

KISAN POST GRADUATE COLLEGE, BAHRAICH (U.P.) 271801

(Autonomous)

Affiliated to Dr. Rammanohar Lohia Avadh University, Ayodhya

Proposed Structure of syllabus for the

PROGRAM: P.G. (M.Sc.)**SUBJECT: BOTANY****Syllabus developed/proposed by**

S. No.	Name of BoS Member	Designation	Department	College/University
1.	Dr. Gopal Krishna Shukla	Convener	Botany	Kisan P.G. College, Bahraich
2.	Prof. S.N. Pandey	University Nominee	Botany	University of Lucknow, Lucknow
3.	Dr.N.K. Singh (Retd.)	Subject Expert	Botany	M.L.K. P.G. College, Balrampur
4.	Dr. P.K. Shukla	Subject Expert	Botany	Brahmanand P.G. College, Kanpur
5.	Dr. Anand Kumar Srivastava	Member	Botany	Kisan P.G. College, Bahraich
6.	Dr. Suresh Chandra Shukla	Member	Botany	Kisan P.G. College, Bahraich
7.	Dr. Rahul Kumar Singh	Member	Botany	Kisan P.G. College, Bahraich
8.	Dr. S.C. Tripathi (Retd.)	Invited Member	Botany	Kisan P.G. College, Bahraich

Course Code	Course Title	Credits	T/P	Evaluation		
				CIE	ETE	
Semester I (Year I)						
B040701T	CORE	General Microbiology	5	T	25	75
B040702T	CORE	Fungi and Plant Pathology	5	T	25	75
B040703T	CORE	Algae and Bryophytes	5	T	25	75
B040704T	FIRSTELECTIVE (Select anyone)	Advance Microbiology	5	T	25	75
B040705T		Environment and Plant Response	5	T	25	75
B040706P	PRACTICAL	Practical's based on Core/Elective & Assignment	5	P	50	50
Semester II (Year I)						
B040801T	CORE	Pteridophyta, Gymnosperms & Palaeobotany	5	T	25	75
B040802T	CORE	Angiosperms: Taxonomy	5	T	25	75
B040803T	CORE	Angiosperms: Plant Development & Reproduction	5	T	25	75
B040804T	SECONDELECTIVE (Select anyone)	Floriculture and Nursery	5	T	25	50
B040805T		Plant Resource Utilization and Applied Botany	5	T	25	50
B040806P	PRACTICAL	Practical's based on Core/elective	5	P	50	50
Semester III (Year II)						
B040901T	CORE	Plant Physiology and Biochemistry	5	T	25	75
B040902T	CORE	Cytogenetics and Biostatistics	5	T	25	75
B040903T	CORE	Ecology, Soil Science and Phytogeography	5	T	25	75
B040904T	THIRDELECTIVE (Select anyone)	Plant Breeding and Crop Improvement	5	T	25	75
B040905T		Instrumentation & Analytical Techniques	5	T	25	75
B040906P	FOURTH ELECTIVE (Select anyone)	Practical based on theory papers/assignment.	5	P	50	50
B040907P		Field Visit/Botanical excursion	5	P	50	50
Semester IV (Year II)						
B041001T	CORE	Plant Molecular Biology and Molecular Techniques	5	T	25	75
B041002T	CORE	Plant Biotechnology and Bioinformatics	5	T	25	75
B041003T	FIFTHELECTIVE (Select anyone)	Research Methodology and IPR	5	T	25	75
B041004T		Biodiversity, Remote Sensing and Environment Management	5	T	25	75
B041005P	RESEARCHPROJECT/ Dissertation	Major Research Project/ Dissertation	10	P	50	50

Program Outcomes (POs)

PO1: In-depth knowledge about plants, and related practices and techniques, necessary for Teaching and Research.

PO2: Understanding of environmental issues needed to become naturalists or conservationists

PO3: Critical and reflective thinking, enabling them to make an honest assessment of their strengths and weaknesses

PO4: Communication skills through effective presentations and interactive sessions in the Class. The Programme will make them competent enough for doing job in Govt. and private sector as well as for national and international competitive examinations especially UGC_CSIR NET/JRF, UPSC, IFoS, BSI, FRI etc.

PO5: Problem-solving skills to help generate confidence for a more substantive life.

Program Specific Outcomes (PSOs)

After completing the two years (Four Semesters) PG Programme (M.Sc.) in Botany, the student would have-

PSO1: Developed a robust comprehension of the diversity of plants and microorganisms, including plant viruses, and understood the vital interactions amongst the plant and environment, microbes, and human beings

PSO2: Gained an insight into the functioning of a cell and understood the techniques and Methods pertaining to Plant physiology, Cell and molecular biology, Cytogenetics and Plant breeding.

PSO3: Acquired necessary training and skill for writing thesis/preparing a project report based on the information collected through review of literature.

PSO4: Identify credible scientific sources to interpret and evaluate the evidences.

PSO5: Analyze and interpret results generated through studies in botany, taxonomical treatments, field studies, excursion tours and laboratory techniques used in the subject.

Programme: Class: M.Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040701T		Course Title: General Microbiology	
Course outcomes: Students would gain wide knowledge about diversity of microbes, their habit and habitat, morphology, architecture and reproduction. Develop conceptual skill about identifying microbes and Lichens.			
Credits: 5		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		No. of Lectures
I	Introduction to microbiology, history and scope of microbiology, Microbial evolution, Systematics and taxonomy of microorganisms. Extremophiles- Thermophiles, Psychrophiles, Osmophiles, Acidophiles & Alkalophiles. Differentiating features of Protists, Eubacteria and Archaeobacteria, Relation between structure & function in Prokaryotic cell. Constituent groups of Archaeae bacteria and their roles.		
II	Bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy/classification including ribotyping and ribosomal RNA sequencing. Different nutritional groups of bacteria. Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation and transduction in bacteria; role of microorganisms in genetic engineering		
III	Isolation of Pure cultures, culture media (defined/synthetic, complex, selective, differential, enriched), Sterilization techniques, inoculation methods (spread-plate, streak-plate, pour plate). Microbial growth; definition, measurement of growth, Arithmetic growth vs Exponential growth, growth curve and growth phases. Diauxic growth, Synchronous and continuous culture. Factors affecting growth; temperature, pH, oxygen.		
IV	Nomenclature and classification of plant viruses, Hypersensitivity in host-virus interaction, Molecular aspects of virus-vector relationship in transmission, Virus detection by serological and nucleic acid hybridization methods, Structure, replication and pathogenicity of viroids, Life cycle of lytic and lysogenic bacteriophage, Prions. Purification of plant viruses, Bioassay Test for viral purity, Quantification, Ultracentrifugation, Density gradient centrifugation		
V	Introduction to lichens, the symbiotic relationship and classification of lichens, Methodology for lichens taxonomy, morphology and anatomy of thallus, reproduction, physiology, ecological aspects and chemistry, conservation, culture, bioprospection and economic importance of lichens.		
<p>Suggested Readings: Suggested Readings:-</p> <ol style="list-style-type: none"> 1. Talaro, K.P., Chess, B, 2011, Foundations in Microbiology, 8th Edition, McGraw-Hill. 2. Stanier, R.Y. General Microbiology 3. Pelczar Mj jr: Chan ECS and Kreig NR: Microbiology 4. Prescott's Microbiology 11th Edition. 5. Brock biology of Microorganism by M.T. Madigan. 6. Galun, M.ed. (1988) CRCH and book of Lichenology. Vol. 3 CRC Press, Inc., Boca Raton. 7. Hale, M.E. (1983). The Biology of Lichens (3rded.) Edward Arnold. 8. Matthew's Plant Virology, R, Hull, 4th Edition , 2003, Elsevier 9. Wilson and Walker's Principal and Techniques of Biochemistry and Molecular Biology, A, Hofmann, S. Clokle 8th Edition Cambridge University Press. 10. Plant Pathology, G.N. Agrios , 5th edition , 2005, Elsevier. 11. Lichenology: Progress and Problems, Brown D.H., Howksworth D.L. and Bailey , R.H. 1976, Academic Press London. 12. Microbiology: An Introduction, G.J. Tortora, 2016, Pearson India Education. <p>Suggestive Digital Platforms/ Web Links: http://www.plantdiseases.com/p/pathogenic_disease_in_plant.html http://insa.in</p>			
This course can be opted as an elective by the students of the following subjects: M.Sc. Botany.			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			

S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25

Course prerequisites: To study this course, a student must have qualified B.Sc. Botany.

