

Sant Gadge Baba Amravati University

Faculty – Science and Technology

Programme- M. Sc. (Botany)

POs

By the end of the programme, students would be able to

PO1	Deep subject Knowledge and intellectual breadth	Apply the subject knowledge to the solution of real-world problems.
PO2	Professional Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the standard practices.
PO3	Creative & Critical Thinking	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO4	Innovation, Research and Problem Solving	Identify, formulate, review research literature, and analyze complex problems reaching substantiated and innovative conclusions. Design solutions for complex problems with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Use research-based knowledge and research methods to provide valid conclusions. Demonstrate the knowledge of, and need for sustainable development.
PO5	Team work and Communication Skills	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Present/communicate research at national/international level, write effective articles, reports and design documentation, make effective presentations, and give and receive clear instructions. Communicate disciplinary knowledge to the community and broader public.
PO6	Professionalism and Leadership Readiness	Demonstrate personal accountability and effective work habits, e.g., punctuality, working productively with others, and time as well as workload management. Demonstrate integrity and ethical behavior, act responsibly with the interests of the larger community in mind, and to learn from his/her mistakes. Use the strengths of others to achieve common goals, and use interpersonal skills to coach and develop others. Assess and manage his/her emotions and those of others; use empathetic skills to guide and motivate; and organize, prioritize, and delegate work.
PO7	Lifelong learning	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
PO8	Competence for Digital World	Prepare well for living, learning and working in a Digital Society; Create, select, and apply appropriate techniques, resources, and modern ICT tools to complex activities with an understanding of the limitations. Use existing digital technologies ethically and efficiently to solve problems, complete tasks, and accomplish goals. Demonstrate effective adaptability to new and emerging technologies.
PO9	Global Citizenship	Act with an informed awareness of global issues. Engage in initiatives that encourage equity and growth for all.

PSOs:

After completing the programme successfully, students would be able to

1. explore the cutting edge technologies and skills currently used in plant sciences.

2. Be aware of social, environmental issues and plant significance in natural interest.
3. create interest in nature conservation and save the natural resources.
4. study the concepts of genetics, plant breeding and their applicability.
5. understand and correlate the various biochemical and physiological processes in plants.
6. study the evolutionary process in Bryophytes and Pteridophytes.
7. study the bioactive principles in plants and their defence 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, and 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 admissions are carried out 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 design as per CBCS 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, nonverbal, 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 Organisation 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 practical's, 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 the Degree in Master of Science in the Programme Botany
(Two year- Four Semester Degree Programme- C.B.C.S.)
(M.Sc. Part I) Semester I**

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-I Cell and Molecular Biology	BOT 101	3	-	-	3	3	-	3	3	80	20	-	-	100	40	P
2	AEC- I Molecular Techniques	BOT 102	-	1	-	1	1	-	1	1	-	-	50	-	50	25	P
3	DSC-II Evolution and Diversity of Algae and Fungi	BOT 103	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
4	DSC -III Economic Botany and Resource Utilization	BOT 104	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
5	DSC- IV Plant Development	BOT 105	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
6	Lab- 1 Practical Based on DSC I & II	BOL 101	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
7	Lab-2 Practical Based on DSC III & DSE- I	BOL 102	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
8	# Internship / Field Work / Work Experience @																
9	Open elective/ GIC/ Open skill/ MOOC* BOEC I Medicinal Plant Diversity	BOEC 101	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
Total						28			26						650		

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience in First or Second or Third semester of Master of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester I to III. This will carry 2 credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.

-OEC (Optional) can be studied during semester I to IV

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester I		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
DSC I	Cell and Molecular Biology	03
Cos :		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. understand structural organization and functional role of cell, organelles and biomolecules. 2. correlate the various life processes and their functioning. 3. understand the process of chromosomal organization and its role in cellular metabolism. 4. evaluate the various life processes and their regulations with special reference to regulation of gene expression. 		
Unit-I	Cell wall, composition and functions Structural organization and functional aspects of membrane, transport, ion channels, active transport, membrane pumps. 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. 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-III	Chromosomal Organization, DNA packaging, histone modifications; chromatin structure, heterochromatin, euchromatin, Organization of Centromeres and Telomeres, Specialized Chromosomes: Polytene, Lampbrush, B Chromosomes. Genome size, Organization; C-value paradox, cot curve, re-association kinetics, hypochromic effect	
Unit-IV	Regulation of gene expression in Prokaryotes: Gene structure, <i>Lac</i> - Operon, <i>Trp</i> - Operon and Phage Operon, Regulation of gene expression in Eukaryotes: <i>cis</i> and <i>trans</i> regulation; promoters, transcription factors, post-transcriptional regulation, role of chromatin remodeling.	
Unit-V	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, secretory protein synthesis; Signal Recognition Particle (SRP).	
Suggested Reading:		
<ol style="list-style-type: none"> 1. De, D.N. 2000. Plant Cell Vacuoles: An introduction. CSIRO Publication, Collingwood, Australia 2. Rost, T. <i>et al.</i>, 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 Aneuploids. 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:		
<ol style="list-style-type: none"> 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 2011 Genes 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: <ol style="list-style-type: none"> 1. Develop strong fundamental basics of cell dynamics. 2. They would be able to analyze and interpret the cell behavior, cell cycle and cell communication processes. 3. They would be able to predict disorders within the biological systems related to gene regulation. 4. They would be able to illustrate and justify the biological mechanisms 5. Able to explain the structure, synthesis and processing of Nucleic acids.

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester I		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
AEC I	Molecular Techniques	01
Cos :		
Upon completion of this course successfully, students would be able to		
Get acquainted about the latest techniques used in plant sciences		
Be trained about the tools and techniques.		
know the principle and applications of these techniques.		
Unit I	<ol style="list-style-type: none"> 1.1 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. 1.2 Analysis at the level of gene transcription – Northern blot, In situ hybridization, RNase protection assay, 1.3 Analysis of DNA protein interactions: Electrophoretic mobility shift assay (EMSA), DNase I foot-printing, Chromatin immuno-precipitation assay. 1.4 Analysis of protein-protein interactions - Co-immunoprecipitation assay, Fluorescence resonance energy transfer (FRET). 	
Suggested Reading:		
<ol style="list-style-type: none"> 1. Molecular Biology: A laboratory Manual, 4th edition, 2012: M. Green and J. Sambrook 2. An introduction to Molecular Biotechnology–Molecular fundamentals, methods and applications in Modern Biotechnology (2006): ed. Micheal Wink 3. Slater, A., Scott, N. W., & Fowler, M. R. (2003). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford: Oxford University Press. 4. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. 		
Course Outcomes:		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. Become expert in laboratory preparation as well as chemical preparations of different concentrations. 2. apply various formulas in preparations of reagents and are aware of their properties. 3. Apply various techniques at appropriate places as per required. 4. standardize the process and techniques on basis of knowledge. 5. Analyze and interpret the results with accuracy. 		

