regulators |
| **Unit-VI** | **Sensory physiology**<br>Sensory physiology: Biochemical and biophysical mechanisms of sense of touch, electric self-defense, taste, light, explosion, sleeping and rhythms. Stimuli/mechanical force triggered movements; actin-myosin motors; neurotransmitters in plants. |

**Suggested Reading:**


9. Davies, P.J. (2004). Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
10. Jordan, B.R. (2006). The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
11. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry (5thed.). New York
12. Buchanan, Gruissem and Jones. 2002. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
13. Annual Review of Plant Biology (formerly Annual Review of Plant Physiology and Plant Molecular Biology).
14. **BASIC REFERENCES:** Alberts et al., Molecular Biology of the Cell (parts related to plants); Salisbury and Ross, Plant Physiology; Taiz and Zeiger, Plant Physiology; Hopkins and Huner, Introduction to Plant Physiology.
15. **CURRENT LITERATURE** (JOURNAL ARTICLES): Plant Physiology, The Plant Cell, Journal of Plant Physiology, Physiologia Plantarum, Plant Physiology and Biochemistry, Postharvest Biology and Technology, Hortscience, Journal of the American Society for Horticultural Science, Science, Nature, Scientific American etc.
16. Many plant physiology journals can be viewed via the net. The URL of one of the sites listing these journals is: http://www.e-journals.org/botany/


**Learning Outcome:**

After successful completion of this course, students will be able to:

5. The students will learn and demonstrate the physiological mechanisms of Water, minerals uptake and transport; they can correlates with present day's challenges for plant growth, development and survival.
6. The students will understand the evolutionary history of photosynthetic organisms and their adaptability in changing environmental conditions; they can interpret the photosynthetic productivity in relation to changing climatic conditions and food security
7. They will acquire the knowledge and demonstrate the various mechanisms of translocation of photosynthetic products to different sink
8. The students will learn various plant responses against environmental changes and challenges; they can understand unique strategies of plants to resolve the various stresses

**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 2023 Year** **PG Programme**
**Programme: M. Sc. Botany**

| **Semester II Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical – VI | Practical based on Paper DSE-II **Advanced Plant Physiology -Elective** | **02** |

**List of Experiments:**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. Demonstration of transpiration with the help of photometers.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of activity of catalase and study of effect of pH and enzyme concentration.
5. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.
7. Separation of photosynthetic pigments by paper chromatography.
8. To determine the RQ of different respiratory substances.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I (Botany), SEMESTER – II (NEP-20)**

**PRACTICAL-VI: Advanced Plant Physiology Elective (DSE-II)**

| **Time: 3 Hrs.** | **Marks: 25+25=50** |
|---|---|
| Q.1: Setting and working on any major experiment | 20 |
| Q.2: Setting and working on any Minor experiment | 15 |
| Q.3: Estimation of biological compounds | 15 |
| **Practical Internal** | |
| Q.4: Viva-Voce | 10 |
| Q.5: Practical Record, Attendance and Assignments | 15 |

**Part B**

**Syllabus Prescribed for 2023 Year** **PG.Programme**

**Programme** **M.Sc.**

**Botany**

**Semester I**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **DSE-II BOT204-E** | **Basic and Applied Mycology** | **03** |

**Cos:**

Upon completion of this course successfully, students would be able to

5. To learn the basic techniques used to collect, grow, observe, and identify fungi.
6. Study important groups of fungi Ascomycota, Basidiomycota, Deuteromycota.
7. To appreciate the beneficial roles fungi play in biotechnology, Nanotechnology, and the Pharmacy.
8. Able to understand the negative impact of certain fungi on humans.

| | |
|---|---|
| **Unit-I Ascomycota** | Structure, Reproduction, Life cycle and significance of the following representative:<br>*1.* Ascomycotina: *Taphrina, Emericella, Chaetomium, Morchella, Neurospora.*<br>General characters and Classification of Pyrenomycetes with life cycle of *Erysiphe*, *Uncinula, Phyllactinia, Sphaerotheca* and *Claviceps*.<br>2. Loculoascomycetes: General characters and importance.<br>3. Archiascomycetes: General characters and importance. |
| **Unit-II Basidiomycota** | 1. Basidiomycota: General vegetative and reproductive |