Suggested equivalent online courses:

SWAYAM , MOOC courses

<https://www.classcentral.com/tag/microbiology>

<https://www.edx.org/learn/microbiology>

<https://www.mooc-list.com/tags/microbiology>

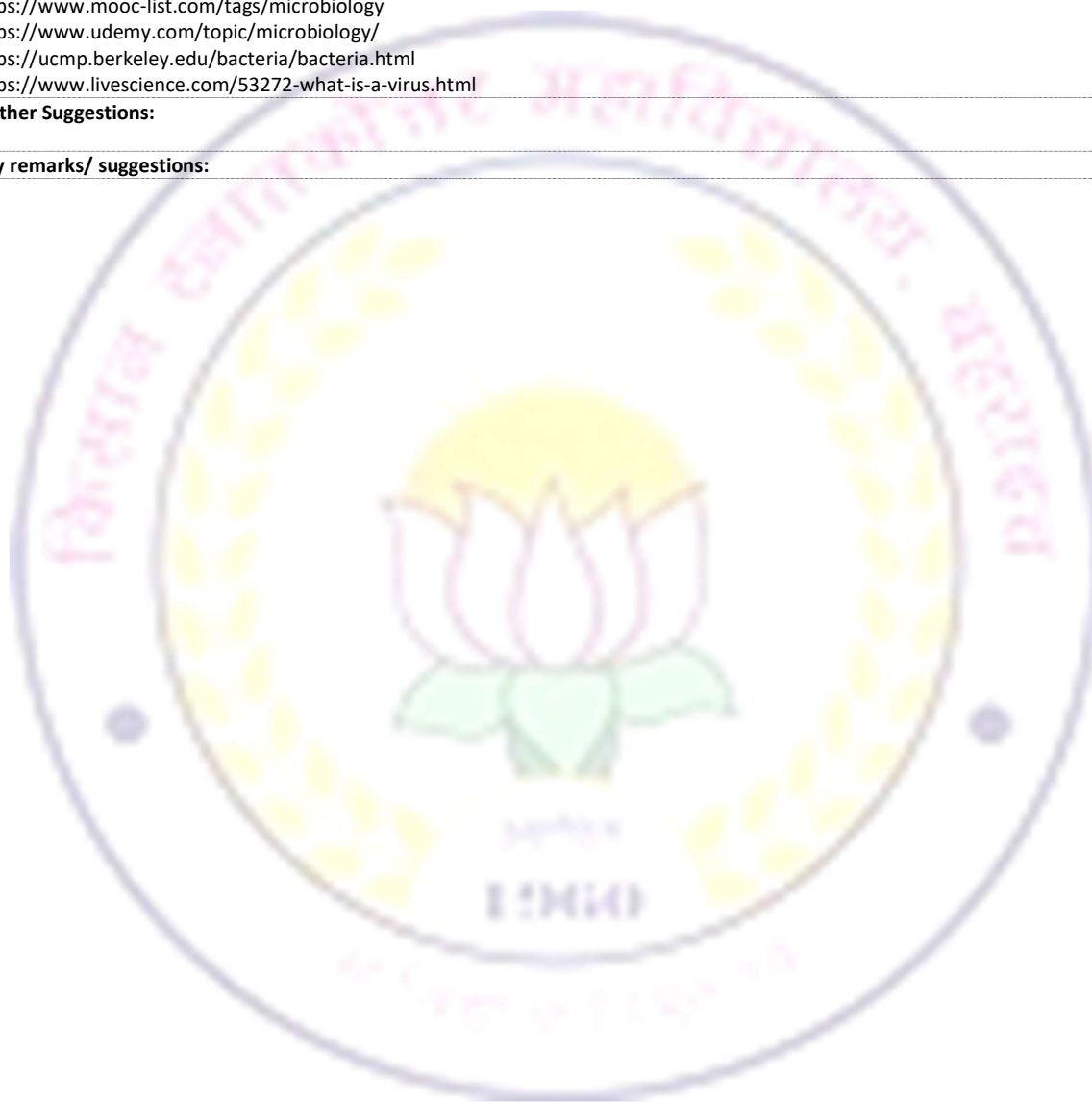
<https://www.udemy.com/topic/microbiology/>

<https://ucmp.berkeley.edu/bacteria/bacteria.html>

<https://www.livescience.com/53272-what-is-a-virus.html>

Further Suggestions:

Any remarks/ suggestions:



Programme: M.Sc. Class: M.Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040702T		Course Title: Fungi & Plant Pathology	
Course outcomes: Students would gain wide knowledge about plant disease causing microbes, symptoms & control. They will also learn about diversity of fungal plant group.			
Credits: 5		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		No. of Lectures
I	General characteristics, Thallus organization and cell structure, Nutritional types of fungi: biotrophs, hemitrophs, symbionts and necrotrophs, Reproduction, hormonal mechanism of sexual reproduction, Heterothallism, heterokaryosis, Physiological specialization, parasexuality, Fungal systematics and phylogeny		
II	Systematic study of structure and reproduction, life cycle, phylogeny and affinities of main groups of fungi and special reference to the following: <ol style="list-style-type: none"> 1. Myxomycetes 2. Plasmodiophoromycetes: Plasmodiophorales 3. Oomycetese: Saprolegniales (<i>Saprolegnia</i>, <i>Achlya</i>), Peronosporales (<i>Pythium</i>, <i>Phytophthora</i>, <i>Albugo</i>, <i>Peronospora</i>) 4. Chytridiomycetes: Chytriales, Mucorales (<i>Pilobolus</i>) 5. Zygomycetes: Entomophthorales 6. Ascomycetes: Protomycetales (<i>Protomyces</i>), Endomycetales (<i>Saccharomyces</i>), Taphrinales (<i>Taphrina</i>), Urotiales (<i>Aspergillus</i>, <i>Xylaria</i>), Erysiphales (<i>Erysiphe</i>, <i>Phyllactinia</i>), Pezizales (<i>Peziza</i>, <i>Marchella</i>) 7. Basidiomycetes: Ustilaginales (<i>Ustilago</i>, <i>Urocystis</i>), Uredinales (<i>Puccinia</i>, <i>Melampsora</i>, <i>Uromyces</i>) 8. Deuteromycetes: Melanconiales (<i>Colletotrichum</i>), Moniliales (<i>Alternaria</i>, <i>Cercospora</i>, <i>Fusarium</i>) 		
III	General introduction to plant pathology, history of plant pathology, Classification of plant diseases, plant disease diagnosis, Koch's Postulates, Chemical weapons of pathogens, Enzymes and toxins, role of growth hormone in plant diseases, pre-existing structural and chemical defense, Induced structural and chemical defense, parasitism and disease development, symptoms, effects of environmental factors of the plant disease development, plant disease epidemiology. Control of plant diseases, Quarantine and inspection, Physical, Chemical, Cultural and Biological methods of disease control, Integrated Pest Management.		
IV	Study of following diseases of principal crops of UP. <ol style="list-style-type: none"> i. Rust (Wheat, Linseed) (ii) Smut (Wheat, Sugarcane) (iii) Bunt (Rice, Wheat) (iv) Blight (Potatoes, Cucurbits) (v) Wilt (Sugarcane, Pigeon pea) (vi) Leaf spot (Rice, Ground nut) (vii) Mildews (Pea) (viii) Cankers (Citrus, White rust of crucifers and stem gall of coriander) (ix) Viral diseases of Potato, tomato, papaya and Bhindi (x) Diseases caused by mycoplasma. 		
V	Rapid methods for diagnosis of plant diseases caused by viruses, bacteria and fungi with reference to ELISA and PCR		
Suggested Readings:-			
<ol style="list-style-type: none"> 1. Webster, John, 1980, Introduction to fungi, Cambridge University Press. 2. Alexopoulos, CL, Mims, CW. And Blackwell, M. 1996, Introductory Mycology, Wiley. 3. Agrios, G.N., 1988. Plant Pathology, Academic Press. 4. Dickinson, C.M., 2003. Molecular Plant Pathology, Bios Scientific Publisher. 5. Willey, J.M., Sherwood, L., Woolverton, C.J., 2010 Prescott's Microbiology. 8th Edition, McGraw-Hill. 6. Singh, R.S., 2008, Principal of Plant Pathology, Oxford and IBH Publishing Co. Pvt. Ltd. 7. Dhingra, O.D., 1995, Basic Plant Pathology Methods, CRC, Press. 8. Mehrotra, R.S., Plant Pathology, Tata McGraw-Hill, New Delhi. 			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects:			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S. No.	Assessment Type		Max. Marks
1	Class performance/Participation/ Interaction		5
2	Quiz/Test/House Examination		10
3	Written assignment/Presentation/Excursion		10
	Total		25
Course prerequisites: To study this course, a student must have qualified B.Sc. Botany.			
Suggested equivalent online courses:			

