जम्मू केंद्रीय विश्वविद्यालय
Central University of Jammu

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No. 4-13/CUJ/Reg/2020/100

05th March, 2020

NOTIFICATION No. 17 /2020

Sub: Course Scheme and Syllabus Notification of 8th **semester** of **Integrated M.Sc. in Botany** w.e.f. Academic session **2019 - 20** – Reg.

Ref: Notification No. 82 of 2018 dated 26.12.2018

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It is hereby notified for the information of all concerned that on the recommendation of the Board of Studies of Department of Botany and Dean, School of Life Sciences, the Vice Chancellor in anticipation of Academic Council has approved the following **Course Scheme** and **Syllabus** of **8th semester** of **Integrated M.Sc. in Botany** w.e.f. Academic Session **2019 - 20**.

Semester – VIII

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
	Core Courses					
ICBOT8C001T	Applied Ecology	4	25	25	50	100
ICBOT8C002T	Genetics and Cytogenetics	4	25	25	50	100
ICBOT8C003T	Molecular Plant Physiology	4	25	25	50	100
ICBOT8C004T	Applied Pteridology and Gymnospermology	4	25	25	50	100
ICBOT8C001L	Applied Ecology Lab	2	25	-	25	50
ICBOT8C002L	Genetics and Cytogenetics Lab	2	25	-	25	50
ICBOT8C003L	Molecular Plant Physiology Lab	2	25	-	25	50
ICBOT8C004L	Applied Pteridology and Gymnospermology Lab	2	25	-	25	50
Total		**24**	-	-	-	**600**

5/3/2020
Deputy Registrar
(Admin – HR)

Encl: Syllabus of 8th semester of Integrated M.Sc. in Botany

To:
Head, Department of Botany

Copy to:
Controller of Examinations

Course Code : ICBOT8C001T

Semester – VIII

Course Title: Applied Ecology

Assessment	
Maximum marks	100
Continuous Internal Assessment (CIA)	25
Mid Semester Exam (MSE)	25
End Semester Exam (ESE)	50
Passing Marks	50

Course Objectives

The course provides student with a thorough understanding and appreciation of ecosystems. The biotic and abiotic components; interactions; physical drivers and remote sensing that define major ecosystem types are described. It is imperative to have a firm grasp on the applicability of general ecological concepts (already dealt in IV sem).

Theory

Unit 1: Concept and Components of Applied Ecology

Introduction; utilization of ecological principles in relation to biotic and abiotic factors; natural systems versus anthropogenically influenced systems; effects of different land use changes on hydrological, chemical and biological processes in air, soil and water; Anthropogenic threats to aquatic ecosystems and associated hydro-morphological changes (construction of dams and dikes; drainage of land); current environmental issues; global carbon budget and cycling; waste and climate change.

Unit 2: Ecotoxicology and Ecological Restoration

Basics of ecotoxicology- sources and fate of toxicants; their routes of exposure, bioavailability, dose-response, biomarkers, risk assessment and biomagnifications; regulation, and monitoring of pollutants; recent developments in bioremediation, their advantages and disadvantages; ecological restoration of degraded ecosystems- methods and strategies for terrestrial and aquatic ecosystems; restoration of biological diversity- Augmentation by reintroduction and introduction of species.

Unit 3: Remote Sensing and Geographic Information System

Principles and concepts; spectral characteristic and reflectance of earth's surface features (rocks, soil, vegetation, water) in different wavelength regions of electromagnetic spectrum; Application of remote sensing and GIS in ecology- monitoring and natural resource management (vegetation mapping and forest resources management).

Unit 4: Ecological modelling

Fundamentals of modelling, different models, statistical computing; skills and resources, process of formulating models of natural systems and confronting them with data; Introduction to modelling platforms- R modelling platform; case studies using current approaches for building, fitting and application of models.

Unit 5: Society and Ecology

Sustainable development- goals, targets and challenges (energy, carbon and climate); Ecological literacy for the development of sustainable society with emphasis on population policy, carrying capacity and eco-footprint; Sustainable and organic agriculture; farm as an ecosystem- pest control, integrated crop and livestock production, and marketing systems; Fundamental concepts and strategies of industrial ecology– Material substitution and De-materialization (reuse and recycling).

Applied Ecology Lab ICBOT8C001L

Assessment	
Max. Marks	50
Continuous Internal Assessment (CIA)	25
End Semester Exam (ESE)	25
Passing Marks	25

Practicals

1. Study of forest vegetation and structure by applying suitable sampling methods and vegetation indices.
2. Quantification of the soil carbon content using titration methods.
3. Quantification of major nutrients (Nitrogen and Phosphorus) of soil by titration.