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester I		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
DSC II	Evolution and Diversity of Algae and Fungi	04
Cos:		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. Understand the phycology with special reference to Indian work. 2. Identify Algae in diversified habitats (Terrestrial, fresh water, marine) Criteria used in classification of algae, Role of algae in human welfare 3. Know General account of thallus organization, reproduction and life history of algae. 4. Study important groups of algae Cyanophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariopyta, Phaeophyta & Rhodophyta. 5. Study General Characters of Fungi Classification., Economic importance of fungi in medicine, 6. Use Algae and fungi in Agriculture (Biopesticide and biofertilizer) & Fungi as plant pathogen. 		
Unit I: Algae	1.1 Occurrence, Range of Thallus organization, Pigments, reserve food, reproduction and	

	<p>types of life cycles in algae, origin and evolution of sex in algae.</p> <p>1.2 Classification of algae proposed by F. E. Fritsch (1935,1948), G. M. Smith (1955), R. E. Lee (2008).</p> <p>1.3 Cyanophyta: Affinities with Prokaryotes and algae, ultrastructure of cell, special Cells-Akinetes, heterocyst and hormogonia, Range of thallus, reproduction and economic importance of cyanobacteria.</p> <p>1.4 Chlorophyta –range of thallus organization, reproduction and life cycle patterns and economic importance of green algae.</p> <p>1.5 Charophyta – Habitat and thallus diversity and reproduction</p>
Unit II: Algae	<p>2.1 Euglenophyta –Cell structure and reproduction</p> <p>2.2 Xanthophyta – Occurrence, distribution, thallus structure and reproduction.</p> <p>2.3 Bacillariophyta- General Characters, Occurrence Morphology Cell structure, Valve Morphology Reproduction and Economic importance of Diatoms</p> <p>2.4 Pheophyta – General characters, geographical distribution, thallus diversity reproduction and economic importance</p> <p>2.5 Rhodophyta – Occurrence, thallus structure and reproduction.</p>
Unit III: Fungi	<p>3.1 Mycelium structure and types, modified hyphal structures, mode of nutrition, mode of asexual reproduction, phases of sexual reproduction and fruiting bodies in different groups.</p> <p>3.2 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.</p> <p>3.3 Myxomycetes –General account and life cycles of typical myxomycete</p> <p>3.4 Chytridiomycetes-, Vegetative structure and reproduction in <i>Allomyces</i>.</p> <p>3.5 Oomycetes- life cycle in <i>Phytophthora</i> and <i>Albugo</i>.</p> <p>3.6 Zygomycetes- Vegetative structure and reproduction in <i>Mucor</i> and <i>Rhizopus</i></p>
Unit IV: Fungi	<p>General account of the following groups and study of representative genus:</p> <p>4.1 Plectomycetes – Vegetative structure and reproduction in <i>Aspergillus</i></p> <p>4.2 Discomycetes - Vegetative structure and reproduction in <i>Peziza</i></p> <p>4.3 Teliomycetes- life cycle of –<i>Ustilago</i></p> <p>4.4 Hymenomycetes - Life cycle of <i>Agaricus</i></p> <p>4.5 Hypomycetes- <i>Alternaria Fusarium</i>,</p> <p>4.6 Coelomycetes- <i>Colletotricum</i></p> <p>4.7 Lichen- nature of association, Morphological types, reproduction and economic importance.</p>
Unit V: Fungi	<p>5.1 Research work in the field of mycology and Phytopathology in India.</p> <p>5.2 Heterothalism and parasexuality in fungi</p> <p>5.3 Role of fungi in –Agriculture, Industry and as a food</p> <p>5.4 Some major fungal diseases- <i>Candidiasis</i>, <i>Aspergillosis</i>, <i>Mucormycosis</i></p> <p>5.5 Role of Fungi in antibiotic production.</p> <p>5.6 Mycorrhiza and its applications.</p> <p>5.7 Regional fungal crop diseases (Fungal, Viral, Bacterial and Phytoplasmal diseases).</p>
Suggested Reading: 5.1	
<ol style="list-style-type: none"> 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. 10. Recent Advances in Phycology - H.D. Kumar Rastogi Publ., Meerut. 11. Aquatic Biology in India - Kachroo P. Bishan S. Mahendra Pal. Dehradun 12. The structure and reproduction in the Algae –Vol. I & II, F.E. Fritsch, Cambridge 4 Uni. Press. 13. Cryptogamic Botany –Vol. I, G.M. Smith, Tata Mac Graw Hill Publication, New Delhi 14. Advances in Phycology— edited by B.N. Verma, APC Publication India. 15. Phaeophyceae in India –J.N. Mishra, ICAR Publication, New Delhi. 16. Sea weeds and their uses –V.J.Chapman 17. Introductory Mycology – Alexopolus, John Wiley and Sons Ind. 18. An Introduction to Mycology – Mehrotra and Aneja, New Age Intermediate Press. 19. Diseases of India – Rangaswami and Mahadevan, Prentice Hall of India Pvt. Ltd., New Delhi. 20. Introduction to Fungi – Webster, Cambridge Univ. Press. 21. Plant Diseases - R.S. Singh, Oxford and IBH Publishing. 22. Microbiology and Pathology – P.D. Sharma, Rastogi Publication, Meerut 23. A text book of modern Plant Pathology – Bilgrami and Dubey, Vikas Publication, New Delhi. 24. Agrios, G.N. 1999. Plant Pathology. Academic Press 25. Annual Review of Phytopathology, 1999. Vol. 37, APS Press 26. Chandanwala, K. 1986. Introduction to Plant Pathology. Anmol Publishers and Distributors 27. Frisvad, J.C. Bridge, P.D. Arora, D.K. 1998. Chemical fungal taxonomy Marcel and Dekker Inc. 28. Ignacimuthu, S.J. 1996. Applied Plant Biotechnology. Tata McGraw –Hill Publ. Company Ltd. 29. Mahadevan, A. 1991. Post infectious defense mechanisms. Today and Tomorrow's Printers and publishers 	

30. Mehrotra, R.S. 1991. Plant Pathology. Tata McGraw – Hill Publishing Company Ltd.
31. Miles, P.G. and Chang, S.T. 1997. Mushroom Biology. World Scientific Publ. Company
32. Roberts, S. Fritz & Elien. I. Simms. 1992. Plant Resistance to Herbivores and Pathogens (Ecology, Evolution and Genetics), University of Chicago Press.
33. Rudra P. Singh, Uma S. Singh & Keisuke Kohmoto (eds.) 1995. Pathogenesis and host specificity in plant diseases. Vol. III Pergamon Press.
34. Scheffer, R.P. 199. The nature of disease in plants. Cambridge University Press.
35. Kumar, H.D. 1988 Introductory Phycology. Affiliated East- West Press Ltd., New Delhi.
36. Morris, I.1986. An Introduction to the Algae, Cambridge University Press, U.K.
37. Round, F.E. 1986. The Biology of Algae, Cambridge University Press, Cambridge.
38. Prescott G.W. (1969) The Algae: A Review, Thomas Nelson and sons, London.
39. Lee,R.E. (1980) Phycology, Cambridge University Press, Cambridge.
40. Kumar, H.D. (1990) Introductory Phycology, East west Press , New Delhi.
41. Misra, J.N. (1966) Pheaeophyceae of India, ICAR, New Delhi.
42. Kumar , H.D.(1989) Algal Cell Biology, 2nd Edition, East west Press New Delhi.
43. Desikachary, T.V. (1959) , Cyanophyta , ICAR, New Delhi.
44. Round , F.E. (1981) The Ecology of Algae. Cambridge University Press, Cambridge.
45. Round , F.E. (1973) The Biology of Algae. 2nd Edition, Edward and Arnold , London.
46. Campbell, D.H. (1961) The evolution of Land Plants. Central Book Depot, Allahabad.
47. 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). Introductory Mycology 3rd Edition, John Wiley and Sons, Inc. Wiley, New York.
49. Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York.
50. Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
51. Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
52. Bilgrami, K.S. and H.C.Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
53. Butler E.J. and S. J. Jones (1949) Plant Pathology, Macmillan & Co. New York.
54. Dube, R.C. and D. K. Maheshwari (2000) Practical Microbiology - S. Chand & Co. Ltd.
55. Gupta, V.K. and M. K. Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rejinder Nagar, Ludhiana.
56. Jha, D.K. (1993) A Text Book of Seed Pathology, Vikas Publication House.
57. Manibhushan Rao, K. and A.Mahadevan - Recent Development in biocontrol of plant pathogenes. Today and Tomorrow publishers, New Delhi.
58. Mehrotra, R.S. and K. R. Aneja (1998) An Introduction to Mycology, New Age Intermediate Press.
59. Mukadam, D.S. and L.V. Gangawane (1978) Experimental Plant Pathology (edited) Marathwada University Aurangabad.
60. Pande, P.B. (1997) Plant Pathology, S. Chand & Co. New Delhi.
61. Preece and Dickeson. Ecology of leaf surface microorganism Academic Press, New York.
62. 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.
64. Thind, T.S. (1998) Diseases of field crops and their management, National Agricultural Technology, Information Centre Ludhiana.
65. C. Manoharachary , K. V. B. R. Tilak, K. V. Mallaiah and I. K. Kunwar 2016, Mycology and Microbiology, Scietific Publishers, Jodhapur Rajasthan.
66. 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
68. 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.