Programme: M.Sc. Class: M.Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040703T		Course Title: Algae & Bryophytes	
Course outcomes: Students would gain wide knowledge about diversity of Algae and Bryophytes and at the same time would learn about their reproduction and economic uses.			
Credits: 5		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		No. of Lectures
I	Introduction of Phycology, principles and systems of classification of algae, Comparative account of algal pigments, food reserve, cell wall, flagellation, chloroplast and eyespots, their phylogenetic and taxonomic importance.		
II	Cyanophyceae: Cyanophyta: cell structure, heterocyst and akinete development, chromatic adaptation, thallus organization and reproduction, Salient features of <i>Gloeocapsa</i> , <i>Microcystis</i> , <i>Anabaena</i> , <i>Gloeotrichia</i> , <i>Nostoc</i> , <i>Rivularia</i> , <i>Scytonema</i> . A brief account of thallus organization, structure and reproduction in Phaeophyta and Rhodophyta; alternation of generation in Phaeophyta and post-fertilization development and site of meiosis in Rhodophyta.		
III	A brief account of Protochlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta: <i>Ectocarpus</i> , <i>Laminaria</i> , <i>Dictyota</i> , <i>Podina</i> , <i>Fucus</i> and <i>Sargassum</i> . Rhodophyta: <i>Porphyra</i> , <i>Batrachospermum</i> , <i>Polysiphonia</i> . Economic importance of algae: as food biofertilizers and phycocolloids.		
IV	Classification of Bryophytes, Comparative account of gametophyte structure, Sporophytic structure and evolution; Peristome structure and its significance in the classification of Mosses		
V	Morphology, structure, reproduction, life history, distribution and phylogeny of bryophytes based on following: (A) Hepaticopsida (i) Sphaerocarpaceae (Sphaerocarpus.), (ii) Marchantiales (Riccia, Marchantia, Cyathodium, Plagiochasma, Lunularia, Asterella), (iii) Monocleales (Monoclea) (iv) Jungermanniales (Pellia, Porella, Fossombronia), (v) Calobryales (Calobryum) (vi) Takakiales (Takakia). (B) Anthocerotopsida: Anthocerotales (Anthoceros and Notothylas). (C) Bryopsida: Sphagnales (Sphagnum), Andreales (Andreaea), Bryales (Funaria) Buxbaumiales (Buxbaumia).		
Suggested Readings:-			
1. Phycology, 5 th Ed., Robert Edward Lee, Publisher-Cambridge University Press, 2018.			
2. Introduction to the Algae, 2 nd Ed., Bold and Wynne, 1984.			
3. Introductory Phycology, H.D. Kumar, 1990.			
4. Biology of Bryophytes. R.N. Chopra and P.K. Kumra. New Age International (P) Limited New Delhi 1988.			
5. An introduction to Bryophyta. (Diversity Development and Differentiation). A. Rashid Vikas Publication house Pvt. Ltd. 1998.			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects:			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S. No.	Assessment Type	Max. Marks	
1	Class performance/Participation/ Interaction	5	
2	Quiz/Test/House Examination	10	
3	Written assignment/Presentation/Excursion	10	
	Total	25	
Course prerequisites: To study this course, a student must have qualified B.Sc. Botany			
Suggested equivalent online courses:			
Further Suggestions:			
Any remarks/ suggestions:			

M.Sc. I (SEMESTER-I) PAPER-IV

Title: Advance Microbiology

Programme: M.Sc. Class: M.Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040704T		Course Title: Advance Microbiology	
Course outcomes: Students would gain wide knowledge about Applications of Microbiology and role of microbes in various human welfare sectors like food, medicine, production of useful microbial products.			
Credits: 5		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		No. of Lectures
I	Nitrogen fixation and Microbes used as biofertilizer, Anoxygenic photosynthesis with special reference to light reaction in purple bacteria, Rhizosphere, Phyllosphere, Mycorrhizae, Actinorrhizae, Tripartite associations, PGPRS, Microbes in agriculture		
II	History of medical microbiology, Normal micro-flora of human body. General characteristics and diseases caused by viruses (Adeno, POX, HIV, & Oncogenic viruses) and bacteria (Neisseria, Mycobacterium, Spirochaete, Rickettsia, and Chlamydiae).		
III	Introduction to food microbiology, common food spoiling, intoxicating and disease causing microorganisms. Factors affecting microbial growth in foods. Antimicrobial constituents of foods. Microbial indicators of food safety. Physical, chemical and biological principles of preservation of foods (cereals, milk, meat, vegetables and fruits). Fermented plant products. Microbial production of organic acids, antibiotics, amino acids, vitamins, recombinant products, alcoholic beverages, microorganisms as source of foods.		
IV	Microbiology of water; distribution and techniques. Algal bloom. Microbiology of water/waste water and treatment systems. Biogas generation. Bio magnifications and bioremediation		
V	Microbial decomposition of organic matter; cellulose, hemicelluloses and lignin. Degradation of pesticide, Genobiotics and plastics. Bio degradable plastic and bio pesticides.		
Suggested Readings:-			
<ol style="list-style-type: none"> 1. Prescott's microbiology, J. Willey, L. Sherwood, 10 edition, 2017, McGraw-Hill Education. 2. Alcamo's Fundamental of Microbiology, J.C. Pommerville, 2nd Ed., 2013, Johnes and Bartlett Learning. 3. Modern Food microbiology by James. 4. Dairy Microbiology by Robinson. 5. Atlas ,RM .1995,Principal of Microbiology, Mobsy 6. Pelczar, JM, Chan, ECS and Krieg, MR. 1993. Microbiology, Tata McGraw Hill. 7. Talaro, K.P.,Chess,B,2011,FoundationsinMicrobiology,8th Edition, McGraw-Hill. 			
Suggestive Digital Platforms/ Web Links:			
https://www.classcentral.com/tag/microbiology https://www.edx.org/learn/microbiology https://www.mooc-list.com/tags/microbiology https://www.udemy.com/topic/microbiology/ https://ucmp.berkeley.edu/bacteria/bacteria.html https://www.livescience.com/53272-what-is-a-virus.html			
This course can be opted as an elective by the students of the following subjects:			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S. No.	Assessment Type	Max. Marks	
1	Class performance/Participation/ Interaction	5	
2	Quiz/Test/House Examination	10	
3	Written assignment/Presentation/Excursion	10	
Total		25	
Course prerequisites:			
Suggested equivalent online courses: https://www.mooc-list.com/tags/microbiology			
Further Suggestions:			
Any remarks/ suggestions:			

Programme: M.Sc. Class: M.Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040705T		Course Title: Environment and Plant Response	
Course outcomes: Students will gain knowledge about various pollutants contaminating air water and soil and at the same time they will also learn about planning strategies for sustainable development.			
Credits: 5		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		No. of Lectures
I	Soil environment: Soil Composition, Organic matter input and decomposition, soil nutrient storage and accumulation in plants, Agrochemical residues and their pollutive effect.		
II	Water Environment: Hydrological cycle, primary production and productivity of different aquatic weeds, distribution, adaptations and dynamics of fresh water and wetland plants communities, water pollution due to sewage, agrochemicals, industrial waste an urban solid waste.		
III	Air Environment and ecological perspective with reference to rural, urban and industrial areas. Effect on pollutants e.g. SO ₂ , fluoride, photochemical, suspended particulates on vegetation of local area.		
IV	Indexing of sensitivity and resistance to pollutants of plants. Nuclear power energy and its environmental effect.		
V	Environmental planning strategies, criteria for environmental standard, monitoring techniques, control of air pollution through plants and microbes. Control of pollution of waterbodies.		
Suggested Readings: -			
1. Odum, E.P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage Pub.			
2. Odum, E.P. 1983 Basic Ecology, Saunders College Publisher.			
3. Singh, J.S., Singh S.P. And Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers.			
4. The Nature and Properties of Soils, Nyle C. Brady and Ray R. Weil, Pearson Education Pvt. Ltd. 2002.			
5. Ecology and Environment. P.D. Sharma			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects: M.Sc. Botany			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S. No.	Assessment Type		Max. Marks
1	Class performance/Participation/ Interaction		5
2	Quiz/Test/House Examination		10
3	Written assignment/Presentation/Excursion		10
	Total		25
Course prerequisites:			
Suggested equivalent online courses:			
Further Suggestions:			
Any remarks/ suggestions:			

M.Sc. I (SEMESTER-I) PAPER-VI
Title: Practical's based on theory

Programme: M. Sc. Class: M. Sc. I		Year: I	Semester: I
Subject: Botany			
Course Code: B040706T		Course Title: Practical's based on theory	
Course outcomes: Develop good skills in the laboratory such as observation and evaluation by the use of modern tools and technology for inspecting various plant groups mentioned in their syllabus along with their identification. By field survey and botanical excursion they will be able to learn the subject in real lap of nature.			
Credits:		Elective	
Max. Marks: 50+50		Min. Passing Marks:	
Unit	Topics		
I	Practicals will be based on plant types prescribed in each plant group (i.e. Algae, Bryophyte and Fungi).		
II	Symptomatology of important fungal, bacterial and viral diseases of plants		
III	Identification of fungal cultures of possible/available fungal types.		
IV	Gram staining of bacteria.		
V	Study of foliose and other types of lichen thalli		
Suggested Readings:-			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects:			
S. No.	Assessment Type	Max. Marks	
1	Class performance/Participation/ Interaction	10	
2	Quiz/Test/House Examination	20	
3	Written assignment/Presentation/Excursion	20	
Total		50	
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
Course prerequisites: To study this course, a student must have qualified B.Sc. Botany.			
Suggested equivalent online courses:			
Courses On MOOC.org, Swayam.gov.in			
Further Suggestions:			
Any remarks/ suggestions:			

