- **M. Sc. in BOTANY** **FACULTY OF SCIENCE**
- **SECOND SEMESTER** (EVEN SEMESTER)

Eligibility Criteria (Qualifying Exams)	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per WeeK			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
After appearing in the First semester examination irrespective of any number of back/ arrear papers	MBT201	CCC	DEVELOPMENTAL BIOLOGY	5	4	2	00	3	00
	MBT211	CCC	DEVELOPMENTAL BIOLOGY (PRACTICAL)	2	00	00	3	00	3
	MBT202	CCC	PATHOGENS AND PESTS OF CROP PLANTS	5	4	2	00	3	0
	MBT212	CCC	PATHOGENS AND PESTS OF CROP PLANTS (PRACTICAL)	2	00	00	3	00	3
	MBT203	CCC	PLANT BIOTECHNOLOGY AND RESOURCE UTILIZATION	5	4	2	00	3	0
	MBT213	CCC	PLANT BIOTECHNOLOGY AND RESOURCE UTILIZATION (PRACTICAL)	2	00	00	3	00	3
	MBT 221	PRJ/FST/EST	SOCIAL OUTREACH AND SKILL DEVELOPMENT	6	00	00	9	00	4
	MBT B01	ECC/CB	ENVIRONMENTAL AND FOREST LAWS	6	4	3	00	3	00
	MBT B02	ECC/CB	SYSTEMATICS, EVOLUTION AND ENVIRONMENTAL SCIENCE						
				TOTAL= 33					

M.Sc (BOTANY)			**IIND SEMESTER**
COURSE CODE: MBT201			**COURSE TYPE: CCC**
COURSE TITLE: DEVELOPMENTAL BIOLOGY			
CREDIT:7		**HOURS:135**	
THEORY: 5	**PRACTICAL:2**	**THEORY:90**	**PRACTICAL: 45**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL:33**	

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.

UNIT-1- *18 Hours*	**Unit-1-Archegoniatae:** Comparative morphology and developmental anatomy of Hepaticae, Anthocerotae and Musci; comparative anatomy of vegetative organs of Pteridophytes; study of stem apex, leaf initiation and early leaf ontogeny in ferns; development of long and short shoots, origin and pattern of development of cortex, pith and procambium in conifers.
UNIT-2- *18Hours*	**Unit-2- Vascular plants**: Meristems; patterns of cell fate, determination and lineage in root and shoot; leaf growth and differentiation; secondary growth; wood development and its diversity; cambial variants; ultrastructure and control of xylem and phloem differentiation; secretory ducts and laticifers; flower, seed and fruit anatomy; patterns of evolution in seed; anatomical adaptations for special habitats, biotic and abiotic stresses; Applications (in brief) of anatomical studies in systematics, archaeology, climate studies, pharmacology, forensic sciences and biomedical research.
UNIT-3- *18 Hours*	**Unit-3- Development of flower**: Transition to flowering - vegetative to reproductive evocation, floral homeotic mutations in *Arabidopsis*, *Antirrhinum* and *Petunia*, axis development in flower, gender expression in monoecious and dioecious plants. **Developmental biology of male and female gametophytes:** Regulation of anther and ovule development, microsporogenesis and microgametogenesis, megasporogenesis and megagametogenesis, male sterility- mechanisms and applications, pollen embryogenesis
UNIT-4- *18Hours*	**Unit-4-Pollen-pistil interaction:** *In vivo* and *in vitro* pollen germination, pollen tube growth and guidance, double fertilization, self-compatibility mechanisms, incongruity
UNIT-5- *18Hours*	**Unit-5-Embryogenesis and seed development:** Polarity during embryogenesis, pattern mutants, *in vitro* fertilization, endosperm development, apomixis, polyembryony, somatic embryogenesis.

LABORATORY WORK (MBT211)

1. Study of morphology and anatomy of thalloid and leafy forms of Bryophytes; Study of Protonema
2. Study of fern gametophyte and soral variations
3. Comparative anatomy of conifers and gnetales.
4. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
5. Origin and development of epidermal structures (trichomes, glands and lenticels).
6. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
7. Study of secretory structures (nectaries and laticifers).
8. Study of secondary growth (normal and unusual) of selected woods with the help of wood microtome and permanent slides.
9. Study of the stages of pollen and ovule development in the wild and mutant plants using permanent slides, electron micrograph and available phenotypes.
10. Pollen *in vitro* germination methods: Sitting drop culture, suspension culture, surface culture.
11. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (*in vitro*) of pollen grains.
12. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases.
13. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
14. Use of DNA fluorochromes to localize nuclei during pollen and ovule development.
15. Study of post-fertilization stage with the help of permanent slides and electron micrographs.
16. Dissection of embryo and endosperm