Syllabus Prescribed for 2022 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	Economic Botany and Resource Utilization	04
Cos :		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. Study the origin, divarication, utility and conservation strategies & natural resources 2. Study importance of food, fiber, medicines & oil yielding plant. 		

	<p>3. Study the plants and their value in the service & mankind.</p> <p>4. Study the conservation of biodiversity.</p>
Unit – I	<p>1.1 Introduction & levels of Biodiversity, species diversity, genetic diversity, ecosystem diversity</p> <p>1.2 Biodiversity threats – habitat loss and over exploitation of resources.</p> <p>1.3 Biodiversity conservation <i>in situ</i> & <i>ex situ</i>;</p> <p>1.4 Biodiversity and agriculture; biodiversity and food diversity, commercial value of biodiversity.</p>
Unit-II	<p>2.1 Centers of origin & cultivated plants and gene diversity utilization & cereals, cultivation and improvement of wheat, rice, jowar, Bajra.</p> <p>2.2 Pulses & forage legumes – general account Origin, evolution, botany, cultivation and uses of</p> <ol style="list-style-type: none"> Regional Food, Forage and fodder crops such as <i>Sorghum</i>, <i>Cajanus</i>, Maize, Paddy, Pulses. Regional Fiber crops – Cotton, Jute & Coir. Regional Medicinal and aromatic plant such as <i>Withania somnifera</i>, <i>Vinca rosea</i>, <i>Aloe vera</i>, <i>Mentha piperita</i> and <i>Cymbopogon</i>. Regional Oil yielding plants & vegetables (<i>Arachis hypogaea</i>, <i>Gossypium</i>, <i>Brassica</i> sp., <i>Solanum</i>, and <i>Abelmoschus esculentus</i>. Spices – Ginger, Turmeric, Cinnamon, Clove, Black paper & Chilies.
Unit-III	<p>3.1 Plants and their value in the service of the mankind</p> <p>3.2 General account and parts from which these are obtains, methods of extraction and uses, paper making Tannins, Dyes, Gum and Resins, Rubber & Latex.</p> <p>3.3 Innovative approaches for meeting world food demands modern agricultural approach.</p> <p>3.4 Plants used as Avenue trees for shade and aesthetics.</p> <p>3.5 Fire wood & Timber woods their identification properties and users, Teak, Shisam, Sal, Neem, Mango, Babul.</p>
Unit – IV	<p>4.1 Strategies for conservation of Biodiversity, causes of decline & Biodiversity.</p> <p>4.2 Importance of sanctuaries, National parks, Biophere reserves (Tiger reserve with reference to Melghat Tiger Project). Wild Management.</p> <p>4.3 Conservation of wild germplasm with reference to endangered & threatened species. Sacred groves & threatened species.</p>
Unit-V	<p>5.1 Concept of lead Botanical gardens and Biodiversity parts field gene banks, seed banks.</p> <p>5.2 Legal aspects of conservation of biodiversity in India.</p> <p>5.3 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</p>
Suggested Reading:	
<ol style="list-style-type: none"> Kumar, S.(2011).Economic Botany. Campus Books International, New Delhi Kochhar, S. L. (2012). Economic Botany in the Tropics. Laxmi Publications, New Delhi Sambamurty, A.V.S.S. & Subrahmanyam, N. S. (2008). A Textbook of Modern Economic Botany, CBS Publishers 7 Distributors Pvt. Ltd., New Delhi Sharma, A.K.& Sharma, R. (2015). Taxonomy of Angiosperms and utilization of Plants. Pragati Prakashan, Meerut. Verma, V. (2013). Text Book of Economic Botany. Ane Books Pvt Ltd, New Delhi. Economic Botany- Hill, Mac Graw Hill Book Comp. Economic Botany- Pandey, S. Chand and Com., New Delhi. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. Science Publication. Primack, R. 2006. Essentials of Conservation Biology. Sinauer Associates, Inc., USA. Hambler, C. 2004. Conservation. Cambridge University Press. Van Dyke, F.2008.Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer. Hastings, A. (Ed.). 1953 Population biology: concepts and models. Springer Science and Business Media Neal, D. 2004. Introduction to Population Biology. Cambridge University Press. Vandermeer, J. H. and Goldberg, D. E. 2013. Population Ecology: First principles. Princeton University Press. Begon, M., Mortimer, M. and Thompson, D. J. 2009. Population ecology: A unified study of animals and plants. John Wiley & Sons. Lomnicki, A. 1988. Population Ecology of Individuals. Princeton University Press. Rockwood, L. R. 2015. Introduction to Population Ecology. John Wiley & Sons. 	

<p>19. Smith, R. L. and Smith, T. M. 2014. Elements of Ecology. Benjamin-Cummings Publishing Company.</p> <p>20. Primack, R. 2014. Essentials of Conservation Biology (Sixth Edition). Sinauer Associates, Inc., USA</p> <p>21. Morris, W. F. and Doak. D. F. 2002. Quantitative Conservation Biology: Theory and practice of Population Viability Analysis. W. H. Freeman Publishers.</p> <p>22. Landi, R., Engen, S. and Saether, B. 2003. Stochastic population dynamics in Ecology and conservation. Oxford University Press.</p> <p>23. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA</p>
<p>Learning Outcome:</p> <p>After completion of this course student would be able to –</p> <ol style="list-style-type: none"> 1. Understand the pattern origin diversification and cultivation & plant in nature. 2. Know about origin and cultivation and various economically importance crop plants. 3. apply the strategies for conservation of biodiversity. 4. become well-versed with the plants utilized by human race.