M.Sc. I (SEMESTER-II) PAPER-I
Title: Pteridophyta, Gymnosperms & Palaeobotany

Programme : M. Sc. Class: M.Sc.	Year: I	Semester: II
Subject: Botany		
Course Code: B040801T	Course Title: Pteridophyta, Gymnosperms & Palaeobotany	
<p>Course out comes: Students would gain wide knowledge about diversity of Pteridophytes and Gymnosperms and at the same time would learn about their reproduction and economic uses. Students will also learn about extinct genera of both the groups and Develop critical understanding on morphology, anatomy and reproduction of Pteridophytes and Gymnosperms. They will also develop understanding of plant evolution and their transition to land habitat along with morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledgebase in understanding plant diversity, economic values & taxonomy of lower group of plants</p>		
Credits: 5		Core
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	Morphology, anatomy and reproduction, phylogenetic relationships with emphasis on detailed study of following- i. Psilopsida -(Psilophytales, Psilotales) ii. Lycopsidea - (Lycopsideales, Sellaginales, Lepidodendrales, Isoetales, Pleuromiales) iii. Sphenopsida - (Equisetales, Hymeniales, Sphenophyllales and Calamitales) iv. Pteropsida – (A General account) v. Filicinae – A General account vi. Eusporangiate ferns - (Ophioglossales, Marattiales) vii. Leptosporangiate ferns – Filiciales	
II	Telome concepts, Apogamy and Apospory, Ecology of pteridophytes, Economic importance of the Pteridophytes, Cytogenetics of pteridophytes. Heterospory and seed habit, evolution of stele in Pteridophytes. Classification and Economic Importance of Pteridophytes. PPG Classification.	
III	General introduction of gymnosperms with special reference to its salient features, similarities and dissimilarities with other groups like Pteridophytes and Angiosperms. Classification of gymnosperms. Origin and evolution of gymnosperm with special reference to Progymnosperms, Devonian pre ovules and origin of seed.	
IV	Brief account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae, and Glossopteridaceae). Comparative study of Cycadales, Ginkgoales, Coniferales (Pinaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae, Taxodiaceae), Taxales and Gnetales (Gnetaceae, Ephedraceae, and Welwitschiaceae) etc. Distribution of Gymnosperms, Endangered gymnosperms and their conservation, Economic importance, cytogenetics and biotechnology of Gymnosperms.	
V	Study of fossils: Methods of preservation, Investigation and Importance in Stratigraphy. Continental drift and geological timescale.	
<p>Suggested Readings:-</p> <ol style="list-style-type: none"> 1. Rashid, A, 2011, An Introduction to Pteridophyta, 2nd Edition, (Reprint), Pub. Vikas Publishing House Pvt. Ltd., Noida. 2. Gifford, Ernest, M., Foster, Adriance. S., 1989 Morphology and Evolution of Vascular Plants. W.H. Freeman; 3rd Ed. 3. Gymnosperm by Sporne. 4. Pteridophyta by Sporne. 5. Stewart W.N., Paleobotany and evolution of plant. Cambridge University Press. New York. 405 p.(1) 6. Stewart, W.N. and G.W. Rothwell. (1993) Palaeobotany and the evolution of plant 2nd Ed. Cambridge University Press. New York. 521p. (1) 7. Andrews, H.N. Jr. 1974 Palaeobotany (1947-1972) Annals of the Missouri Botanical Garden 61: 179-202. (8). 8. Pant, D.D. 2002, An introduction to Gymnosperms, Cycas and Cycadales, BSIP. 9. Parihar, N.S. 1977, The Biology and Morphology of the Pteridophytes, Central Book Depot. 		
<p>Suggestive Digital Platforms/ Web Links:</p>		
<p>This course can be opted as an elective by the students of the following subjects: M.Sc.Botany</p>		

Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25

Course prerequisites: To study this course, a student must have qualified B.Sc. Botany

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:



M.Sc. I (SEMESTER-II) PAPER-II
Title: Angiosperms: Taxonomy

Programme: M. Sc. Class: M.Sc. I	Year: I	Semester: II
Subject: Botany		
Course Code: B040802T	Course Title: Angiosperms: Taxonomy	
<p>Course out comes: This course is primarily aimed to introduce people to the richness of plant diversity found in surrounding areas. Lectures sessions are designed to cover fundamental topics concerning classification of plants and their utilization required for understanding the flora and vegetation. They will understand the details of external and internal structures of flowering plants, their composition, modifications, internal structure & architecture of flowering plants for becoming a Botanist</p>		
Credits: 5		Core
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	Latin diagnosis, definition and use of Taxonomic terms, History of Plant Taxonomy in India, History of Plant Classification, Need and Aim of Classification, Units of Classification, Delimitations of Taxa and their Practical Consideration, Artificial, Natural, and Phylogenetic System of Classification, A Critical Study of Takhtajan, Modern System of Classification, An Introduction of Angiosperm Phylogeny Group (APG), Characteristics and Phylogeny of Orders.	
II	Need and Aim of Nomenclatures, International Rules of Botanical Nomenclature: Rank of taxa, Valid publication, Priority of publication (law of priority), Typification and Concept of Species genus and family.	
III	Interrelationship of Plant taxonomy with morphology, anatomy, embryology, palynology, cytology, genetics, biosystematics, biochemical and molecular systematic, numerical taxonomy, phytogeography and phyto chemistry.	
IV	A general knowledge of herbarium and botanical garden of the world and India, BSI, and identification keys.	
V	General knowledge of distinguishing features of important families with special reference to local flora. a) Dicotyledons: Magnoliaceae, Ranunculaceae, Papaveraceae, Anacardiaceae, Fabaceae, Rosaceae, Myrtaceae, ApiaceaeRubiaceae, Cucurbitaceae, Capparidaceae, Carryophyllaceae, Malvaceae, Rutaceae, Meliaceae, Asteraceae, Scrophulariaceae, Primulaceae, Asclepiadaceae ,Apocynaceae, Convolvulaceae, Verbenaceae, Bignoniaceae, Lamiaceae, Acanthaceae, Polygoniaceae, Euphorbiaceae. b) Monocotyledons:- Orchidaceae, Liliaceae, Musaceae, Palmae, Cyperaceae, Graminae (Poaceae).	
<p>Suggested Readings:-</p> <ol style="list-style-type: none"> 1. J. Harbone, B. L.Turner and D. Boulter - Chemotaxonomy of Leguminosae, Academic Press London, 1971. 2. John Hutchinson-The Families of Flowering Plants, Clarendon Press, 1959. 3. Arther John Cronquist- The Evolution and Classification of Flowering Plants, Shiva offset Press, 1981. 4. Tod F. Stuessy-Plant Taxonomy, Shiva Offset Press, 2002. 5. Alfred BartonRandle- The classification of Flowering Plants, Harvard University, 1994. 6. Peter H.A. Sneath and Robert R. Sokal-Numerical Taxonomy, Wayne State UniversityPress,1973. 7. Angiosperms by Sporne. 8. Plant Systematics: Theory and practice by Gurucharan Singh. 		
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects: M.Sc.Botany		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
	Total	25
Course prerequisites:		
Suggested equivalent online courses:		
Further Suggestions:		
Any remarks/ suggestions:		

M.Sc. I (SEMESTER-II) PAPER-III

Title: Angiosperms: Plant Development & Reproduction

Programme: M. Sc. Class: M.Sc. I		Year: I	Semester: II
Subject: Botany			
Course Code: B040803T		Course Title: Angiosperms: Plant Development & Reproduction	
<p>Course out comes: Students would gain wide knowledge about reproduction of Flowering plants around them and know about developmental process. They will understand reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of flowering plants.</p>			
Credits: 5		Core	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		
I	Introduction to morphology and anatomy including brief historical account; external and internal organization of higher plants; morphology of root and stem and their modifications, ergastic substance; microscopic and submicroscopic structure and organization of cell wall. Meristems: organization of root apical meristem (RAM) and shoot apical meristem (SAM) differentiation; quiescent Centre, xylem and phloem; ontogeny and structure of components and phylogeny, transfer cells. Secretary and excretory structure; primary structure of root and stem, origin of lateral roots, root - stem transition, nodal anatomy and its evolutionary significance; leaf-structure and function with special reference to epidermis. Systematic significance of trichomes and stomata.		
II	Vascular cambium and its derivatives, primary anomalies in stem and anomalous secondary growth, floral morphology and anatomy, fruits and seeds. Periderm, wood structure, sapwood and heartwood, growth rings.		
III	Experimental and applied embryology: Haploid production, Embryo culture, Nucleus culture, Ovule and Seed culture. Morphogenetic Phenomenon – Symmetry, Polarity, Correlation, Differentiation, and Phyllotaxy. Factors effecting morphogenetic phenomenon: Genetic, Physical and Chemical.		
IV	Introduction to life history of angiosperms, brief history of plant embryology; Anther: Structure and development of wall layers and their role; Microsporogenesis: Pollen wall morphogenesis and anther dehiscence; Pollen Morphogenesis, Development of male gametophyte, ultrastructure, abnormal male gametophyte, Pollen germination.		
V	Mega sporogenesis: Mega sporangium (types of ovule, integument), The female gametophyte (Embryo sac and its types). Pollen – pistil interaction: role of pollen wall proteins and stigma surface proteins, pollen tube growth in pistil, fertilization and apomixis: Endosperm: major types, ultrastructure and his to chemistry; Embryo: major types, Polyembryony, Embryogeny in relation with Taxonomy.		
<p>Suggested Readings:-</p> <ol style="list-style-type: none"> 1. Dickison William C. (2000), Integrative Plant Anatomy. Academic Press. 2. Carlquist, S. (1961), Comparative Plant Anatomy, Holt, Rinehart and Winston, New York Press. 3. Eames, A.J. & MacDaniels Laurence H. (1951), An Introduction to Plant Anatomy, McGraw-Hill. 4. Eames A.J. (1961), Morphology of Angiosperms, McGraw - Hill, New York. 5. Esau. Katherine, Anatomy of Seed Plants (1960), Wiley, New York. 6. Esau. Katherine, Plant Anatomy (1965), Wiley, New York. 7. Bhojwani, S.S. and Bhatnagar, S.P. (1985), Embryology of Angiosperms, Vikash Publishing house, New Delhi. 8. Johri, B.M. (1984) Embryology of Angiosperms. Springer –Verlag Berlin Heidelberg. 9. Maheshwari, P. (1950) An Introduction to the Embryology of Angiosperms. Tata McGraw-Hill. 			
<p>Suggestive Digital Platforms/ Web Links:</p>			
<p>This course can be opted as an elective by the students of the following subjects: M.sc. Botany.</p>			
<p>Suggested Continuous Evaluation Methods (Max. Marks: 25)</p>			