4. To determine the soil moisture content on a dry weight basis. To measure the compactness and porosity of different soils (agricultural land, barren land or degraded compact soils).
5. To analyze the inorganic and organic contaminants from soil or water system for toxicity study.
6. To study and calculate of exposure risk of pollutants (air/water/soil) to human health using data from clinical centres.
7. To study the enrichment and isolation of bacteria that degrade 2,4-Dichlorophenoxyacetic acid.
8. To demonstrate the ability of a soil bacterial community to adapt to imposed metal stress.
9. To detect *E. coli* in water by the most probable number (MPN) method.
10. To determine the biodegradation rate of a synthetic phenol or other phenolic compounds.
11. To demonstrate, introduction and installation of R software platform.
12. To demonstrate hands on R software, data entry, basic plotting and basic calculation.
13. Practical modelling exercises as per theory classes.
14. Demonstration and hand on remote sensing sensors; data extraction and data processing.
15. Remote sensing imagery resources and image processing and interpretation.
16. Analysis of RS and GIS data and interpreting the data for modelling applications.

SUGGESTED READINGS:

1. Singh JS, Singh SP, Gupta SR (2014) Ecology Environmental Science and Conservation, S Chand & Co. New Delhi.
2. Barbour MG, Burk JH, Pitts WD (1987) 2nd Edition Terrestrial Plant Ecology, The Benzamin/Cummings Publishing Company, San Francisco.
3. Omasa K, Nouchi I, De Kok LJ (2005) Plant responses to air pollution and global change, Springer Japan, Tokyo.
4. Gurjar BR, Molina T, Ojha CSP (2010) Air Pollution Health and Environmental Impacts, CRC Press, Boca Raton, U.S.A.

5. Singh JS (1993) Restoration of degraded land: concepts & strategies. Rastogi Publications, Meerut.

6. Smith RL (2001) Ecology and Field Biology, 6th edition. Benjamin Cummings.

7. Soetaert K and Herman PMJ (2009) A Practical Guide to Ecological Modelling. Springer Publication.

8. Sven Erik Jorgensen and Brian D Fath (2011) Fundamentals of Ecological Modelling Academic Press. Elsevier.

9. Michael H, PhD, Dong (2014) An Introduction to Environmental Toxicology, 3rd Edition, Create space Independent Pub.

10. Basudeb Bhatta (2011) Remote Sensing and GIS, Oxford University Press, 2nd edition.

11. Lillesand, Kiefer and Chipman (2011) Remote Sensing and Image Interpretation, Wiley, Sixth edition.

Course Code : ICBOT8C002T

Semester – VIII

Course: Genetics and Cytogenetics

Assessment	
Maximum marks	100
Continuous Internal Assessment (CIA)	25
Mid Semester Exam (MSE)	25
End Semester Exam (ESE)	50
Passing Marks	50

Course objectives

The course intends to provide the students with the detailed knowledge of applications of genetics and cytogenetics in fields like plant breeding, population genetics, evolutionary genetics and taxonomy.

Unit 1: Fungal Genetics

Introduction; Mutants and wild types- Isolation and characterisation of different mutants (complementation and functional allelism); functional mutants (auxotrophs, conditional lethals, resistance mutants, reverse mutants); Parasexual cycle - ~~Parasexual cycle~~, heterokaryosis, haploidisation, mitotic crossover and recombination, genetic analysis; Meiotic recombination - methods of analysis, linkage and tetrad analysis, gene mapping, gene conversion; Extra-chromosomal elements - Mitochondrial genome and plasmids, 2-micron plasmid, killer plasmid and linear plasmid;. Epigenetic gene silencing in filamentous fungi - RIP, MIP, Quelling, Heterothallism and mating type switch

Unit II: Eukaryotic Genome

Structure, organization evolution of plant genome; recombination- Molecular mechanism, linkage and crossing over; genetic and molecular markers, construction of linkage maps; Physical mapping of genes; correlation of genetic and physical maps; QTL mapping; concept of GWAS. Plant Genome Projects-History, organization and goals; case studies (*Arabidopsis thaliana*, *Oryza sativa* and *Cicer arietinum*); Indian scenario.

Unit III: Transposable Genetic Elements

Discovery; transposable elements in bacteria (IS, composite and non-composite Tn), transposable elements in Yeast and maize; host cell interaction in the regulation of

transposition. Role of transposons in plant genetic and epigenetic regulation, and speciation; gene creation; evolutionary significance of transposable elements.