| | |
|---|---|
| | characteristics of Urediniomycetes, Hymenomycetes and Gasteromycetes.<br>2. A comparative account of vegetative and reproductive structures, Life cycle patterns of<br>*3. Puccinia, Ustilago, Termitomyces, Pleurotus, Auricularia, Ganoderma, Polyporus, Lycoperdon, Dictyophora, Geastrum, Cyathus.* |
| **Unit-III Deuteromycota** | 1. Characteristics features and classification of Deuteromycota<br>2. General Characteristics of class Agonomycetes, Hypomycetes, and Coelomycetes.<br>*3.* Morphological and pathological comments on some important Genera -*Alternaria*, *Fusarium*, *Colletotrichum*, *Curvularia*, *Helminthosporium*, *Phoma, Phyllosticta, Ascochyta Botryodiplodia, Macrophoma, Diplodia, Cercospora.* |
| **Unit-IV Fungal biotechnology** | 1. Saprophytes - Fungal decomposition of organic matter, coprophilous fungi, cellulolytic fungi, lignolytic fungi.<br>2. Keratinophilic fungi- Distribution, Isolation and economic importance<br>3. Endophytic fungi for natural product.<br>4. Fungal Volatile organic compounds and their applications.<br>5. Fungi and bioluminescence<br>6. Fungi as Human pathogens- Dermatomycosis (*Tinea*), systemic mycosis, its symptoms, Clinical aspects and control measures<br>7. Phytoalexins: General account, types and importance.<br>8. Mycotoxins: General account, types and importance. |
| **Unit-V Fungal Nanotechnology** | 1. Introduction: Myconanotechnology, Mycosynthesis<br>2. Role of Fungi in Synthesis of Nanoparticles<br>3. Synthesis of Different Nanoparticles using Fungi<br>4. Mechanism of Synthesis<br>5. Applications of nanoparticles synthesized by Fungi. |
| **Unit-VI Fungi in Pharmaceuticals** | 1. Endophytic Fungi and their secondary metabolites.<br>2. Drug development from Fungal Secondary metabolites.<br>3. Bioactive molecules from fungi and their Applications.<br>4. Fungal compounds as anticancer agents. |
| **Suggested Reading:** | |
| 26. Illustrated Generic names of Fungi Miguel Ulloa, E. Aguirre-Acosta APS PRESS 2019<br>27. Illustrated Dictionary of Mycology Miguel Uloa, Richard T. Hanlin Amer Phytopathological Society; 2000 ISBN-10: 0890542570; ISBN-13: 978-0890542576<br>28. Introductory Mycology, 4ed C.J. Alexopoulos, C.W. Mims, M. Blackwell Wiley; Fourth edition, 2007 ISBN-10: 8126511087; ISBN-13: 978-8126511082<br>29. K. R. Aneja An Introduction to Mycology New Age International Private | |

Limited; Second edition; 2015 ISBN-10: 8122437966; ISBN-13: 978-8122437966
30. Alexopoulos, Mims and Blackwell. Introductory Mycology, Fourth Edition. John Wiley & Sons, New York, 1996
31. Arora, David, Shepherd, Glenn, Economic Botany, Vol. 62, #3, The New York Botanical Garden Press, Bronx, NY, 2008
32. Ainsworth, G.C. and A.S.Sussman (eds). The Fungi, An advance Treatise Vol.I, II, III & IV Academic Press, New York. 48. Alexopoulos, C.J. and Mims C.W. (1979).
33. Introductory Mycology 3rd Edition, John Wiley and Sons, Inc. Wiley, New York.
34. Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York.
35. Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
36. Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
37. Bilgrami, K.S. and H.C.Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
38. Butler E.J. and S. J. Jones (1949) Plant Pathology, Macmillan & Co. New York.
39. Dube, R.C. and D. K. Maheshwari (2000) Practical Microbiology - S. Chand & Co. Ltd.
40. Gupta, V.K. and M. K. Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rejinder Nagar, Ludhiana.
41. Jha, D.K. (1993) A Text Book of Seed Pathology, Vikas Publication House.
42. Manibhushan Rao, K. and A. Mahadevan - Recent Development in biocontrol of plant pathogenes. Today and Tomorrow publishers, New Delhi.
43. Mehrotra, R.S. and K. R. Aneja (1998) An Introduction to Mycology, New Age Intermediate Press. . Mukadam, D.S. and L.V. Gangawane (1978) Experimental Plant Pathology (edited) Marathwada University Aurangabad.
44. Pande, P.B. (1997) Plant Pathology, S. Chand & Co. New Delhi. 61. Preece and Dickeson. Ecology of leaf surface microorganism Academic Press, New York.
45. Rangaswamy, G. and A.Mahadevan (1999) Diseases of Crop Plant in India, Prentice Hall of India. 63. Sing, R.S. (1994) Plant Pathology, Oxford and IBH Publication Co. New Delhi.
46. Thind, T.S. (1998) Diseases of field crops and their management, National Agricultural Technology, Information Centre Ludhiana.
47. C. Manoharachary , K. V. B. R. Tilak, K. V. Mallaiah and I. K. Kunwar 2016,Mycology and Microbilogy, Scietific Publishers, Jodhapur Rajasthan.
48. KR Aneja, R.S. Mehrotra 2015 An Introduction to Mycology, New Age International private Limited. 67. Introduction to Fungi, Bacteria and Viruses 2017 HC Dubey Agribios, India
49. Text Book Of Fungi 2010, R.C.Gupta ,O.M.Prakash Sharma Oxford publication.
50. Text Book Of Fungi O.M.Prakash Sharma, Tata McGraw-Hill Publishing Company, 1989.