S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
	Total	25

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:



M.Sc. I (SEMESTER-II) PAPER-IV
Title: Floriculture and Plant Nursery

Programme: M.Sc. Class: M.Sc. I		Year: I		Semester: II	
Subject: Botany					
Course Code: B040804T			Course Title: Floriculture and Plant Nursery		
Course outcomes: In this course the students will be taught flower cultivation methods and Development of nursery for growing plants.					
Credits: 5			Elective		
Max. Marks: 25+75			Min. Passing Marks:		
Unit	Topics				
I	Commercial Floriculture: Scope and importance in India. Techniques of producing ornamental plants like rose, marigold, chrysanthemum, orchid, gladiolus, Gerbera etc. Orchards: importance, objectives, merits and demerits. Horticultural crops and their nutritive value				
II	Vermicomposting Green manuring. Bio fertilizers and use of biocontrol agents. Bio pesticides, Pheromones. Organic food and human health.				
III	Vegetative propagation, Goo tee, layering, grafting. Micro propagation and its industry. Seed propagation and its limitation. Plant Quarantine.				
IV	Scope and objectives of Gardening, style of gardens: formal, informal types of gardens: English, Mughal and Japanese. Components of garden, planning of outdoor gardens: small, residential, larger home garden, roof garden, terrace garden, children's garden, school and institutional garden, park, industrial garden, housing complex, indoor garden.				
V	Principles of land scape design, elements, planning and layout plant material for landscaping, symbols and tools. Landscape design for specific areas: residence, commercial buildings, educational institutes and hotels. Computer applications in land scape design.				
Suggested Readings:-					
1. Lyndy J. McGaw et. al. Medicinal plants for holistic healing.					
2. Bhani Ram, Mamta Dail and Anil Sharma. Plantation Crops.					
3. Roy A. Larson – Introduction to Floriculture.					
4. S. Prasad-Commercial Floriculture.					
5. Bijan Bihari Dutta-A Handbook of Plant Resource Utilization and Conservation.					
6. Peter Mchoy – Garden planning & garden design. (South Water Publication)					
7. Harry Tomlinson – A complete book of Bonsai.					
8. Chris Young – Encyclopedia of Land scape design. (D.K. Publication).					
9. Stephan Erwin and Hope Nasdrouck - Landscape Modelling.					
Suggestive Digital Platforms/ Web Links:					
This course can be opted as an elective by the students of the following subjects:					
Suggested Continuous Evaluation Methods (Max. Marks: 25)					
S. No.	Assessment Type				Max. Marks
1	Class performance/Participation/ Interaction				5
2	Quiz/Test/House Examination				10
3	Written assignment/Presentation/Excursion				10
	Total				25
Course prerequisites:					
Suggested equivalent online courses:					
Further Suggestions:					
Any remarks/ suggestions:					

M.Sc. I (SEMESTER-II) PAPER-V		
Title: Plant Resource Utilization and Applied Botany		
Programme : M.Sc. Class: M.Sc.	Year: I	Semester: II
Subject: Botany		
Course Code: B040805T	Course Title: Plant Resource Utilization and Applied Botany	
Course out comes: This course provides abroad understanding of identifying, growing and using plants. This will help them to learn how to make use of flowering plants around them for human welfare.		
Credits: 5		Elective
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	Plant diversity and sustainable development: basic concepts and status in India.	
II	Cultivation and uses of economically important plants (with special reference to origin, evolution, cultivation and uses). Food, forage and fodder crops: Cereals, legumes, Nuts and general account of fodder crops. Fiber yielding crops: Textile fiber plants and their products, its uses and cultivation in India. Medicinal plants in Aromatic plants: Plants of medicinal importance and general account of aromatic plants as source of essential oil. Important firewood and timber yielding plants: A general account. Non-wood forest products (NWFPs): Bamboo, rattans, raw material of paper industry, gums, tannins, dyes resins, rubber and latex-products: A general account. Fumigatories and masticatories: A general account.	
III	Green revolution: Benefits and adverse conditions, innovation for meeting world food demands	
IV	Conservation biology: principles of conservation, strategies for conservation <i>in situ</i> . Conservation (a general account of sanctuaries, national parks, biosphere reserves, wetlands, mangroves, for conservation of wild biodiversity), <i>ex-situ</i> conservation (principles and practices A general account of the activities of B.S.I., National Bureau of Plant Genetic resource (NBPGR), Indian Council of Agricultural research (ICAR) for conservation of plants and non-formal conservation efforts.	
V	Organisms of conservation concern: Rare, endangered species. Bio remediation, Phytoremediation and Biosensor.	
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects:		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
	Total	25
Course prerequisites:		
Suggested equivalent online courses:		
Further Suggestions:		
Any remarks/ suggestions:		

M.Sc. I (SEMESTER-II) PAPER-VI
Title: Practical's based on theory

Programme: M.Sc. Class: M.Sc. I	Year: I	Semester: II
Subject: Botany		
Course Code: B040806P	Course Title: Practical's based on theory	
Course outcomes: Practical sessions are organized following theory for easy understanding of the various parts of the plants, structural organization of floral parts and diversity there in. Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora. In the long run, will contribute towards building momentum for people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge inherited over generations		
Credits: 5	Elective-Practical	
Max. Marks: 50+50	Min. Passing Marks:	
Unit	Topics	
I	<p>A. Mono graphic Studies of–</p> <ol style="list-style-type: none"> 1. Psilotum 2. Isoetes 3. Equisetum 4. Ophioglossum 5. Adiantum 6. Glossopteris 7. Ginkgo 8. Araucaria 9. Taxus 10. Gnetum <p>B. Preparation of Herbarium</p> <p>C. Semi-technical description of some important families of Angiosperms (available during current season).</p> <p>D. Study of stomatal type</p> <p>E. Study of Anomalous secondary growth in Nyctanthus, Bignonia Dracaena, Boerhaavia, Casuarina a stem etc.</p> <p>F. Demonstration of Annual rings.</p> <p>G. Study of pollen germination.</p> <p>H. Perform Goo tee, layering and grafting in the suitable plants.</p> <p>I. Preparation of vermicompost.</p> <p>J. Cultivation of Azolla bio fertilizer.</p>	
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects:		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	10
2	Quiz/Test/House Examination	20
3	Written assignment/Presentation/Excursion	20
	Total	50
Course prerequisites:		
Suggested equivalent online courses:		

M.Sc. II (SEMESTER-III) PAPER-I
Title: Plant Physiology & Biochemistry

Programme: M.Sc. Class: M.Sc.		Year: II	Semester: III
Subject: Botany			
Course Code: B040901T		Course Title: Plant Physiology and Biochemistry	
Course outcomes: Understand the role of Physiological and metabolic processes for plant growth and development. Learn the symptoms of Mineral Deficiency in crops and their management. Assimilate Knowledge about Biochemical constitution of plant diversity			
Credits: 5		Core	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics	Total Lectures	
I	Photosynthesis: Light harvesting complexes; mechanisms of Electron transport, Photo protective mechanism; CO ₂ fixation – C ₃ , C ₄ and CAM pathways. Respiration and photorespiration: Glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Nitrogen metabolism: Nitrogen cycle and biological nitrogen fixation, nitrate and ammonium assimilation, amino acid biosynthesis. Metabolism of carbohydrate, lipids, amino acids, nucleotides.		
II	Plant hormones: Biosynthesis, storage, breakdown and transport; Physiological effects and mechanisms of action on Phytochromes, Cryptochromes and Phototropins. Stomatal movement; photoperiodism and biological clocks. Growth and Development Aspects: Metabolic changes during seed germination, factors affecting seed germination and dormancy, breaking of dormancy, biochemistry of flowering: initiation and development of flower, induction of flowering-vernalization, physiology and biochemistry of leaf abscission and senescence.		
III	Solute transport and photo assimilate translocation – uptake, transport and translocation of water, ions, solutes, and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; Mechanisms of loading and unloading of photo assimilates. Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Sensory photobiology: Phytochromes and cryptochromes and their photochemical and biochemical properties, photo physiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression. Secondary metabolites; biosynthesis of terpenes, phenols, and nitrogenous compounds and their roles. Programmed cell death (PCD).		
IV	Bioenergetics: Law of thermodynamics, concept of enthalpy and entropy and their significance in biological systems, water biochemistry, high energy molecules, redox potential; Amino acids and proteins: Structure and physicochemical properties of amino acids; Proteins: Primary, secondary, tertiary and quaternary structure of proteins. Physical and chemical properties of proteins and their biological significance. Enzymes: Classification, physicochemical nature, enzyme kinetics, mechanism of action and regulation, allosteric enzyme, isozyme, abzymes.		
V	Carbohydrate: structure and function, structure and properties of carbohydrate, biological significance, glycoproteins. Lipid: classification structure and properties, fatty acid biosynthesis, storage lipids and their catabolism, vitamins and coenzymes: structure and biochemical aspect.		
Suggested Readings:-			
<ol style="list-style-type: none"> 1. Taiz & Zeiger, 2010 Plant Physiology, 5th Edition. Sinurer Associates 2. Hopkins, W.G. and Huner N.P.A., 2009 Introduction to Plant Physiology, 4th Ed. Wiley International Ed., John Wiley and Sons, USA. 3. Peter Scott, Physiology and behavior of Plants Wiley - Blackwell. 4. Nelson, D.L. and Cox, M.M. 2008, Linger Principles of Biochemistry, W.H. Freeman &Co, New York, USA. 5. Murray, R, Murray, RK, Bender, D, Gotham, KM, Kennelly, PJ, Rodwell, Vand Weil, PA. 2012. Harper's Illustrated Biochemistry McGraw - Hill. 6. Frank Boyer Salisbury and Cleon Ross, 1991, Plant Physiology, CA. 7. Plant physiology by Dalvin 8. Instant notes of Biochemistry by Hames and Hooper. 9. Biochemistry by J.L. Jain 			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects:			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			