Unit IV: Chromosome- physical structure, numerical and structural changes

Chromosome architecture – Linear differentiation; structure and role of centromere and telomere; unique and repetitive DNA; euchromatin and heterochromatin; banding patterns; karyotype evolution; DNA content and C-value paradox; transmission and characterization of mono-and trisomics and their use in chromosome mapping of diploid and polyploid species; breeding behaviour and genetics of complex translocation heterozygotes, translocation tester sets, Robertsonian translocations; breeding behaviour and genetics of inversion heterozygotes; production, characterization and utility of alien addition and substitution lines.

Unit V: Modern techniques in genetics and cytogenetics

Brief idea about application of- Chromosome banding; fluorescence in-situ hybridization (FISH); Genomic in-situ Hybridization (GISH); multicolor genomic in-situ hybridization (McGISH); primed in-situ (PRINS) DNA labeling; fiber-FISH; flow cytometry (Determination of nuclear DNA content, ploidy and genome size); chromosome microdissection and utilization of micro-isolated DNA; three-dimensional, live-cell imaging of chromatin dynamics in plant nuclei using chromatin tagging systems; chromatin immunoprecipitation for detecting epigenetic marks on plant nucleosomes; image analysis of DNA fiber and nucleus in plants.

SUGGESTED READINGS:

1. Swanson CP, Merz T, and Young WJ, (1967), Cytogenetics, Prentice Hall of India, Pvt. Ltd.
2. Russel PJ, (1998), Genetics, Benjamin/Cummings Publishing Co, Inc.
3. Sinnott EW, Dunn LC and Dobzhansky T (1958); Principles of Genetics, Kugakusha Co; Ltd.
4. Snustad DP and Simmons MJ (2000); Principles of Genetics. John Wiley & Sons. NY.
5. Klug and Cummings (2012) Concept of Genetics, 10th Edn; Pearson publications.
6. Acquaah G (2007) Principles of Plant Genetics and Breeding; Blackwell Publishing Ltd; USA.
7. Allard RW (1999) Principles of Plant Breeding (2nd Edition); John Wiley and Sons.
8. Hartl DL and Jones EW (2007) Genetics – Analysis of Genes and Genomes; 7th edition; Jones and Barlett publishers.

9. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM, Veres RC (2006) Genetics – From Genes to Genomes; 3rd edition; McGraw Hill.
10. Lewin B (2008) Genes IX; Jones and Barlett Publishers.
11. Singh RJ (2002) Plant Cytogenetics; 2nd edition; CRC Press.
12. Smartt J and Simmonds NW (1995); Evolution of Crop Plants (2nd Edition) Longman.
13. Strickberger MW (2008) Genetics; 3rd Edition; Pearson (Prentice Hall).
14. Weising K, Nybom H, Wolff K and Kahl G (2005) DNA Fingerprinting in Plants: Principles; Methods and Applications; 2nd ed; Taylor and Francis Group; Boca Raton.
15. JRS Fincham. (1979). Fungal Genetics. Botanical Monographs Vol 4. University of California Press.

ICBOT8C002L

Genetics and Cytogenetics Lab

Practicals

Assessment	
Max; Mark	50
Continuous Internal Assessment (CIA)	25
End Semester Exam (ESE)	25
Passing Marks	25

1. To study of mitotic chromosomes of *Allium cepa, ~~Avena~~ sativum, Hordeum vulgare* by squash technique - Pre-treatment; Fixation and Staining of Chromosomes
2. To study meiotic chromosomes of *Phlox drummondii/ Allium cepa/ Tradescantia* sp., *Delphinium* sp., *Aloe* sp.
3. Karyotype analysis and preparation of idiograms.
4. Analysis of molecular polymorphism in parental lines and derived mapping population using different types of molecular markers.
5. Construction of a linkage map using available data.
6. To demonstrate the effect of polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
7. To study the effect of mono and trisomy on fertility and meiotic behaviour.
8. To study the effect of translocation heterozygosity on chromosome behaviour, pollen and seed fertility.
9. To study the meiosis of complex translocation heterozygotes.
10. Experiments based on the chapter 5.

Course Code : ICBOT8C003T

Semester – VIII

Course: Molecular Plant Physiology

Assessment	
Maximum marks	100
Continuous Internal Assessment (CIA)	25
Mid Semester Exam (MSE)	25
End Semester Exam (ESE)	50
Passing Marks	50

Course objectives

The course deals with details of plant developmental, sensory and stress physiology and secondary metabolism, signal transduction; programmed cell death and defense.

Theory

Unit 1: Developmental Physiology

Stages of fruit development and their regulation; biochemical and related events during fruit ripening in climacteric and non-climacteric fruits; physiology and biochemistry of fruit abscission; post-harvest changes; production of transgenic fruits; hormonal regulation of seed development; events associated with seed maturation- factors regulating seed dormancy; mechanisms of mobilization of food reserves during seed germination.