Syllabus Prescribed for 2022 Year	PG. Programme
Programme	M.Sc. Botany
Semester I	
Code of the Course Subject	Title of the Course/ Subject
DSC IV	Plant Development
	No. of periods/ week
	04
Cos :	
Upon completion of this course successfully, students would be able to	
<ol style="list-style-type: none"> 1. Deal with regulation of growth and development of plants in relation to bio-molecular interaction. 2. know the various structural and anatomical components of plant tissue and reproductive parts. 3. Understand Structure and development of Flower, Male gametophyte, Female gametophyte, Seed development, dormancy. 	
Unit-I	Concepts of growth and development, zygote, embryonic development; stages; polarity and symmetry, developmental plasticity; Morphogenetic gradients, pluripotency; cell fate and cell lineages determination, Meristem development, types of meristem; Anatomical features, vascular elements; differentiation of xylem, phloem, secretory tissues, Nectaries, laticifers, resin ducts.
Unit-II	Organization of Shoot and Root Apical Meristems (SAM & RAM), molecular regulation and mutant analysis in <i>Arabidopsis</i> and <i>Antirrhinum</i> , Leaf development, determination of phyllotaxy and molecular regulation in <i>Arabidopsis</i> and <i>Antirrhinum</i> ; leaf anatomy, development of epidermis, mesophyll, trichomes and stomata. Secondary growth; cambium, structure and development of wood.
Unit-III	Transition to flowering; morphological and histochemical changes in shoot apex, floral meristems and floral development; homeotic mutants in <i>Arabidopsis</i> and <i>Antirrhinum</i> , sex determination. Regulation of anther and ovule development, microsporogenesis; microgametogenesis, tapetum.
Unit-IV	Pollen development, pollen wall structure and pollen tube formation; Floral rewards; pollination; agencies and types of pollination; pollen-pistil interactions, pollen tube guidance, self-incompatibility. Double fertilization and triple fusion, role of synergids, endosperm development, types of endosperm
Unit-V	Seed structure and development, seed dormancy; mechanism and types and significance, seed dispersal, seed germination; mobilization of reserve food, Polyembryony, apomixis, apospory, diplospory and adventive embryony, <i>In-vitro</i> plant regeneration through embryo, pollen and anther-culture, Senescence; mechanism; metabolic changes and factors affecting senescence
Suggested Reading:	
<ol style="list-style-type: none"> 1. Bailey, J.D. and Black, M. 1994. Seeds: Physiology of development and Germination, Plenum Press, New York. 2. Fahh, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford. 3. Fosket, D.E. 1004. Plant Growth and Development. A Molecular approach. Academic Press, San Diego. 4. Howell, S.H. 1998. Molecular Genetics of Plant Development Cambridge University Press, Cambridge. 5. Lyndon, R.F. 1990. Plant Development. The Cellular Basis. Unnin Hyman, London. 6. Mauseth, J.D. 1988. Plant Anatomy. Benjamin Cummings. California. 7. Pullaiah, T., Naidu, K.C., Lakshminarayana, K., and Hanumantha Rao, B. 2007. Plant Development. Regency Publications, New Delhi. 	

8. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition) Wordsworth Publishing, Belmont, California.
9. Steeves, T.A. and Susses, I.M. 1989. Patterns in Plant Development (2nd edition), Cambridge University Press, Cambridge.
10. 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.
11. Wilkins, M. B. (1976): Physiology of Plant Growth and Development. McGraw-Hill Publishing Company Limited.
12. Shivanna, K. R. and Rangaswamy N. S.1992. Pollen Biology - A Laboratory Manual, Narosa Publishing House, New Delhi.
13. Batygina T. B.2009. Embryology of Flowering Plants Terminology and Concepts, Volume 3, Reproductive Systems, Science Publishers, USA.
14. Raghavan V.2000. Developmental Biology of Flowering Plants, Springer-Verlag, New York.
15. Bhojwani S. S. and Bhatnagar S. P.1992. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi.
16. Johri B.M.1984. Comparative Embryology of Angiosperms, Ind. Nat. Sci. Acad., New Delhi.
17. Maheshwari P.1985. An Introduction to Embryology of Angiosperms, Tata McGraw Hill, New Delhi.
18. Esau K.1985. Plant anatomy, 2nd Edition, Wiley Eastern Limited, New Delhi.
19. Metcalf C. R. and Chalk L.1950. Anatomy of Dicots Vol. I & II, London Press, Oxford.
20. Romberger J. A., Hejnowicz Z. and Hill J. F.1993. Plant Structure: Function and Development, Springer-Verlag.
21. Nair P.K.K. Essentials of Palynology, Asha Publishing House, New York.
22. Shivanna, K. R. and Sawhney V. K.1997. Pollen Biotechnology for Crop Production and Improvement, Cambridge University press. U.K.
23. Lyndon R. F.1990. Plant Development, the Cellular Basis. Cambridge University Press, UK.
24. Hesse M. and Ehrendorfer F.1990. Morphology, Development and Systematic Relevance of Pollen and Spores, Springer-Verlag, New York.
25. Kashinath Bhattacharya, M. R. Majumdar and S. G. Bhattacharya. 2006. A text Book of Palynology, New Central Book Agency (P) Ltd., Kolkata, India

Learning Outcome:

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

1. Know about plant anatomical structure, their developmental patterns.
2. Identify plant reproductive parts development of male, female gametophytes, seed and fruits.
3. Know anomalous Secondary Growth.
4. Apply the knowledge of anatomy, structure and functions to all flowering plants.
5. Apply the embryological techniques and methods to various plant species and situations.
6. Understand and apply the knowledge of pollen biology and methods and techniques to various plant species.

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

PG Programme

Semester I Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
Practical – I	Practical based on DSC I & II	06

DSC I Cell and Molecular Biology

COs:

Upon completion of this course successfully, students would be able to demonstrate the following activities/tasks

Laboratory Exercises

1. Differential Centrifugation for isolation of cell fractions.
2. Isolation and extraction of cell organelles like mitochondria/ chloroplast.
3. Isolation of Polytene Chromosome from *Chironomus/ Drosophila* larvae.
4. Isolation and observations of B Chromosome.
5. Preparation of cytological slides for chromosomal non-disjunction in *Rhoeo/ Tradescantia*.
6. Prepare slides of mitosis and meiosis in some monocots and dicots like *Allium, Aloe, Maize, Brassica* etc.
7. To determine mitotic index.
8. SDS PAGE separation of seed storage proteins and quantification of each fragment.
9. Isolation and purification of genomic DNA from plant materials by CETAB Method.
10. Isolation and purification of RNA from plants.
11. Quantitative estimation of genomic DNA and RNA using spectrophotometer.
12. Agarose gel electrophoresis of genomic DNA and RNA and detection using gel documentation system.
13. Digestions of DNA by restriction enzymes and size fractionation of fragments
14. Isolation of Plant DNA and prepare Cot curve.
15. Demonstration of western blotting.
16. Study of electron micrographs of cell organelles.
17. Study of permeability of living cell to acids and bases.
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) <i>Oscillatoria, Nostoc, Anabaena, Spirulina, 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.</i>
2	Morphological Studies and monograph of Fungi (any 15 of the following) <i>Stemonities, Perenospora, Phytophthora, 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.</i>
3	Permeant Slides or Culture of following fungal forms <i>Rhizopus, Mucor, Aspergillus, Penicillium, Drechslera, Curvularia. Phoma, Colletotrichum, Alternaria, Helminthosporium Trichoderma.</i>
4	Symptomology of some diseased plants (any 10 of the following). 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 (ii) Photography of Diseased plant parts (iii) Microphotography of fungal isolates
	<p>Learning Outcome: Upon completion of this course successfully, students would be able to</p> <ol style="list-style-type: none"> 1. Create monographs of algal isolates. 2. Classify and identify algal genus 3. Demonstrate the application of algae in different fields 4. Create monographs of fungal isolates 5. Classify and identify algal genus. 6. Perform Diagnosis of plant diseases 7. Create compendium of plant diseases

* List of Practical/Laboratory Experiments/Activities etc.

Sant Gadge Baba Amravati University, Amravati

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

PG Programme

Semester I Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicu m/hands-on/Activity)	(No. of Periods/Week)
Practical II	Practical based on DSC III & DSC- IV	06

* 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*, *Rauwolfia 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. Know the importance cultivation & uses of economically important plants.
2. Identify medicinal plants & uses of medicinal plants, which are locally available.
3. Survey extramural, sources of various non-wood forest products.
4. Know Conservation strategies of rare & threatened plant species
5. Identify important plants & their value in the service of the mankind

BOEC I

Syllabus Prescribed for 2022 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:		
Upon completion of this course successfully, students would be able to		
1. study the Ethnic tribes in ethnobotany		

	<ol style="list-style-type: none"> 2. study the significance and cultivation of medicinal plants 3. be aware about IPR. 4. 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: <i>Asparagus</i> , <i>Chlorophytum</i> , <i>Tinospora cordifolia</i> , <i>Dioscorea</i> , <i>Aloe</i> 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:	
<ol style="list-style-type: none"> 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 <i>et al.</i> (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. Tribes of India (Vol- I & II) by A. Ashok and P. V. Lakshmaiah (2018). 21. Medicinal Plants of Uttarakhand by C.P. Kala (2010). 22. 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 23. Modern Phytomedicine – Ahmad Iqbal, Aqil Farrukh, Owais Mohammad 24. Herbal medicine: bimolecular & clinical aspects - FF Benzie & SW Galor. 	
Learning Outcome:	
The students will be able to	
<ol style="list-style-type: none"> 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. Use some of these plants practically in minor ailments. 4. Know <i>ex-situ</i> and <i>in-situ</i> conservation of some rare medicinal plants. 5. Know patenting and preservation of Traditional knowledge. 	

**Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Botany
(Two year- Four Semester Degree Programme- C.B.C.S.)
(M.Sc. Part I) Semester II**

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-V Plant Physiology	BOT 201	3	-	-	3	3	-	3	3	80	20	-	-	100	40	P
2	AEC- II Modern Techniques	BOT 202	-	1	-	1	1	-	1	1	-	-	50	-	50	25	P
3	DSC-VI Evolution and Diversity of Bryophytes and Pteridophytes	BOT 203	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
4	DSC -VII Genetics and Plant Breeding	BOT 204	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
5	DSC- VIII Plant Biochemistry and Pharmacognosy	BOT 205	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
6	Lab- 3 Practical Based on DSC V & VI	BOL 201	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
7	Lab-4 Practical Based on DSC VII & DSC-VIII	BOL 202	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
8	# Internship/ Field Work/ Work Experience @																
9	Open elective/ GIC/ Open skill/ MOOC* Floriculture and nursery Management	OEC-I	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
Total						28			26						650		

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience in First or Second or Third semester of Master of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester I to III. This will carry 2 credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.

-OEC (Optional) can be studied during semester I to IV

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester II		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
DSC V	Plant Physiology	03
<p>Cos : Upon completion of this course successfully, students would be able to</p> <p>Grasp concepts of proteins, enzymes, basic plant signaling mechanisms, sensory photobiology. deal with physiology of nutrient uptake, photosynthesis and nitrogen metabolism</p>		
Unit-I	<p>Bioenergetics, enzyme kinetics: Thermodynamics, entropy, enthalpy; Bioenergetics; Gibbs's free energy, concept of catalysis and mechanism, types of enzymes, enzyme kinetics, enzyme regulation and inhibition; isozymes</p>	
Unit-II	<p>Photosynthesis: 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.</p>	
Unit-III	<p>Respiration and secondary metabolites: Regulation of glycolysis; citric acid cycle, alternate oxidase; plant mitochondrial electron transport and ATP synthesis; PPP, Glyoxylate pathway and its significance. Stress Physiology: responses to biotic and abiotic stresses.</p>	
Unit-IV	<p>Plant hormones and photomorphogenesis: Biosynthesis, storage, breakdown, and transport; physiological effects and mechanisms of action. Auxins Gibberellins, Cytokinins, Ethylene, Abscissic acid, Brassinosteroids, Jasmonic acids, Polyamines, salicylic acid. Structure, function and photomorphogenic responses, of phytochromes, cryptochromes and phototropin, photoperiodism and floral induction, Biological Clocks; Stomata movements.</p>	
Unit-V	<p>Solute transport and photo assimilate translocation: 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. Assimilation of nitrate, ammonia, sulphur and phosphate.</p>	
Suggested Reading:		
<ol style="list-style-type: none"> 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 Library, 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, Amsterdam, The Netherlands. 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. 		
<p>Learning Outcome: Upon completion of this course successfully, students would be able to</p> <ol style="list-style-type: none"> 1. 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. 		

<p>2. 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.</p> <p>3. 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.</p>
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Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester II		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
AEC II	Modern Techniques	01
Cos :		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> learn about the latest techniques used in plant sciences get training on the tools and techniques. know the principle and applications of these techniques. 		
Unit I	<p>1.1 Electrophoresis: Principle, types, separation of proteins and nucleic acids, buffer, detection assay, storage, safety of application. Western blotting, Northern blotting, southern blotting</p> <p>1.2 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).</p> <p>1.3 Column chromatography: principles, general aspects, adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents, (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications.</p> <p>1.4 Paper chromatography: principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two-dimensional development, reverse phase paper chromatographic technique visualization and evaluation of chromatograms, applications.</p> <p>1.5 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.</p>	
Suggested Reading:		
<ol style="list-style-type: none"> Schewer M.A. and Zeclinskin.1989. Methods in plant Molecular biology. Academic Press New York. Wilson E and Walker J. 2000. Practical Biochemistry Principles and Techniques. Cambridge publications. Ream W and Field K.G.1999. Molecular Biology Techniques Academic Press London. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition. 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. Douglas A. Skoog, Donald M. West and F. James Holler, analytical chemistry an introduction, Saunders college publishing, New york, 1990. 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. Pietrzyk and Frank. Analytical chemistry, 1990. KVSG Muralikrishna, An Introduction to ISO 14000, Environmental Management, 1998. Y.Anjaneyulu, Quality Assurance and GLP – IGNOU Pub., New Delhi, 1999. Omachonu V.K.and Ross J.E. Principles of Total quality, S.Chand & Co. Ltd., New Delhi, 1997. Werner Funk, Vera Damman, Gerhild Donnervert. Quality Assurance in Analytical Chemistry, VCH Publishers, New York, NY (USA), 1997. 		

13. Bertamd L.Hanser and Prabhakar Ghani. Quality Control and Applications, Prentice-Hall
<p>Learning Outcome: Students would be able to-</p> <ol style="list-style-type: none"> 1. Become expert in laboratory preparation as well as chemical preparations of different concentrations. 2. Apply electrophoresis techniques for biological sample analysis. 3. Standardize the process and techniques on basis of knowledge. 4. Analyze and interpret the results with accuracy. 5. demonstrate the various chromatographic techniques.

Syllabus Prescribed for 2022 Year	PG. Programme
Programme	M.Sc. Botany
Semester II	
Code of the Course Subject	Title of the Course/ Subject
DSC VI	Evolution and Diversity of Bryophytes and Pteridophytes
	04
Cos :	
Upon completion of this course successfully, students would be able to	
<ol style="list-style-type: none"> 1. understand evolutionary diversification of early land plants and morphology and reproduction in bryophytes, pteridophytes. 2. know the Ecological and Economic Importance of bryophytes, pteridophytes. 3. classify Bryophytes into various groups, study their importance 4. classify Pteridophytes into various groups, study their importance and multiplication of important ferns 5. know the applied aspects of Bryophytes and Pteridophytes. 	
Unit I: Bryophyta	<ol style="list-style-type: none"> 1. Evolutionary trends in Bryophytes with special emphasis on thallus organization and sporophyte evolution, fossil Bryophytes, Bryology in India. 2. G. M. Smith (1955) Classification of Bryophyta 3. Thallus Organization; Internal structure and reproduction, Comparative account and distinguished adoptive feature of: - Hepaticae: <ol style="list-style-type: none"> i. Sphaerocarps ii. Marchantiales iii. Anthocerotales iv. Jungermanniales v. Metzgeriales vi. Calobryales
Unit II: Bryophyta	<ol style="list-style-type: none"> 1. Alternation of generation in Bryophytes. 2. Thallus Organization; Internal structure and reproduction with special reference to key distinguishing characters in: - Musci: <ol style="list-style-type: none"> i. Sphagnales ii. Andreales iii. Eubryales iv. Takakiales 3. Contribution of Shiv Ram Kashyap, Ram Udar and S. C. Srivastava in Bryology. 4. Endemism and endemic liverwort genera of India and conservation of bryophytes.
Unit III: Pteridophyta	<ol style="list-style-type: none"> 1. A brief account of origin of pteridophytes, heterospory and seed habit, evolution of stelar system, telome theory, evolution of sorus, apogamy, apospory and apomixis. 2. G.M. Smith (1955) Classification of Pteridophyta. 3. A brief account of the following classes with emphasis on evolution: <ol style="list-style-type: none"> i. Psilophytosida: <i>Rhynia</i>, <i>Horneophyton</i> ii. Psilotosida: <i>Psilotum</i>. iii. Lycoposida: <i>Lycopodium</i>, <i>Lepidodendron</i>, <i>Lepidocarpon</i>, <i>Selaginella</i>, <i>Isoetes</i>. iv. Sphenopsida: <i>Hyenia</i>, <i>Sphenophyllum</i>, <i>Calamites</i>, <i>Equisetum</i>.
Unit IV: Pteridophyta	<ol style="list-style-type: none"> 1. The fertile sporophyte: sporangia: position, ontogeny types, structure. 2. Comparative study of Pteropsida: Eusporangiate (Ophioglossales and Marattiales) with special reference to phylogeny of Ophioglossales.