- www.drfungus.org
- www.mycobank.org

- www.mycologyonline.org
- www.aspergillus.org.uk
- www.fungusfocus.com
- www.mycology.adelaide.edu.au

**Learning Outcome:**

On completion of this course, the students will be able to:

- Summarize the characteristic features of fungi
- Compare between myxomycota and eumycota.
- List the general characters of mastigomycotina.
- Describe the ways of asexual and sexual reproduction in ascomycotina
- List the characteristic features of ascomycotina and their classification
- Differentiate between famous genera within ascomycetes.
- Write economic importance of Aspergillus and Penicillium.
- Subdivide the different classes in basidiomycetes
- Summarize the characters of deuteromycotina
- Compare between studied genera within deuteromycotina

| **Semester IV Code of the Course/Subject** | **Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity) | **(No. of Periods/Week)** |
|---|---|---|
| Practical –VI | Practical Based on DSE-I Basic and Applied Mycology | **02** |

**Laboratory Exercises**

1. Study of the following genera:

*Taphrina, Emericella, Chaetomium, Morchella, Neurospora, Erysiphe*, *Uncinula, Phyllactinia, Sphaerotheca* and *Claviceps*. *Puccinia, Ustilago, Termitomyces, Pleurotus, Auricularia, Ganoderma, Polyporus, Lycoperdon, Dictyophora, Geastrum, Cyathus, Alternaria*, *Fusarium*, *Colletotrichum*, *Curvularia*, *Helminthosporium*, *Phoma, Phyllosticta, Ascochyta Botryodiplodia, Macrophoma, Diplodia, Cercospora.*

2. Isolation of Endophytic fungi.
3. Isolation of Keratinophilic Fungi.
4. Isolation of Secondary Metabolites from fungi.
5. Synthesis of Nanoparticles from fungi.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

**PRACTICAL EXAMINATION (Botany) , SEMESTER II –(NEP-20)**

**Practical – VI - Basic and Applied Mycology**

| **Practical – I (Internal Practical Examination)** | **Marks-25** |
|---|---|
| 1. Attendance | 05 |
| 2. Performance (any three fungal material) | 09 |
| 3. Activity<br>Botanical Excursion/Short/Long- Report Submission.<br>Visit to any Biodiversity Area to study the plant diversity in natural | 03 |

habitat Report submission.

| | |
|---|---|
| 4. Record Book | 05 |
| 5. Internal Viva-Voce | 03 |

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

**PRACTICAL EXAMINATION (Botany) , SEMESTER II –(CBCS New)**

**Practical-VI- - Basic and Applied Mycology**

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**Practical – II (External Practical Examination)**
**Time – 4 Hours** **Max Marks-25**

| | | |
|---|---|---|
| Salient features and identification of Fungal material (Any two) | | 10 |
| Isolation of secondary metabolite from one fungi or isolation of endophytes (Any one) | | 05 |
| Spotting (fungal material/slide) | (Any Five) | 05 |
| External Viva voce | | 05 |

| | |
|---|---|
| **PartB** | |
| **Syllabus for2023Year** | **PG.Programme** |
| **Programme** | **M.Sc.Botany** |
| **Semester II** | |
| **Code of the Course Subject** | **Title of the Couse/Subject** **No.of periods/week** |
| **DSE-I BOT204-F 03** | **Molecular Biology, Biotechnology & Plant BreedingElective-II** |

**Cos:** On completion of the course, the student should be able to
1.Tolearnthebasicprinciplesofmolecular biology & plant breeding
2.Todemonstratethemethodsin molecular biology & plant breeding
3. Understand the applicability of molecular biology & plant breeding in Relation to present day problems.
4. To gain the Knowledge about laboratory organization for molbio.
5. Understand various Aseptic techniques for plant tissue culture.