S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:



M.Sc. II (SEMESTER-III) PAPER-II
Title: Cytogenetics & Biostatistics

Programme : M.Sc. Class: M.Sc.		Year: II	Semester: III
Subject: Botany			
Course Code: B040902T		Course Title: Cytogenetics & Biostatistics	
<p>Course outcomes: Understand behavior of chromosomes, genetics, and the application of statistics to biological data. Acquire knowledge on cell ultra-structure.</p> <p>Understand the structure and chemical composition of chromatin and concept of cell division. Interpret the Mendel's principles; acquire knowledge on cytoplasmic inheritance and sex-linked inheritance.</p> <p>Understand the concept of 'one gene one enzyme hypothesis along with the molecular mechanism of mutation'.</p>			
Credits: 5		Core	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics	Total Lectures	
I	Basic concept and organization: Chromosome, structure, special type of chromosomes-polyene chromosomes, lamp brush chromosomes, B chromosomes. Gene concept; allele concept, multiple alleles, ISO alleles, Pseudo alleles, Cell division.		
II	Inheritance Genetics: Principles of Mendelian Inheritance Extensions of Mendelian principles: Codominance, incomplete dominance, gene interaction, pleiotropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex determination in plants and sex linkage, sex limited and sex influenced characters. Gene mapping methods: Linkage maps. Extra chromosomal inheritance: Inheritance of Mitochondrial and Chloroplast genes, maternal inheritance.		
III	Quantitative genetics: Polygenic Inheritance, heritability and its measurements, QTL mapping. Population genetics: Populations, Gene pool, Gene frequency; Hardy Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.		
IV	Mutation: Types, causes and detection, mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, physical and chemical mutagens, insertional mutagenesis. DNA damage and repair mechanism. Structure and numerical alternations of chromosomes: Deletion, duplication, inversion, translocation, Ploidy and their genetic implications.		
V	Biostatistics: General Concept of statistics and biometry. Measurement of central tendencies (mean, mode, median), measurement of deviation (standard deviation, standard error). Significance test (chi square test & t-test). Diagrammatic representation of statistical data. Correlation. Types of statistical software (SPSS, Python, JMP, XLSTAT etc.) and their application in data analysis.		

Suggested Readings:-

1. Clark, M.S. and Wall, W.J. 1996 Chromosomes: The Complex Code. Chapman and Hall, London.
2. Stebbins, G.L.1950, Variation and Evolution in Plants. Columbia Univ. Press, New York.
3. Lewine, Benjamin, Jones and Bartlet, Genex X, Sudbury, Massachusetts.
4. Klug, Cummings, Spencer, Palladino, Concepts of Genetics 10th Ed. International Ed. Pearson Publication.
5. Principles of Genetic by Gardner.
6. Peter, D, Snustand and Simmons, M.J. John Wiley and Sons Inc.
7. A Textbook of Biostatistics by Satguru Prasad.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:

M.Sc. II (SEMESTER-III) PAPER-III
Title: Ecology, Soil Science & Phytogeography

Programme : M.Sc. Class: M.Sc.		Year: II	Semester: III
Subject: Botany			
Course Code: B040903T		Course Title: Ecology, Soil Science & Phytogeography	
<p>Course outcomes: Acquaint the students with complex interrelationship between organisms and environment; Make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.</p>			
Credits: 5		Core	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		Total Lectures
I	<p>Introduction to ecology, and environmental terminology, population dynamics, vegetation organization and development: population characteristics, population growth forms, density dependent and density independent controls, population structure (distribution, aggregation, isolation territoriality) energy partitioning r-and k-selection, concept of carrying capacity: wild life sanctuaries, botanical gardens.</p> <p>Concept of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, competition, ecological niche, succession, mechanism of ecological succession (relay floristic and initial floristic composition facilitation, tolerance and inhibition models), concept of climax.</p>		
II	<p>Ecosystem organization, structure and function: primary production (methods of measurement), energy dynamics (trophic organization, energy flow pathway, energy quality, ecological efficiencies), biogeochemical cycles.</p>		
III	<p>Pollution and climate change: kinds, sources and effects of pollution, heavy metals (Pb, Cd, Hg), greenhouse gases (CO₂, CH₄, NO, CFCs), Green –house effect and global warming, ozone layer depletion and ozone hole, acid rain.</p>		
IV	<p>Soil type, soil profile, soil formation, soil texture, soil humus. Soil moisture constants. Soil erosion and conservation.</p>		
V	<p>Phytogeography: Distribution pattern, barriers, endemism and age-area hypothesis. Environmental impact assessment threatened and endangered plant species, role of diversity in ecosystem stability. General account of remote sensing and its application, sustainable development. Major terrestrial biomes, biogeographical area and major vegetation's of India.</p>		
<p>Suggested Readings:-</p> <ol style="list-style-type: none"> 1. Odum, E.P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage Pub. 2. Odum, E.P. 1983 Basic Ecology, Saunders College Publisher. 3. Singh, J.S., Singh S.P. And Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers. 4. The Nature and Properties of Soils, Nyle C. Brady and Ray R. Weil, Pearson Education Pvt. Ltd. 2002. 5. A Textbook of Ecology by R.S. Ambasht. 6. Ecology and Environment by P.D. Sharma. 			
<p>Suggestive Digital Platforms/ Web Links:</p>			
<p>This course can be opted as an elective by the students of the following subjects:</p>			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S.No.	Assessment Type	Max. Marks	
1	Class performance/Participation/ Interaction	5	
2	Quiz/Test/House Examination	10	
3	Written assignment/Presentation/Excursion	10	
	Total	25	
<p>Course prerequisites:</p>			
<p>Suggested equivalent online courses:</p>			
<p>Further Suggestions:</p>			
<p>Any remarks/ suggestions:</p>			

M.Sc. II (SEMESTER-III) PAPER-IV
Title: Plant Breeding and Crop Improvement

Programme: M.Sc. Class: M.Sc.		Year: II	Semester: III
Subject: Botany			
Course Code: B040904T		Course Title: Plant Breeding and Crop Improvement	
Course outcomes: The students will learn about hybrid plants and techniques to develop superior quality crops. Role of genetics for improving crops will be taught.			
Credits: 5		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		Total Lectures
I	Importance, scope and major achievements of plant breeding. Germplasm; kinds of germplasm, collection, evaluation and organizations concerned with germplasm, <i>in-situ</i> and <i>ex-situ</i> conservation. Modes of reproduction in crop plants; sexual and asexual reproduction, apomixes, identification of apomictic plants. Incompatibility; genetic, physiological and biochemical basis of incompatibility, utility of self-incompatibility. Male sterility, genetic and cytoplasmic male sterility and its applications.		
II	Plant introduction; types of introduction, procedure, uses of plant introduction and organizations associated with introduction. Pure line selection, mass and progeny selection, procedure and achievements. Pedigree selection, recurrent selection and their applications.		
III	Role of mutation in plant breeding, isolation of useful mutants and major achievements. Role of polyploidy in crop improvement.		
IV	Hybridization- kinds, procedure and its utility. Hybrid breeding in self and cross-pollinated crops. Backcross breeding. Types of hybrids-single cross, three way cross, double cross hybrid synthetic and composite crosses. Heterosis and its theories, Inbreeding depression.		
V	Protoplast fusion and somatic hybrids. Gene transfer methods and Transgenic, Marker assisted selection. Breeding for disease resistance, salt tolerance and quality traits.		
Suggested Readings: -			
<ol style="list-style-type: none"> 1. Introduction to Plant Breeding, R.C. Chaudhary, Oxford & IBH Publishers, 1982. 2. Plant Breeding V. Kumaresan, Saras Publication, 2015 3. Plant Breeding, Principles and Methods, B.D. Singh, Kalyani Publishers, 1983. 4. Fundamental of Plant Breeding, Phundan Singh, Kalyani Pub 2017. 5. Principles of Plant Breeding, I.D.Tyagi, Jain Brothers, 2015. 6. Principles of Plant Breeding, Robert W. Allard, 2018, John Wiley and Sons. 			
Suggestive Digital Platforms/ Web Links:			
This course can be opted as an elective by the students of the following subjects:			
Suggested Continuous Evaluation Methods (Max. Marks: 25)			
S.No.	Assessment Type	Max. Marks	
1	Class performance/Participation/ Interaction	5	
2	Quiz/Test/House Examination	10	
3	Written assignment/Presentation/Excursion	10	
Total		25	
Course prerequisites:			
Suggested equivalent online courses:			
Further Suggestions:			
Any remarks/ suggestions:			