	<ol style="list-style-type: none"> 3. Protoleptosporongiate (<i>Osmunda, Leptopteris</i>) 4. Leptosporongiate: <ol style="list-style-type: none"> a) Filicales (<i>Hymenophyllum, Adiantum, Pteris, Dryopteris</i>) b) Marsileales (<i>Marsilea</i>) c) Salviniaceae (<i>Salvinia, Azolla</i>). 5. Endangered and endemic pteridophytes and their conservation
Unit V: Role and Applications	<ol style="list-style-type: none"> 1. Emerging source for herbal remedies and usability of bryophytic material in forensic studies. 2. Economic importance of Bryophytes, Bryophytes as monitors of mineral deposition, Air Pollution Indicators. 3. Diversity of Ferns - an ecological perspective, Cultivation and maintenance of ornamental ferns. 4. Ethnomedicinal uses of Pteridophytes.
Suggested Reading:	
<ol style="list-style-type: none"> 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. 3. Kashyap, S. R. (1932). Liverworts of the Western Himalayas and the Panjab plain (illustrated): Part 2 The Chronica Botanica New Delhi. 4. Kashyap, S. R. (1929). Liverworts Of The Western Himalayas And The Panjab Plain Part 1 Chronica Botanica New Delhi. 5. Parihar, N. S. (1980). Bryophytes: An introduction to Embryophyta Vol I, Bryophyta central Book Depot. 6. Prem puri (1981). Bryophytes: Morphology, Growth and Differentiation, Atma ram and Sons, New Delhi. 7. Udar, R. (1975). Bryology in India: Chronica Botanica Co., [c], New Delhi. 8. Udar, R. (1970). Introduction to Bryophyta. Shashidhar Malaviya Prakashan Lucknow 9. Watson, E. V. (1971). Structure and life of bryophytes 3rd, Hutchinson University Library London. 10. Schofield, W.B. (1985). Introduction to Bryology. Macmillan. ISBN, 0029496608, 9780029496602. 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:	
<p>Upon successful completion of this course, the student would be able to:</p> <ol style="list-style-type: none"> 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. 	

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester II		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
DSC VII	Genetics and Plant Breeding	04
Cos:		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. understand the concept of classical and modern genetics clearly. 2. study the inheritance pattern. 3. know the role of chromosomes in evolution and the factors leading to changes in them. 4. study mutations and breeding and their significance in crop improvement. 5. study the variation in populations. 		
Unit-I	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-II	Chromosome structural aberrations; deletion, duplication, inversion, translocation, complex translocation. Chromosomal Numerical aberrations, Aneuploidy and Euploidy and their genetic implications. Polyploidy: Types, origin and meiotic behaviour, Karyotype analysis; method and evolution; banding patterns, applications	
Unit-III	Gene mutation; types; spontaneous and induced mutations; causes, physical and chemical mutagens, genetic recombination and repair Gene mapping methods; Linkage maps, tetrad analysis, restriction mapping Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping	
Unit-IV	Plant Breeding; history, Breeding methods; self-pollinated crops; mass selection, pureline selection, pedigree selection, bulk method, backcross method, Clonal selection, Hybridization Mutational breeding: chemical mutagenesis, physical mutagenesis, treatments, selections of mutants. Macro and micro mutants, significance in crop improvement Role of polyploids in plant breeding, heterosis and inbreeding depression	
Unit-V	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. Biostatistics: samples, data, graphs, frequency distribution, mean, variance and deviation, Binomial and Poisson distribution and Chi-Square test.	
Suggested Reading:		
<ol style="list-style-type: none"> 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, (8th 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. Hartl D. L., Jones E.W. 2001. Genetics an analysis of Genes and Genomes (5th edition). Jones & Bartlett Publishers, Boston 6. Klung, W. and Cummings, M. R 2003. Concepts of Genetics. (7th edition) Pearson Education, Singapore. 7. Russell, P.J. 2005. Genetics A Molecular Approach (2nd edition). Pearson/Benjamin Cummings, San Francisco. 8. Stansfield 1991. Genetics (3rd 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, 12. R.S. Shukla and P.S.Chandel, 3rd Edition, 2004. Cytogenetics, Evolution and Plant Breeding. 13. Chandrasekaran, S.N. & Parthasarathy. S.V. 1975. Cytogenetics and plant breeding (Revised Edition) Eds. Krishnaswamy. P. Varadachary & Co., Madras. 14. Elliott. J. 1958. Plant Breeding and Cytogenetics. McGrawHill Publications, London. 15. Goodenough, U. 1984. Genetics. Holt – Saunders International, London 16. Jain, K & Kharkwal, M.C. 2004. Plant Breeding – Mendelian to Molecular Approaches. Narosa Publishing House, New Delhi. 17. Jorde, B.L., Carey, J.C. Bamshed, M.J. & White, R.L. 2003. Medical Genetics (3rd edition), Elsevier Scientific Publ. Amsterdam. 18. Sen, S. Kar, D.K. 2005. Cytology and Genetics – Narosa Publishing House, New Delhi. 19. Allard, R.W.1960. Principles of Plant Breeding. John Wiley & Sons. Inc. New York. 		

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. Singh B. D. (2015). Plant Breeding-Principles and Methods (10 th Edition). Kalyani publishers., Ludhiana.

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. apply their knowledge to the changes in population genetics.

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester II		
Code of the Course	Subject Title of the Course/ Subject	No. of periods/ week
DSC VIII	Plant Biochemistry and Pharmacognosy	04
Cos:		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> 1. study the plant biochemistry and its various aspects. 2. study the metabolism and regulation of bio molecules. 3. understand the medicinal properties of plants and its constituents. 4. study the evaluation and standardization methods of drugs 		
Unit-I	Carbohydrates: 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: <ul style="list-style-type: none"> • Uptake, Assimilation and Reduction of Nitrogen • Amino acid classification, properties, functions • Biosynthesis of Amino acid • Proline metabolism for stress tolerance • Catabolism of Amino acid 	
Unit-III	Lipids: <ul style="list-style-type: none"> • Classification, Structure and properties, functions, • Biosynthesis of Fatty acids, • Membrane lipids, Structural lipids, Storage lipids, • Catabolism of lipids, • Phospholipids, Sphingolipids, derived lipids, 	
Unit-IV	Natural Products: <ul style="list-style-type: none"> • Classification, Structure, Properties, of Secondary metabolites • Occurrence, distribution and Synthesis of Secondary Metabolites • Analytical tools used for Natural Products Stability testing, Applied Pharmacognosy • Ethno-botany: Concept, relevance and classification • Ethnopharmacology and its application 	