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| **Unit-I** | 1.1**Gene mutation:** Insertion deletion, frame shift andsuppressor mutation, chemical and physical agents<br>1.2Repair of DNA and Various enzymes involved in repair of DNA.<br>1.3.**Genetic recombination**: Mechanism of genetic recombination, Transformation, Transudation, Conjugation,<br>1.4 Various models of recombination., |
| **Unit-II** | **Genetics and Molecular organization**:<br>2.1Genes concept, genome, Multigene families, Pseudogenes, split genes, overlapping genes,genetic code.<br>**Nuclear genome organization** : |

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| | 2.2Genome size, Kinetics ofDNA denaturation and renaturation, the law of DNAconstancy and C- value paradox<br>2.3Kinetic classes of DNA – Repetitive and Unique DNA<br>Sequences and its significance.<br>**Genomic stability** :<br>3.4 Molecular characteristics, propertiesand significance of eukaryotic mobile genetic elements –Ty elements in Yeast; Copia elements in Drsophila, Ac-Ds,Spm – dSpm elements in maize. Role of mobile geneticelements in evolution. |
| **Unit-III** | 3.1**Plant transformation** technologyBasis of tumour formation , hairy root, features of Ti and Riplasmid,Mechanisms of DNA transfer , role of virulence genes,use of Ti and Ri plasmid as vector, binary vector; Use of35S and other promotors,<br>3.2 **Genetic markers**, use of reportergenes, reporter genes with introns, use of scaffoldattachment regions;<br>3.3 **Methods of nuclear transformation**,viral vectors and their application , multiple gene transfer;<br>3.4 **Vectors-less or direct** DNA transfer and particlebombardment, eletroporation, microinjection. |
| **Unit-IV** | 4.1**Gene cloning vectors:** Plasmids: general cloning vector,fusion plasmids, plasmids with bacteriophage promoters,<br>4.2 **Vectors;**Shuttle vectors, phagmids, phages: as cloning vector, insertion vectors, replacement vectors, Ca MV, Animal viral vectors- SV-40, Vaccinia/Bacculo and retro viral cosmids,<br>4.3**Artificial chromosomes**: yACs, mega yACs. BAC vector; Methodsof detection of recombinant;<br>4.4 **Nucleic acid purification**:Different chemicals used in isolation and purification ofnucleic acids, Yield analysis: |
| **Unit-V** | **5.1 Nucleic acid amplification** and its application: History and<br>Method of nucleic acid amplification, Nucleic acidamplification: DNA amplification, RAPD, AFLP, asymmetric<br>5.2 **Polymer chain reaction,**PCR, RT PCR, 5‘RACE, 3‘ RACE, invert PCR, Syber green,hybridization probe amplification, hydrolysis probeamplification (Taq man), Scorpion primers;<br>**5.3Basic biochemical**requirement of thermal cycler: Solutions, enzymes, buffer,primers, designing of primers, necessary conditions requiredfor designing primers,<br>**5.4fluorescent:**use of fluorescent dyes andquenchers in primers used for real time PCR, annealingtemperature, calculation of Tm of primers and optimizationof PCR conditions; Instrumentation of thermal cycler:Instrumentation of general thermal cycler, gradient cyclerand Real time cycler; Applications of nucleic acid<br>amplifications in different fields |

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| **Unit-VI** | **6.1Self-incompatibility** and male sterility in crop plants and their commercial exploitation.<br>**6.2Pure line** theory, pure line selection and mass selection methods; Line breeding, pedigree,<br>**6.3 Bulk,** backcross, single seed descent and multiline method; Population breeding in self pollinated<br>**6.4 Crops** (diallel selective mating approach). |

**SuggestedReading:**


1.Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Sprin Harbor Laboratory Press, New York, 2000

2. DNA Cloning: a Practical Approach, D.M. Glover and B.D. Hames, IRL Press, Oxford, 1995

3. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu, D. Kim and L.J: Cseke, CRC Press, Florida, 1995

4. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc.San Diego, 1998

5. Methods in Enzymology Vol 185, Gene Expression Technology,D.V. Goeddel, Academic Press, Inc., San Diego, 1990

6. DNA Science. A First Course in Recombinant Technology, D.A. Mickloss and G.A. Freyer, Cold Spring Harbor Laboratory Press, New YorK, 1990

7 Molecular Biotechnology (2"d Edn.), S.S. Primrose, Blackwell Scientific Publishers, Oxford, 1994

8. Milestones in Biotechnology. Classic papers on Genetic Engineering, J.A. Davies and W.S. Reznikoff, Butterworth- Heinemann, Boston, 1992

9. Route Maps in Gene Technology, M.R. Walker and R. Rapley, Blackwell Science Ltd., Oxford, 1997

10. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford, 1998

11. Molecular Biotechnology - Glick.

12 Recombinanat DNA and Biotechnology: Guide to teachers by Helen Kreuzer

13. Academia to biotechnology By Jeffery M Gimble

14. Biotechnology and safety assessment by Jhon A Thomas

15. Methods in biotechnology by Michel Schweizer

16. Bioethics an introduction for the Bioscience By Mepham.Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.

17. Breeding Field Crops. Oxford & IBH. Chopra VL. 2001.

18 Plant Breeding. Oxford & IBH. Chopra VL. 2004

18. Practical Plant Breeding. Agribios. Gupta SK. 2005.

19.Breeding Asian Field Crops. Oxford & IBH. Pohlman JM & Bothakur DN. 1972

20. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ.
House. Roy D. 2003.

21.Principles and Practice of Plant Breeding. Tata McGraw-Hill. Sharma JR. 2001.

22 .Principles of Crop Improvement. English Language Book Society Simmonds NW. 1990..

23 Plant Breeding. Kalyani. Singh BD. 2006.

24 .Objective Genetics and Plant Breeding. Kalyani. Singh P. 2002.

25 Essentials of Plant Breeding. Kalyani. Singh P. 2006

26.Genetic Bases and Methods of Plant Breeding. Singh S & Pawar IS. 2006.

27.Quantitative Genetics and Selection in PlantBreeding. Walter de Gruyter Wricke G & Weber WE. 1986.

28.Singh P & Narayanan SS. 1993. Biometrical Techniques in Plant Breeding. Kalyani

29.Biometrical Genetics. Chapman & Hall. Mather K & Jinks JL. 1971.

30. Watson J.D, Baker T.A, Bell S.P, Gann A, Levine M and LosickR. Molecular Biology of the Gene. . Benjamin-Cummins Publishing Co.,

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**Learning Outcome:**

**After successful completion of this course, students will be able to:**

1. Become familiar with sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis,
2. Support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic tools,
3. Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.
4. Outline the fundamental steps in a genetic engineering procedure.

| **Semester I** | **Code of the Course/Subject** | **(No. of Periods/Week)** |
|---|---|---|
| Title of the Course/Subject | (Laboratory/Practical/practicum/ hands-on/Activity) | 02 |

**List of Experiments:**

1.Isolation of genomic DNA
2 Southern blotting
3.Isolation of RNA
4.Preparation of tissue culture medium.
5.Cell fusion with PEG.
6.Isolation of plasmid DNA.
7.Artificial seed preparation.

8Incompatibility – Pollen viability test

a. *In vitro* a. Brewbaker's medium preparation

b. Staining test in acetocarmine

9.Principles of PCR, Electrophoresis.

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**
**PRACTICAL EXAMINATION**
**M.Sc. I (Botany), SEMESTER – II (NEP-20)**
**PRACTICAL-VI: Molecular Biology, Biotechnology, and Plant Breeding-Elective-II DSC-II**

| **Time: 3 Hrs.** | **Marks: 25+25=50** |
|---|---|
| Q.1: Setting and working on any major experiment | 15 |
| Q.2: Setting and working on any Minor experiment | 05 |
| Q.3 Comment on principle and working of analytical instrument. | 05 |
| **Practical Internal** | |
| 1. Attendance | 05 |
| 2. Visit to any Molecular/Biotechnology & Report Submission. | 10 |
| 3. Activity- Botanical Excursion/Short/Long- to study the plant diversity in natural habitat Report Submission. | 05 |
| 4. Record Book | 05 |