Unit 2: Sensory physiology and Secondary metabolism

Biochemical and biophysical mechanisms of thigmotropism- electric self-defence, taste, light; explosion, sleeping and rhythms; stimuli that trigger rapid movements- movements based on mechanical forces, mobility triggered by sense of touch, taste and electricity; motors driving movements in the living world, actin-myosin motors; photosensing- chemistry of excitability; neurotransmitters in plants; natural products (secondary metabolites)- their range and eco-physiological functions; overview of terpenoidal, alkaloidal, and phenolic metabolites and their biosynthesis.

Unit 3: Sensory Photobiology and Signal Transduction

Cryptochromes and phototropins- Structure, function and mechanisms of action; stomatal movement- scotomorphogenesis and photomorphogenesis; specific signalling mechanisms and their regulation- simple and hybrid type of two-component sensor-regulator system in

bacteria and plants (examples of chemotaxis, osmosensing, ethylene and cytokinin signaling); quorum sensing; gasotransmitters.

Unit 4: Stress Physiology

Introduction to stress; plant responses to biotic and abiotic stresses; mechanisms of stress tolerance- drought, salinity, metal toxicity, freezing and heat stress; nitrosative and oxidative stress – effects and causes; reactive oxygen species metabolism; nitric oxide (NO) biosynthesis and metabolism; NO-mediated signalling; markers; antioxidant mechanisms.

Unit 5: Programmed cell death (PCD) and defense

Concept of PCD and its types in plants during vegetative and reproductive stages; developmental and stress-induced PCD; Plant, leaf and flower senescence and their characteristics; altered metabolism during senescence and its regulation; hormonal modulations; biochemical mechanisms of plants chemical war against other plants and animals; plant responses to herbivory; defense mechanisms; induced phytochemical responses.

Molecular Plant Physiology Lab ICBOT8C003L

Assessment	
Max; Mark	50
Continuous Internal Assessment (CIA)	25
End Semester Exam (ESE)	25
Passing Marks	25

Practicals

1. To study the effect on different chemicals/phytohormone/stress on seed germination.
2. To study the effect of light on seed germination.
3. Demonstration of fruit ripening in climacteric and non-climacteric fruits.
4. Chlorophyll estimation of leaves (of different age) using spectrophotometric methods.
5. Demonstration of plant movements.
6. Extraction of metabolites from plant tissue and their qualitative analysis using TLC.
7. Demonstration of chemicals/phytohormone on stress alleviation.

8. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
9. Demonstration of cell membrane damage during stress conditions.
10. To study ROS generation during development and stress conditions.
11. To study the effect of different concentrations of IAA on coleoptile elongation (IAA Bioassay).

SUGGESTED READINGS:

1. Ainsworth C (2006) Flowering and its Manipulation Annual Plant Reviews, Vol. 20 Blackwell Publishing. Oxford. U.K.
2. Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition. Kluwer Academic Publisher. Dordrecht. The Netherlands.
3. Hopkins. G.W and Huner. N.P.A. (2008) Introduction to Plant Physiology. 4thEdn Wiley and Sons. Inc. New York. U.S.A.
4. Jordan BR. (2006) The Molecular Biology and Biotechnology of Flowering. 2nd Edition. CAB International, Oxfordshire. U.K.
5. Nelson D.L. and Cox. MM (2013). Lehninger-Principles of Biochemistry. Worth Publishers Inc. New York. U.S.A.
6. Salisbury FB and Ross CW (1992). Plant Physiology, 4thEdn. Wadsworth Publishing Co. California. U.S.A.
7. Taiz L and Zeiger E. (2006) Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, U.S.A.
8. Taiz. L. Zeiger. E. Moller IM and Murphy A (2015). Plant Physiology and Development, Sinauer Associates Inc. U.S.A. 6th edition.

Course Code :- ICBOT8
C004T

Semester – VIII

Course Title: Applied Pteridology and Gymnospermology

Assessment	
Maximum marks	100
Continuous Internal Assessment (CIA)	25
Mid Semester Exam (MSE)	25
End Semester Exam (ESE)	50
Passing Marks	50

Course objectives: The objective of the course is to give detailed knowledge of distribution, morphology, anatomy, cytology and reproductive biology of some important families of Pteridophytes and Gymnosperms. Students will also be acquainted with experimental studies in ferns and gymnosperms.

Theory

Unit 1 Pteridophytes

Diversity and distribution of Pteridophytes in India, their Phenology and habitat specificity ~~and~~ in western Himalaya. Important concepts and their significance in plant evolution. Range of structure and reproduction in Lepidodendrales, Calamitales, Ophioglossales, Marattiales, Osmundales, Filicales and Salviniales.