	<ul style="list-style-type: none"> • Nutraceutical and Cosmetical: Introduction, classification, formulations, Botanical Sources, properties and uses • Crude drugs: Definition, Importance, Standardization, Biomarkers. • Standardization, quality efficacy, Safety requirements and Assessments procedures of herbal medicine USFDA
Unit-V	<p>Drug Evaluation:</p> <ul style="list-style-type: none"> • Concept, consideration, Quality control as per Pharmacopeia and guidelines. • Comparative study of Intellectual Property, European Pharmacopeia, Ayurvedic Pharmacopeia. • Pharmacognostic studies of some drug: Geographical distribution, Cultivation, Collection, Macroscopic and Microscopic Characters, Commercial products, Chemical Constituents, tests, therapeutic uses, Commercial varieties adulterants, Substitutes • Root Drug: Rhizome, Stem Drug Bark Drug, Leaf Drug: <i>Ocimum sanctum</i>, <i>Adhathoda vasica</i>, Flower Drug: <i>Coriandrum sativa</i> Fruits Drug, Seed Drug
Suggested Reading:	
<p>26. Bajracharya D. (1998). Experiments in Plant Physiology, Narosa Publishing House, New Delhi.</p> <p>27. Bhattacharya A and Vijay Laxmi (2015). Methods and techniques in plant physiology, New India Publishing Agency, New Delhi</p> <p>28. Mandal S.C., Mandal V and Das A. K. (2015), Essentials of Botanical Extraction, Academic Press, London</p> <p>29. Evans W. C. (2009). Trease and Evans Pharmacognosy, Saunders Elsevier, Edinburgh</p> <p>30. Wilson, E. & Goulding, K.H. 2000 A Biologists' Guide to Principles and Techniques of Practical Biochemistry ELBS.</p> <p>31. Jayaraman, J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.</p> <p>32. Modern Experimental Biochemistry, (3rd Edn.) R.Boyer, Benjamin Cumming, 2000.</p> <p>33. Practical Biochemistry, Principle and Technique (5th Edn.) K. Wilsen and J. Walker, Cambridge University press. 2000.</p> <p>34. Plant Biochemistry, P.M dey and J.B. Harborne, Harcourt Asia Ltd. Academic press, 1997.</p> <p>35. Horborne. J.B. 1983. Phyto chemical methods. Chapman and Hall. London.</p> <p>36. Trease. G.E. and Evan W.C. Pharmacognosy. 12 Edition. Bailliere, Tindall, East Bourne, U.K. 1983.</p> <p>37. Kokate. C.K.Purohit A.P. and S.B. Gokhale. Pharmacognosy Nivali Prakashan Publication.</p> <p>38. Miller. L.P. Phyto chemistry. 1-3 volumes Van Nostrand, Reinhold Co. 1973.</p> <p>39. Lehinger, A.L.(1987) Principles of Biochemistry, Worth Publications, Inc. USA.</p> <p>40. Noggle, G.R. & Fritz, G.J 1986. Introductory Plant Physiology, Prentice Hall of India Ltd., New Delhi.</p> <p>41. Sinha, R.K 2004. Modern Plant Physiology, Narosa Publishing House, New Delhi.</p> <p>42. Bruneton J., 1999. Pharmacognosy, Phytochemistry, Medicinal Plants, Intercept Ltd., Paris.</p> <p>43. Dewick P.M., 2002. Medicinal Natural Products: A biosynthetic approach, John Wiley & Sons Ltd.</p> <p>44. Evans W.C., 2002, Trease and Evan's Pharmacognosy, W.B. Saunders.</p> <p>45. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall.</p> <p>46. Houghton P.J. and A. Raman, 1998. Laboratory handbook for fractionation of natural extracts, Chapman and Hall.</p> <p>47. Kokate C.K., 1991. Practical Pharmacognosy, Vallabh Prakashan, Delhi.</p> <p>48. Samuelsson G., 1999. Drugs of naural origin: A text book of Pharmacognosy,</p> <p>49. Swedish Pharmaceutical Society, Swedish Pharmaceutical Press, Stockholm, Sweden.</p> <p>50. Tyler V.E., L.R. Brady and J.E.. Robbers, 1988. Pharmacognosy, Indian Edition, K.M. Varghese Company, Bombay.</p> <p>51. Vickery M.L. and B. Vickery, 1981. Secondary Plant Metabolism, The MacMillan Press Ltd.</p> <p>52. Wallis T. 1967. Text Book of Pharmacognosy, J & A Churchill, London.24</p> <p>53. Wagner H., S. Bladt and E.M. Zgainski (Translated by A. Scott) 1984, Plant Drug Analysis, Springer-Verlag.</p> <p>54. Vermerris Wilfred & Nicholson Ralph, 2006, Phenolic compound Biochemistry</p>	
<p>Learning Outcome:</p> <p>After completion of this course, the student would be able to:</p> <ol style="list-style-type: none"> 1. Classify Carbohydrates, Lipids, fatty Acids and their importance 2. learn about the techniques of crude drug preparations. 3. expand knowledge domain in tune with Drug development. 	

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

PG Programme

Semester II 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 V & DSC-VI	06

* 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.
11. Principles of colorimetry, spectrophotometry and fluorimetry.
12. Demonstration of an electron transport system.
13. Estimation of carbon dioxide liberated during respiration.
14. To demonstrate the process of antagonism.
15. To demonstrate the process of tissue tension.
16. Detection of amino acids by chromatography.
17. Effect of various salts on the permeability of the plasma membrane.
18. Estimation of Ascorbic Acid in the given material.

Minor:

1. Estimation of reducing, Non-reducing and total sugars.
2. To determine the Osmotic pressure of vacuolar sap of *Rheo discolor* or *Tradescantia* leaves by Plasmolytic method (50% plasmolysis)
3. To determine the diffusion pressure deficit (water potential) of potato tuber tissue by weighing method
4. To determine the structure, size and frequency of stomata in mesophytic and xerophytic leaves
5. To determine the rate of transpiration of plant i. Weight ii. Potometer method
6. To determine the rate of transpiration by Cobalt Chloride paper method and to calculate transpiration index (TI), Transpiration efficiency (TE) of various leaves
7. To measure the rate of photosynthesis in aquatic plants by Willmotts bubble counting method
8. 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
9. To extract the major plant pigments from leaves by different solubility method.
10. Demonstration of polyphenoloxidase in plant tissue.
11. Action of invertase on sucrose.
12. Effect of temperature on enzyme activity.
13. 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*, *Notothylyus*; *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*, *Angiosperis*.
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

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

PG Programme

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 VII and VIII	06

* 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 agents for the material
2. Preparation of mitosis and meiotic slides from suitable plant materials.
3. To determine mitotic index and mitotic index frequency.
4. Karyomorphological studies from slides/photograph.
5. Banding studies using Giemsa, Orcein, Florescent dyes.
6. Induction of mitotic abnormalities through mutagens.
7. To determine pollen viability and germination using fluorescent dyes and cell wall staining with Calcoflour.
8. Problem on Mendelian inheritance and interaction of genes, linkage and crossing over.
9. Demonstration of SEM.
10. Feulgen staining.
11. To study polygenic inheritance.
12. Study of quality traits in some local crops cotton, soybeans, Wheat, *Brassica* etc.
13. Study the Meiotic configurations in maize, *Allium*, *Rheo*, *Tradescantia*, *Aloe* etc.
14. Study of chromosomal aberrations in irradiated material.
15. Induction of polyploidy through Colchicine in suitable plant material.
16. Study of Floral Biology of some crop plants.