**Other faculty/ stream course**

**Part B**
**Syllabus Prescribed for 2022 Year** **PG. Programme**
**Programme** **M.Sc. Botany**
**Semester II**

| **Code of the Course Subject** | **Title of the Couse/ Subject** | **No. of periods/ week** |
|---|---|---|
| **BOEC II** | **Floriculture and nursery Management** | **04** |

**Cos :**

Upon the satisfactory completion of class assignments and the classroom experiences provided in the course, the student should expect to be able to:

1. List and describe procedural steps necessary during floriculture crop production from propagation to marketing.
2. Identify and define environmental factors that regulate growth and flowering of floriculture crops.
3. Develop production schedules for floriculture crops.
4. Grow several crops in the greenhouse through nursery management.
5. Identify and name some floriculture crops and classify them as potted, cut and/or garden crops.
6. Develop methodology for production of horticultural crops through seeds.

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| **Unit-I** | Floriculture: Concept, Scope and importance of Floriculture, Scope of Floriculture in India, Study of Floricultural tools. |
| **Unit-II** | Common Garden operation using different implements, commercial floriculture, soil selection, preparation of soil nursery beds, system of plating, water and nutrient management, bed management, propagation by cutting, budding, grafting. |
| **Unit-III** | Harvesting & Processing of Flowers: Harvesting technique, Postharvest handling and grading, packing and storage, transportation & marketing commerce. |
| **Unit-IV** | Nursery Site: Types of Nursery, Factors to be consider for Nursery establishment, Size of Nursery, Soil type, Production area, Germination section, Transplanting area. |

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| **Unit-V** | Horticultural crop management: Seeds handling, seed procurement and storage, viability, Germination process, time of sowing, soil of sowing, media for growing plants, Soil, Sand, Peat, Sphagnum Moss, Vermiculture, Cocopet, plant protect in Nursery Management. |
| **Suggested Reading:** | |
| 1. Hartmann, H.T., Kester D.E., Davis, F.T and R.L Geneve (2010) Plant Propagation: Principles and practices (8th Edition).<br>2. Sharma, R.R and Srivastav M (2004): Plant propagation and nursery management (First Edition) International Book Distributing Co.<br>3. K.K.Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher-New Delhi-Ludhiana.<br>4. Bose,T.K.Sanyal, D and Sandhu, M.L.(1998) Propagation of Horticultural crops. Naya Prakash Publishers, Kolkatta.<br>5. Hartman, H.T. and Beutel, A (1979). Propagation of temperate zone fruit plants. Leaflet, California, Agri. Expt. Sta. California.<br>6. Website URL: http//www.wikipedia.org/wiki/plant propagation | |
| **Learning Outcome:**<br>To learn management practices for wholesale container and field production nurseries. Business development, management, site selection and financial aspects. Acquire knowledge of harvesting and processing of nursery plants. | |