M.Sc. II (SEMESTER-III) PAPER-V

Title: Instrumentation & Analytical Techniques

Programme : M.Sc. Class: M.Sc. II		Year: II	Semester: III
Subject: Botany			
Course Code: B040905T		Course Title: Instrumentation & Analytical Techniques	
Course outcomes: Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.			
Credits: 5		Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		
I	Techniques of Collection, fixation, embedding, dehydration and Staining.		
II	Microscopy: Simple, Compound, Phase-contrast, Fluorescence, Electron (SEM and TEM) microscopy, Micrometry and Camera Lucida.		
III	Centrifugation: Rotors, Benchtop, Low speed, High speed, Cooling, Ultracentrifuge. Electrophoresis: Native, Denaturing, Isoelectric focusing, 2-D Electrophoresis; Spectroscopy: UV, Visible, IR, Raman, Spectrofluorometric, Mass AAS, NMR		
IV	ESR Radioactivity - GM counting, Scintillation counting, Autoradiography; Chromatography: - Paper, TLC, Column, Gel Filtration, Ion Exchange, HPLC, GC.		
V	Microtomy; DNA Chip technology and Microarrays, Mass Spectrometry for genome and proteome analysis.		

Suggested Readings:-

1. Analytical Methods, Interpretation, Identification and Quantification by R. Gopalan and K S Vishwanathan University Press.
2. Principles and Techniques of Biochemistry and Molecular Biology, Samuel Clokie 8th Edition Wilson and Walkar's.
3. Basic Techniques in Biochemistry and Molecular Biology By Sharma, R.K. and Sangha, S.P.S, Dreamtech Press.
4. Techniques for Molecular Biology, Tagu, D , Moussard, C, CRC Press.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
	Total	25

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:

M.Sc. II (SEMESTER-III) PAPER-VI
Title: Practical Based on Theory

Programme: M.Sc. Class: M.Sc. II	Year: II	Semester: III
Subject: Botany		
Course Code: B040906P	Course Title: Practical Based on Theory	
Course outcomes: Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora. In the long run, will contribute towards building momentum for people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge in her it ad over generations		
Credits: 5	Elective	
Max. Marks: 50+50	Min. Passing Marks:	
Unit	Topics	
I	<p>PRACTICAL EXERCISES BASED ON PHYSIOLOGY AND BIOCHEMISTRY</p> <ol style="list-style-type: none"> 1. Effect of time, enzyme concentration, substrate concentration on enzyme activity (diastase, catalase, nitrate reductase). 2. To show substrate in ducibility of enzyme nitrate reductase. 3. Extraction of chloroplast pigments and separation of chlorophylls and carotenoids by paper chromatography. 4. Extraction and isolation of seed protein and test by biuret reagent. 5. Determination of osmotic potential of cell sap using epidermal peelings- plasmolytic method. 6. Determination of osmotic potential of storage tissue – plasmolytic method. 7. To study frequency of stomata and transpiration (photometer method). 8. To compare rate of transpiration from two surfaces of leaf. 9. To determine real rate of photosynthesis by continuous air stream method. 10. To determine rate of respiration in germinating seeds by continuous air stream method. 11. To isolate and estimate reducing sugar from plant material (onion bulb) by using fehling's reagent. 	
II	<p>PRACTICAL EXERCISES BASED ON ECOLOGY</p> <ol style="list-style-type: none"> 1. To find out minimum size and number of quadrat required for reliable estimate of grassland vegetation. 2. Study of quantitative characteristics of grassland vegetation by quadrat and point frame method. <ol style="list-style-type: none"> (i) Frequency and relative frequency. (ii) Density and relative density. (iii) Dominance and relative dominance. (iv) Importance value Index (IVI) 3. Comparison of leaf are an index of two types of vegetation. 4. To find out association between important grass land species using chi – square - test. 5. Estimation of standing biomass of a local vegetation by any standard method. 6. To determine netphy top lankt on productivity by light and dark bottle method. 7. To determine, soil moisture content, water holding capacity of soil collected from different location. 8. To determine percent organic carbon in soil sample of crop land and grass land, titrimetric ally. 9. To determine dissolved oxygen in water samples by Winkler's method. 10. Rapid test of pH, carbonate, N.P.K. and based efficiency. 	
	<p>PRACTICALEXERCISESBASEDONGENETICSANDBIOSTATISTICS</p> <ol style="list-style-type: none"> 1. To study cell structure using onion leaf peels. 2. Study of protoplasmic streaming movement (cyclosis) In Hydrilla_ and staminal hairs of <u>Trades cantia</u> flower. 4. Examination of mitosis and meiosis using appropriate plant material (onion root – tip, flower bud of sweet pea and flax). 5. Cytological examination of specialty pes of chromosomes. 6. Emasculation of flower bud and demonstration of hybridization technique. 7. Statistical exercise based on theory paper. 	
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects:		

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	10
2	Quiz/Test/House Examination	20
3	Written assignment/Presentation/Excursion	20
	Total	50

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:



M.Sc. II (SEMESTER-IV) PAPER-VII

Title: Field Survey (Botanical Excursion)/ Report Presentation

Programme: M.Sc. Class: M.Sc. II	Year: II	Semester: III
Subject: Botany		
Course Code: B040907P	Course Title: Field Survey (Botanical Excursion)/ Report Presentation	
Course outcomes: Excursions are arranged to give exposure to students. Field education is equally important as classroom teaching. It adds vigor in learning processes and relieves monotones of indoor education. Field study is an essential part botany as plants are best studied in their natural habitat. These tours also help to build good repo amongst students a teachers.		
Credits: 5	Elective	
Max. Marks: 50+50	Min. Passing Marks:	
Botanical Excursions: One teacher along with a batch not more than 7 students be taken for Botanical Excursion to places of Botanical interest, one in each term. If there are female students in a batch of 7 students, one additional lady teacher is permissible for excursion. Each excursion will not be more than SEVEN days during college working days. T.A. and D.A. for teachers and non-teaching staff participating in excursions should be paid as per rules. Tour report duly certified by tour in charge teacher and Head of the Department should be submitted at the time of practical examination. For every study tour take the prior permission of the head of the department and Principal. The marks will be counted under Internal assessment and external assessment both. In external assessment student will have to present his excursion report along with industrial training/central labs visits and BSI or museum visits. In internal assessment he shall have to label the campus plants with botanical details/develop herbal/floristic garden/conserve plants in botanical garden/contribute specimens via collection. A project supported along with photographs taken during field study to be submitted giving comprehensive Idea about different types of inflorescence, flowers and fruits/ At least three field excursions at hills/Oceans/Deserts including one Compulsory excursion to Botanical Garden, FRI/BSI and Central National Herbarium (CNH). Central Research Institutes/Hot Spot etc.		

M.Sc. II (SEMESTER-IV) PAPER-I

Title: Plant Molecular Biology & Molecular Techniques

Programme : M.Sc. Class: M.Sc. II		Year: II	Semester: IV
Subject: Botany			
Course Code: B041001T		Course Title: Plant Molecular Biology & Molecular Techniques	
Course out comes: Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process. Know about Processing and modification of RNA and translation process, function and regulation of expression.			
Credits: 5		Core	
Max. Marks: 25+75		Min. Passing Marks:	
Unit	Topics		
I	Structure and conformation of nucleic acid; Replication of DNA; damage and repair, Gene structure; Transcription of gene; Structure of mRNA, rRNA and tRNA, Regulation of transcription, post-transcriptional modification of RNA, RNA editing; Transport of RNA.		
II	Protein synthesis: Genetic code, mechanism of translation (initiation, elongation and termination); post-translational modification; Protein sorting in the cell, Regulation of protein synthesis in prokaryotes and eukaryotes.		
III	Signal transduction: Overview of receptors and G-proteins, phospholipids signifying role of cyclic nucleotides, calcium calmodulin cascade diversity in protein kinase and phosphates specific signaling mechanism, Secondary messengers, Gene silencing mechanisms, Epigenetics.		
IV	Isolation and purification of Nucleic Acids, Electrophoresis and quantification of nucleic acids, DNA sequencing Sanger's Dideoxy Method, Maxam and Gilbert method. High through put sequencing, Nuclear run -on assay, Nucleic acid blotting techniques, DNA Synthesis, Chromatin remodeling.		
V	Isolation and purification of protein, Electrophoresis and quantification of proteins, Western Blotting. Protein – nucleic acid interaction analysis, Protein-Protein interaction analysis; ELISA, RIA; Protein immune precipitation, sequencing strategies, Radioactive isotope labeling, Mass spectrometry.		