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. Determination of ascorbic acid from plant sample
9. Estimation of phytic acid
10. Determination of total phenol content from powdered drugs.
11. Determination of free radical scavenging activity of methanolic extracts of powdered drugs.
12. Effect of pH on enzyme activity.
13. Estimation of PPO oxidase from plant sample.
14. Estimation of Ascorbic acid [Calorimetric / volumetric]
15. Estimation of Riboflavin
16. Estimation of Tannins [Folin – Denis / Vanillin hydrochloride]
17. Separation of proteins by SDS-PAGE
18. Determination of Nitrate reductase activity
19. Estimation of ascorbate peroxidase enzyme from plants
20. Estimation of carbohydrate by Anthrone reagent
21. Determination and quantification of tannins.. flavonoids. phenolics. Alkaloids
22. Pharmacological screening of Anti-diabetic Agents.
23. Determination of anti-oxidant activity from local plants.
24. Screening of Crude Drugs for Anti-microbial activity.
25. Phytochemical screening methods: Paper Chromatography, TLC, HPLC, Spectrometry.
26. Identification of amino acids by Paper Chromatography..
27. Identification and Estimation of Lipids
28. Determination of adulteration in crude drugs.
29. Determination of extractive value of crude drugs.
30. Identification of organized and unorganized plant drugs
31. Separation of anthocyanin from flower petals using TLC
32. Quantitative estimation of an alkaloid – Solanine.
33. Extraction and estimation of lycopene.
34. Determination of pH of fresh and dry material of the following plants (*Ocimum*, *Adhatoda* leaves, *Terminalia arjuna* fruit,)
35. Estimation of curcumin in given sample. Evaluation of natural products – estimation of the ash value and determination of water soluble and acid soluble ash (Muffle furnace);

36. Determination of moisture content of sample using moisture balance method; Determination of microscopic characters
37. Estimation of Rutin

Syllabus Prescribed for 2022 Year		PG. Programme
Programme		M.Sc. Botany
Semester II		
Code of the Course Subject	Title of the Course/ Subject	No. of periods/ week
BOEC I	Floriculture and nursery Management	04
Cos :		
Upon the satisfactory completion of class assignments and the classroom experiences provided in the course, the student would be able to:		
<ol style="list-style-type: none"> List and describe procedural steps necessary during floriculture crop production from propagation to marketing. Identify and define environmental factors that regulate growth and flowering of floriculture crops. Develop production schedules for floriculture crops. Grow several crops in the greenhouse through nursery management. Identify and name some floriculture crops and classify them as potted, cut and/or garden crops. Develop methodology for production of horticultural crops through seeds. 		
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.	
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, Cockpit, plant protect in Nursery Management.	
Suggested Reading:		
<ol style="list-style-type: none"> Hartmann, H.T., Kester D.E., Davis, F.T and R.L Geneve (2010) Plant Propagation: Principles and practices (8th Edition). Sharma, R.R and Srivastav M (2004): Plant propagation and nursery management (First Edition) International Book Distributing Co. K.K.Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher- New Delhi-Ludhiana. Bose, T.K.Sanyal, D and Sandhu, M.L.(1998) Propagation of Horticultural crops. Naya Prakash Publishers, Kolkatta. Hartman, H.T. and Beutel, A (1979). Propagation of temperate zone fruit plants. Leaflet, California, Agri. Expt. Sta. California. Website URL: http://www.wikipedia.org/wiki/plant_propagation 		
Learning Outcome:		
Upon completion of this course successfully, students would be able to		
<ol style="list-style-type: none"> learn management practices for wholesale container and field production nurseries. Understand Business development, management, site selection and financial aspects. Acquire knowledge of harvesting and processing of nursery plants. 		

**Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Botany
(Two year- Four Semester Degree Programme- C.B.C.S.)
(M.Sc. Part II) Semester III**

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory + MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-IX Systematics and Taxonomy of Angiosperms	BOT 301	4	-	-	4	4	-	4	4	80	20	-	-	100	40	P
2	DSC-X Paleobotany, Evolution and Diversity of Gymnosperms.	BOT 302	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
3	DSE- I	BOTE-I 301 to 308	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
4	DSE -II	BOTE-II 301 to 308	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
5	Lab- 5 Practical Based on DSC IX & X	BOL 301	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
6	Lab- 6 Practical Based on DSE I & DSE- II	BOL 302-309	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
7	# Internship/ Field Work/ Work Experience @																
8	Open elective/ GIC/ Open skill/ MOOC* Post-harvest Technology	OEC I 303	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
Total						28			26						600		

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience in First or Second or Third semester of Master of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester I to III. This will carry 2 credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.

-OEC (Optional) can be studied during semester I to IV

Sr. No.	Course	Code
1	DSC-IX Systematics and Taxonomy of Angiosperms	BOT 301
2	DSC-X Paleobotany, Evolution and Diversity of Gymnosperms.	BOT 302
3	DSE- I 1. PLANT TISSUE CULTURE-I (Elective) 2. BIOINFORMATICS-I (Elective) 3. Angiosperm Taxonomy, Phytochemistry and Pharmacognosy-I (Elective) 4. Molecular Systematics I (Elective) 5. ADVANCED PLANT PHYSIOLOGY – I (Elective) 6. MOLECULAR BIOLOGY, BIOTECHNOLOGY AND PLANT BREEDING-I (Elective) 7. REPRODUCTIVE BIOLOGY OF ANGIOSPERMS-I (Elective) 8. PLANT PATHOLOGY-I (Elective)	BOTE-I 301 to 308
4	DSE -II 1. PLANT TISSUE CULTURE-II (Elective) 2. BIOINFORMATICS-II (Elective) 3. Angiosperm Taxonomy, Phytochemistry and Pharmacognosy-II (Elective) 4. Molecular Systematics II (Elective) 5. ADVANCED PLANT PHYSIOLOGY –II (Elective) 6. MOLECULAR BIOLOGY, BIOTECHNOLOGY AND PLANT BREEDING-II (Elective) 7. REPRODUCTIVE BIOLOGY OF ANGIOSPERMS-II (Elective) 8. PLANT PATHOLOGY-II (Elective)	BOTE-II 301 to 308
5	Lab- 5 Practical Based on DSC IX & X	BOL 301
6	Lab- 6 Practical Based on DSE I & DSE- II	BOL 302-309
7	Open elective/ GIC/ Open skill/ MOOC* Post-harvest Technology	OEC I 303

**Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Botany
(Two year- Four Semester Degree Programme- C.B.C.S.)
(M.Sc. Part II) Semester IV**

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-XI Applied Botany	BOT 401	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
2	DSC-XII Plant Ecology	BOT 402	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
3	DSC -XIII Environmental Ecology	BOT 403	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
4	SEC- I Plant Biotechnology and Genetic Engineering	BOTS 401	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
5	Lab- 7 Practical Based on DSC XI, XII, XIII & SEC-I	BOL 401	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
6	Lab-8 Practical Based on Project	BOL 402	-	-	6	6	-	3	3	*	-	-	-	100	100	50	P
7	# Internship/ Field Work/ Work Experience @																
8	Open elective/ GIC/ Open skill/ MOOC* Gardening and Landscaping	OEC 401	4	-	-	4	4	-	4	3	80	20	-	-	100	40	P
Total						28			26						600		

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience in First or Second or Third semester of Master of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester I to III. This will carry 2 credits for learning of 60 hours or 3 Credits for learning of 90 hours. Its credits and grades will be reflected in final semester IV credit grade report.

-OEC (Optional) can be studied during semester I to IV.

Sr. No.	Course	Code
1	DSC-XI Applied Botany	BOT 401
2	DSC-XII Plant Ecology	BOT 402
3	DSC -XIII Environmental Ecology	BOT 403
4	SEC- I Plant Biotechnology and Genetic Engineering	BOTS 401
5	Lab- 7 Practical Based on DSC XI, XII, XIII & SEC-I	BOL 401
6	Lab-8 Practical Based on Project	BOL 402
7	Open elective/ GIC/ Open skill/ MOOC* Gardening and Landscaping	OEC 401