MOOCS/ SWAYAM platforms courses list

| SN | Course ID | Discipline | Course Name | SME Name | Institute | Duration | Start date | End date | Exam date | Enrollment End date | Exam Registration End date | UG/PG | Core/ Elective | Applicable NPTEL Domain | Click here to join the course |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | noc23-bt34 | Biotechnology and Bioengineering | Next Generation Sequencing Technologies : Data Analysis And Applications | Prof. Riddhiman Dhar | IITKGP | 12 weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Core | Computational Biology | https://onlinecourses.nptel.ac.in/noc23_bt34/preview |
| 2 | noc23-bt35 | Biotechnology and Bioengineering | Genetic Engineering: Theory And Application | Prof. Vishal Trivedi | IITG | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Bioprocesses Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt35/preview |
| 3 | noc23-bt36 | Biotechnology and Bioengineering | Introduction To Proteogenomics | Prof. Sanjeeva Srivastava | IITB | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Computational Biology | https://onlinecourses.nptel.ac.in/noc23_bt36/preview |
| 4 | noc23-bt37 | Biotechnology and Bioengineering | Drug Delivery: Principles And Engineering | Prof. Rachit Agarwal | IISc | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Bioengineering | https://onlinecourses.nptel.ac.in/noc23_bt37/preview |
| 5 | noc23-bt39 | Biotechnology and Bioengineering | Cellular Biophysics: A Framework For Quantitative Biology | Prof. Chaitanya A.Athale | IISER pune | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | PG | Elective | Bioengineering | https://onlinecourses.nptel.ac.in/noc23_bt39/preview |
| 6 | noc23-bt41 | Biotechnology and Bioengineering | Computer Aided Drug Design | Prof. Mukesh Doble | IITM | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Core | Computational Biology | https://onlinecourses.nptel.ac.in/noc23_bt41/preview |
| 7 | noc23-bt42 | Biotechnology and Bioengineering | Plant Cell Bioprocessing | Prof. Smita Srivastava | IITM | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG | Core | Bioprocesses | https://onlinecourses.nptel.ac.in/noc23_bt42/preview |
| 8 | noc23-bt43 | Biotechnology and Bioengineering | Introduction To Developmental Biology | Prof. Subramaniam K | IITM | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt43/preview |
| 9 | noc23-bt44 | Biotechnology and Bioengineering | Principles Of Downstream Techniques In Bioprocess | Prof. Mukesh Doble | IITM | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Bioprocesses | https://onlinecourses.nptel.ac.in/noc23_bt44/preview |
| 10 | noc23-bt45 | Biotechnology and Bioengineering | Bioreactors | Prof. G.K. Suraishkumar | IITM | 4 Weeks | July 24, 2023 | August 18, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG | Core | | https://onlinecourses.nptel.ac.in/noc23_bt45/preview |
| 11 | noc23-bt46 | Biotechnology and Bioengineering | Tissue Engineering | Prof. Vignesh Muthuvijayan | IITM | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | PG | Elective | Bioengineering | https://onlinecourses.nptel.ac.in/noc23_bt46/preview |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | noc23-bt47 | Biotechnology and Bioengineering | Transport Phenomena In Biological Systems | Prof. G. K. Suraishkumar | IITM | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Core | Bioengineering Bioprocesses | https://onlinecourses.nptel.ac.in/noc23_bt47/preview |
| 13 | noc23-bt49 | Biotechnology and Bioengineering | Organ Printing | Prof. Falguni Pati | IIT Hyderabad | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | PG | Elective | Bioengineering | https://onlinecourses.nptel.ac.in/noc23_bt49/preview |
| 14 | noc23-bt50 | Biotechnology and Bioengineering | Introduction To Cell Biology | Prof. Nagaraj Balasubramanian Prof. Girish Ratnaparkhi | IISER pune | 8 Weeks | August 21, 2023 | October 13, 2023 | October 29, 2023 | August 21, 2023 | September 15, 2023 | UG | Core | | https://onlinecourses.nptel.ac.in/noc23_bt50/preview |
| 15 | noc23-bt51 | Biotechnology and Bioengineering | Genome Editing And Engineering | Prof. Utpal Bora | IITG | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt51/preview |
| 16 | noc23-bt52 | Biotechnology and Bioengineering | Introduction To Dynamical Models In Biology | Prof. Biplab Bose | IITG | 4 Weeks | August 21, 2023 | September 15, 2023 | October 29, 2023 | August 21, 2023 | September 15, 2023 | UG/PG | Elective | Computational Biology | https://onlinecourses.nptel.ac.in/noc23_bt52/preview |
| 17 | noc23-bt53 | Biotechnology and Bioengineering | Functional Genomics | Prof. S.Ganesh | IITK | 4 Weeks | August 21, 2023 | September 15, 2023 | October 28, 2023 | August 21, 2023 | September 15, 2023 | UG | Elective | Computational Biology | https://onlinecourses.nptel.ac.in/noc23_bt53/preview |