Suggested Readings:-

1. Cell Biology 6th Edition W.H. Freeman and Comp, New York.
2. Bourton E. Tropp, Molecular Biology, 4th Ed., Jones & Barlett learning.
3. Brown, T.A., DNA Cloning and Gene Sequencing Willey-Blackwell, Oxford.
4. Genes IX by Benjamin Lewin, Jones and Barlett.
5. Y. Gerald Karp, Cell and Molecular Biology 6th Ed., John Willey & Sons.
6. Nelson, D.L. and Cox, M.M., 2008, Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman & Co. New York, USA.
7. Cooper, G.M. and Robert. E. Hausman The Cell: A Molecular Approach 5th Ed. (Co-Published by ASM Press And Sinauer Assoc. Inc).
8. Watson ,J.D., TA Bell, S.P. Gann ,A, Levine M and Richard.L.2008. Molecular Biology of the Gene. Pearson Education Inc.
9. U. Satya Narayan., Biotechnology.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25

Course prerequisites:

Suggested equivalent online courses:

Further Suggestions:

Any remarks/ suggestions:

M.Sc. II (SEMESTER-IV) PAPER-II		
Title: Plant Biotechnology and Bioinformatics		
Programme : M. Sc. Class: M.Sc. II	Year: II	Semester: IV
Subject: Botany		
Course Code: B041002T	Course Title: Plant Biotechnology and Bioinformatics	
Course outcomes: Understand and develop skill for conducting molecular experiments for genetic engineering. Gain working knowledge of the practical and theoretical concepts of bioinformatics.		
Credits:		Core
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	A brief introduction to Biotechnology; Recombinant DNA technology: Restriction Endonucleases, DNA polymerases; Vectors, Markers and reporter genes, Cloning, Screening of recombinant clone; Polymerase chain reaction: Principle, method, variants and practical applications.	
II	Gene cloning and identification: Genomic and cDNA library, Hybridization techniques; Southern, northern and western hybridization; FISH; Molecular markers: RFLP, RAPD, AFLP, SSR, SNP; functional genomics: Quantitative Real Time PCR, Microarray, RNA interference, Mutagenesis and Genome editing, Protein production strategies in Expression System; Metagenomics	
III	Methods of gene transfer, Agro bacterium mediated genetic transformation of plants, Tot potency, Regeneration methodologies and Screening of trans formants; Genetic engineering and its applications in Agriculture: Genetic manipulation pest resistance, abiotic and biotic stress tolerance, Molecular farming; Transformation of chloroplast genome and its advantage; Bio safety concerns in Plant Biotechnology	
IV	Bioinformatics: Introduction, Databases (Genomic and Protein Database), Similarity Searching: BLAST and FASTA; Tools for DNA, RNA and protein sequence analysis, Ex PASy- PROSITE, Sequence Retrieval Methods, Primer Designing tools, Gene Prediction, Restriction Site Annotation, ORF Finder, Sequence Alignment; Molecular evolution and analysis methods.	
V	Applied Biotechnology– Biofertilizers, organic farming, Environmental biotechnology, Ethics in Biotechnological research.	
Suggested Readings:-		
1. J.D. Watson, T.A. Baker, S.P. Bell, A Gann, M. Levine & R. Losick Molecular Biology of the Gene, Cold Spring Harbor Laboratory.		
2. Bernard R. Glick and Jack J. Pasternak, Molecular Biotechnology; Principles and Applications of Recombinant DNA, ASM Press, Washington, D.C.		
3. T.A. Brown, Genomes-Garland Science (Taylor & Francis Group), New York, London.		
4. Alberts Bruce, Johnson Alexander, Lewis, Julian Raff Martin, Roberts Keith and Walter Peter Molecular Biology of the Cell-Garland Science.		
5. Lodish, Harvey, Berk Arnold, et.al., Molecular Cell Biology.		
6. Introduction to Plant Biotechnology by H.S. Chawla.		
7. Plant Biotechnology –B.D. Singh		
8. U. Satyanarayana , Biotechnology		
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects:		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S. No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25
Course prerequisites:		
Suggested equivalent online courses:		
Further Suggestions:		
Any remarks/ suggestions:		

M.Sc. II (SEMESTER-IV) PAPER-III

Title: Research Methodology an IPR (Intellectual Property Right)

Programme : M. Sc. Class: M.Sc.	Year: II	Semester: IV
Subject: Botany		
Course Code: B0401003T	Course Title: Research Methodology and IPR	
Course outcomes: The Students will learn various methodologies which will help them in perusing research work in future. The paper will introduce to them the knowledge of reading and writing research papers in reputed journals.		
Credits:		Elective
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	Meaning, Object & Basic Principles of Research, Legal Research in India, Evaluation and Development, Problems & Challenges	
II	Tools and Techniques of Legal Research: Doctrine and Empirical Research, Interview Techniques, Scaling Techniques of Socio Legal Research, Research Design, Sampling Designs, Data Collection and Analysis Creativity, Innovation, Originality and Advancement of Knowledge and Application to the Society	
III	Report writing and the writing of research papers; Layout, chaptering, preparation of Introduction and Conclusion, Methods of citation, Bibliography and Abbreviations Communication Skills, review of published research, seminar, presentation etc.	
IV	Computer application for research, Types of statistical software and their application in analysis of data, Word Processing, Data Processing, Graphical Processing, Use of Web-2 tools for research, use of Graphical Software, Use of Multimedia Tools.	
V	Ethics in Research, Concept of bioethics, benefits and harm, consent, privacy and confidentiality, sharing of benefits; Intellectual Property Right: Definition of IPR, World Intellectual Property Organization (WIPO) and its role; Patent: Kinds of Patent classification, patent criteria, Procedure of obtaining patent, copy right and trade mark, Organization of patent office's in India.	
Suggested Readings:-		
<ol style="list-style-type: none"> 1. Research Design, Qualitative, Quantitative and mixed methods approaches by John W. Cress well. 2. Research Methods and Techniques 4th Ed. By G.R. Kothari and Gaurav Garg, New Age International Publisher. 3. Biological Instrumentation and Methodology by Dr. P. K. Bajpayee S. Chand Publiher. 4. Research Methodology for Biological Science by N. Gurumani. 5. Saras – Research Methodology for Life Sciences by Dr. N. Arumugam. 6. IPR, Biosafety and Bioethics by Deepa Goyal and Shomini Parashar. Pearson Education India. 7. Intellectual property- A primer for Academia by Prof. Rupinder Tewari and Mamata Bhardwaj 		
Suggestive Digital Platforms/ Web Links:		
https://dst.gov.in		
This course can be opted as an elective by the students of the following subjects:		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
Total		25
Course prerequisites:		
Suggested equivalent online courses:		
Further Suggestions:		
Any remarks/ suggestions:		

M.Sc. II (SEMESTER-IV) PAPER-IV		
Title: Biodiversity, Remote Sensing and Environment Management		
Programme: M.Sc. Class: M.Sc.	Year: II	Semester: IV
Subject: Botany		
Course Code: B041004T	Course Title: Biodiversity, Remote Sensing and Environment Management	
Course out comes: The students will learn about Biodiversity and its threat, remote sensing and analytical techniques and their uses in life sciences and Environmental management.		
Credits: 5		Elective
Max. Marks: 25+75		Min. Passing Marks:
Unit	Topics	
I	Biodiversity: Definition, Measurement (Alpha, Beta & Gamma), Global biodiversity	
II	Levels of biodiversity: Genetic, Species, community and ecosystem; Magnitude and distribution: Diversity gradients	
III	Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book	
IV	Strategies for biodiversity conservation: Principles of biodiversity conservation, <i>In-situ</i> and <i>ex-situ</i> conservation strategies.	
V	Remote sensing, Environmental management and Environmental forecasting.	
Suggested Readings:-		
<ol style="list-style-type: none"> 1. Remote Sensing and GIS by Basudeb Bhatta, 3rd Ed. Oxford Higher Education Publisher. 2. An Advanced Text book of Biodiversity by KV Krishnamurthy. 3. Environmental Management by Ajith Sankar R.N. Oxford Higher Education Publisher. 		
Suggestive Digital Platforms/ Web Links:		
This course can be opted as an elective by the students of the following subjects:		
Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	Assessment Type	Max. Marks
1	Class performance/Participation/ Interaction	5
2	Quiz/Test/House Examination	10
3	Written assignment/Presentation/Excursion	10
	Total	25
Course prerequisites:		
Suggested equivalent online courses:		
Further Suggestions:		
Any remarks/ suggestions:		

M.Sc. II (SEMESTER-IV) PAPER-V
Title: Major Research Project/Dissertation

Programme: M.Sc. Class: M.Sc. II	Year: II	Semester: IV
Subject: Botany		
Course Code: B0401005P	Course Title: Major Research Project/Dissertation	
<p>Course outcomes: Project work will supplement field experimental learning and deviations from classroom and laboratory transactions. Project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision – making processes. It will promote creativity and the spirit of enquiry in learners. They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation inform of dissertation writing. It will enhance their abilities, enthusiasm, and interest.</p>		
Credits: 10	Core-Research Project/Dissertation	
Max. Marks: 50+50	Min. Passing Marks:	
Topics		
<p>The topic would be decided by the candidate in consultation with the respective supervisor, Major Research Project/ Dissertation will be based on existing branches of botany and the title will be decided keeping the view on the modern aspect in the related discipline. It will be the part of semester IV; however, the title of Major Research Project/ Dissertation will be assigned by concerned faculty member/ board in the beginning of semester III to provide sufficient time to complete Major Research Project/Dissertation.</p>		
Suggested Continuous Evaluation Methods (Max. Marks: 50)		
S.No.	Assessment Type	Max. Marks
1	Class performance	10
2	Project writing	20
3	Presentation/Dissertation	20
	Total	50
Course prerequisites:		
Suggested equivalent online courses:		