Unit 2 Advances studies in Pteridophytes

Gametophyte as a model for biotechnological studies; methods of mass multiplication— *in vitro* gametophyte development, gametophyte explant culture, regeneration in clone gametophytes; propagation of sporophytes *in-vitro* conditions, acclimatization and transplantation; traditional uses of ferns in pharmaceuticals— Secondary metabolites of ferns, types, composition and their therapeutically/medicinal role; fern conservation- ex situ storage of spore, gametophyte and sporophyte, *in-vitro* culture, and cryopreservation; genetic marker for fern diversity research; non-specific markers and microsatellites; *Ceratopteris richardii* as a model system of physiological control of sex expression.

Unit 3 Gymnosperms

Diversity and distribution of living gymnosperms in India; range of structure and reproduction in Cordiatales, Coniferales, Taxales, Ginkgoales, Podocarpales and Welwitschiales.

Unit 4 Advanced studies in Gymnosperms

In vitro studies on gymnosperms using vegetative tissues, organs, microspores and male gametophytes and their significance in conservation and silviculture. Biotechnological approaches—somatic embryogenesis, genetic transformation, protoplast culture and micropropagation; phytochemistry of gymnosperms— secondary metabolites, medicinal value and drugs.

Unit 5 Applied aspects of Pteridophytes and Gymnosperms

Role of ferns in environmental clean-up; removal of contaminants by ferns in soil and water; organic and inorganic contaminants. Environmental biotechnology: role in ecotoxicology and bioremediation in ferns. Ferns in horticulture- significance and different practices; role of climatic and other factors. Ecological role of gymnosperms on regional climate, soil, and vegetation; gymnosperms in horticulture— significance and different practices; role of climatic and other factors. Genetic marker for gymnosperms diversity; research non-specific markers and microsatellites.

Practicals

Assessment	
Max; Mark	50
Continuous Internal Assessment (CIA)	25
End Semester Exam (ESE)	25
Passing Marks	25

1. Study of external morphology of vegetative and reproductive structures of *Ophioglossum*, *Dryopteris*, *Adiantum*, *Asplenium*, *Cheilanthes*, *Salvinia*, *Azolla* etc.
2. Study of soral structure, spores' types, their viability and germination.
3. Field visits to local areas to study the pteridophyte diversity, habitat specificity and economic importance.
4. Study of secondary metabolites of ferns and their use in medicines.
5. In vitro study of pteridophyte spores or plant to propagate the plant.

6. Study of external and internal morphology of vegetative and reproductive structures of living gymnosperms (*Gingko*, *Podocarpus*, *Taxodium*, *Araucaria*).
7. Study of pollen grains of gymnosperms, their viability and attempt germination in different media.
8. Field visits to study the diversity and habitat specificity of gymnosperms.
9. Practical based on in vitro studies of gymnosperms.
10. Study of nutritional and medicinal value of gymnosperms.
11. Study of phytochemical analysis of gymnosperms.

SUGGESTED READINGS:

Pteridophyte

1. Gifford E. M, Foster A.S. (1989). *Morphology and evolution of Vascular plants,* (3rd Edn). W H. Freeman & Co.
2. Rashid A. (1976). *An Introduction to Pteridophytes*. Vikas Publishing House.
3. Sporne K.R. (1986). *Morphology of Pteridophytes.* Hutchinson University Library, London.
4. Surange K.R. (1966). Indian Fossil Pteridophytes. Council of Scientific and Industrial Research.
5. Chandra S. &Srivastava M. (2003). Pteridology in the New Millennium. Khuwar Acad. Publishers
6. Stewart W.N. &Rothwell G.W. (2005). Palaeobotany and the Evolution of Plants, (2nd Edn.) Cambridge University Press.
7. Sharma O.P. (2006). Text book of Pteridophyta. Macmillan India Ltd., New Delhi.
8. The Morphology of Gymnosperms. K.R. Sporne. 1965. London. Hutchinson University Library; ed. H. Munro Fx. Hutchinson & Co. (Publishers).
9. John M. Coulter and Charles J. Chambrlain, 2018, Morphology of Gymnosperms. CreateSpace Independent Publishing Platform.
10. S.P. Bhatnagar and Alok Moitra, 1996, Gymnosperms. New Age International.
11. C. Biswas and B.M. Johri. 1997. The Gymnosperms. Springer-Verlag Berlin Heidelberg.
12. H. Fernández (ed.), 2018, Current Advances in Fern Research, Springer International Publishing.