| 18 | noc23-bt55 | Biotechnology and Bioengineering | Wildlife Ecology | Prof. Ankur Awadhiya | IITK | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | | https://onlinecourses.nptel.ac.in/noc23_bt55/preview |
| 19 | noc23-bt56 | Biotechnology and Bioengineering | Experimental Biotechnology | Prof. Vishal Trivedi | IITG | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | PG | Elective | Bioprocesses Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt56/preview |
| 20 | noc23-bt58 | Biotechnology and Bioengineering | Introduction To Biostatistics | Prof. Shamik Sen | IITB | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Core/Elective | | https://onlinecourses.nptel.ac.in/noc23_bt58/preview |
| 21 | noc23-bt59 | Biotechnology and Bioengineering | Introduction To Proteomics | Prof. Sanjeeva Srivastava | IITB | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt59/preview |
| 22 | noc23-bt60 | Biotechnology and Bioengineering | Environmental Biotechnology | Prof. Pinaki Sar | IITKGP | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | Bioprocesses | https://onlinecourses.nptel.ac.in/noc23_bt60/preview |
| 23 | noc23-bt61 | Biotechnology and Bioengineering | Industrial Biotechnology | Prof. Debabrata Das | IITKGP | 12 Weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG | Core | | https://onlinecourses.nptel.ac.in/noc23_bt61/preview |
| 24 | noc23-bt68 | Biotechnology and Bioengineering | Cell Culture Technologies | Prof. Mainak Das | IITK | 8 Weeks | August 21, 2023 | October 13, 2023 | October 28, 2023 | August 21, 2023 | September 15, 2023 | PG | Elective | Bioengineering Biosciences | https://onlinecourses.nptel.ac.in/noc23_bt68/preview |
| 25 | noc23-bt70 | Biotechnology and Bioengineering | Biomedical Nanotechnology | Prof. P. Gopinath | IITR | 4 Weeks | August 21, 2023 | September 15, 2023 | October 28, 2023 | August 21, 2023 | September 15, 2023 | UG/PG | Elective | Bioengineering | https://onlinecourses.nptel.ac.in/noc23_bt70/preview |
| 26 | noc23-cy60 | Chemistry and Biochemistry | NMR Spectroscopy For Chemists And Biologists | Prof. Ashutosh Kumar, Prof. R. V Hosur | IITB | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | PG | Elective | | https://onlinecourses.nptel.ac.in/noc23_cy60/preview |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | noc23-cy61 | Chemistry and Biochemistry | Overview And Integration Of Cellular Metabolism | Prof. Aritri Bir & Prof. Arindam Ghosh | IITKGP | 12 weeks | July 24, 2023 | October 13, 2023 | October 28, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Core | | https://onlinecourses.nptel.ac.in/noc23_cy61/preview |
| 28 | noc23-ge33 | Multidisciplinary | Ecology And Environment | Prof. Abhijit Deshpande Prof. R. Ravi Krishna | IITM | 8 Weeks | August 21, 2023 | October 13, 2023 | October 28, 2023 | August 21, 2023 | September 15, 2023 | UG | Core | Energy and Environment | https://onlinecourses.nptel.ac.in/noc23_ge33/preview |
| 29 | noc23-ge36 | Multidisciplinary | Introduction To Research **New title: Research Methodology** | Prof. Edamana Prasad Prof. Prathap Haridoss | IITM | 8 Weeks | August 21, 2023 | October 13, 2023 | October 28, 2023 | August 21, 2023 | September 15, 2023 | PG | Elective | Faculty Domain - Fundamental | https://onlinecourses.nptel.ac.in/noc23_ge36/preview |
| 30 | noc23-ge37 | Multidisciplinary | Introduction To Biomimicry | Prof. Shiva Subramaniam Prof. Sivakumar Srinivasan Prof. Satya Seshadri Prof. Mrinalini | IITM | 8 Weeks | July 24, 2023 | September 15, 2023 | September 24, 2023 | July 31, 2023 | August 18, 2023 | UG/PG | Elective | | https://onlinecourses.nptel.ac.in/noc23_ge37/preview |
| 31 | noc23-hs155 | Multidisciplinary | Environmental Science | Prof. Samik Chowdhury & Prof. Sudha Goel | IITKGP | 12 Weeks | July 24, 2023 | October 13, 2023 | October 29, 2023 | July 31, 2023 | August 18, 2023 | UG | Core | Environment | https://onlinecourses.nptel.ac.in/noc23_hs155/preview |

| TIMELINE | 4 Weeks (SET 1) | 8 Weeks (SET 1) | 12 Weeks | 4 Weeks (SET 2) | 8 Weeks (SET 2) |
|---|---|---|---|---|---|
| Start of Course | July 24, 2023 | July 24, 2023 | July 24, 2023 | August 21, 2023 | August 21, 2023 |
| End of Course | August 18, 2023 | September 15, 2023 | October 13, 2023 | September 15, 2023 | October 13, 2023 |
| Exam Dates - 1 | Sep 24, 2023 - 2 Sessions on each date (9am-12 noon; 2pm-5pm) | | Oct 28/29, 2023 - 2 Sessions on each date (9am-12 noon; 2pm-5pm) | | |
| Open enrollment to the Course | Enrollments are open now! | | | | |
| Close enrollment to the Course | July 31, 2023 - 5pm | | | Aug 21, 2023 - 5pm | |
| Open exam registration form | June 19, 2023 | | | | |
| Close exam registration form | Aug 18, 2023 5:00 PM | | | Sep 15, 2023 5:00 PM | |