SUGGESTED READINGS

1. Anderson RA (2005) Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
2. Bhatnagar SP and Moitra A (2005) Gymnosperms. New Age Interactive (P) Ltd. Publishers, New Delhi.
3. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
5. Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom
6. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
7. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
8. Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK.
9. Fosket DE. (1994) Plant, Growth and Development: A Molecular Approach, Academic Press.
10. Fritsch FE (1935, 1945). The Structure and Reproduction of Algae Vols. I and II. Cambridge University Press, Cambridge, UK.
11. Hopkins WG. (2006). The Green World: Plant Development, Chelsea House Publication
12. Howell SH. (1998) Molecular Genetics of Plant Development, Cambridge University Press.
13. Leyser O and Day S (2003) Mechanism of Plant Development, Blackwell Press
14. Mauseth JD (1988). Plant Anatomy, The Benjamin/ Cummings Publisher, USA
15. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.
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16. Parihar NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II – Pteridophyta, Central Book Dept. Allahabad.
17. Raghavan V (2000) Developmental Biology of Flowering Plants, Springer, Netherlands
18. Raghavan V (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press.
19. Richards AJ (1986) Plant Breeding System, George Allen and Unwin.
20. Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publishers.

M.Sc (BOTANY)			IIND SEMESTER
COURSE CODE: MBT202 COURSE TYPE: CCC			
COURSE TITLE: PATHOGENS AND PESTS OF CROP PLANTS			
CREDIT:7		**HOURS:135**	
THEORY: 5	**PRACTICAL:2**	**THEORY:90**	**PRACTICAL: 45**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL:33**	

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.

UNIT-1- *18 Hours*	**Unit-1-General characteristics of pests including viruses,** • Life cycles • Nature of disease(s) and damage caused.
UNIT-2- *18Hours*	**Unit-2- Case studies of economically important causative agents with specific references to crop plants:** • Plant-virus interactions with emphasis on potyviruses and horticultural crops.
UNIT-3- *18 Hours*	**Unit-3- bacteria, fungi, insects and nematodes with reference to the following**: Host range • Control mechanisms based on genetics, chemical treatments, biological control and genetic engineering
UNIT-4- *18Hours*	**Unit-4-** Plant-bacterial interactions with emphasis on *Erwinia*sp. and potatoes. • Plant-fungus interactions with emphasis on *Magnaporthe*sp. and rice. • Plant-nematode interactions with emphasis on *Meloidogyne*sp. and tomato. • Plant-Insect interactions with emphasis on *Pieris*sp. and crucifers
UNIT-5- *18Hours*	**Unit-5- Plant pathogenic organisms**

LABORATORY WORK (MBT)	1. Methods of sterilization; Media preparation (selective media); inoculation procedures. 2. Characterization of disease symptoms and identification of pathogenic organisms. 3. A study on effects of various formulation and doses of BTK on growth and development of selected pest species. 4. Isolation and identification of rhizosphere soil fungi, seed borne fungi 5. Isolation and estimation of DNA from fungus 6. Biochemical markers of enhanced resistance (i) Estimation of total phenols and O-di hydroxy phenols in sugarcane and groundnut (ii) Estimation of activity of Phenylalanine ammonia lyase in healthy and diseased leaves of sugarcane (iii) Estimation of deoxyribonuclease and ribonuclease enzymes produced by virus infected and healthy leaves of tobacco 7. Research paper discussions.

SUGGESTED READINGS	1. Agrios GN (2005) Plant Pathology, 5th Edition. 2. Buchanan B, Gruissem G and Jones R (2000) Biochemistry and Molecular Biology of Plants", American Society of Plant Physiologists, USA.

M.Sc (BOTANY)			II[ND] SEMESTER
COURSE CODE: MBT203			**COURSE TYPE: CCC**
COURSE TITLE: PLANT BIOTECHNOLOGY AND RESOURCE UTILIZATION			
CREDIT:7		**HOURS:135**	
THEORY: 5	**PRACTICAL:2**	**THEORY:90**	**PRACTICAL: 45**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL:34**	

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.

UNIT-1- *18 Hours*	**Unit-1-Plant tissue culture**: History, concepts of cell differentiation and totipotency; pathways for *in vitro*regeneration: organogenesis, somatic and gametic embryogenesis; protoplast isolation, culture and regeneration; somatic hybridization; Applications: micropropagation, meristem culture, embryo rescue, synseed production, somaclonal and androclonalvariations,cryopreservation and germplasm storage.
UNIT-2- *18Hours*	**Unit-2- Principles, methods and applications of genetic transformation:** *Agrobacterium* biology and biotechnology; Plant - *Agrobacterium* interactions; Direct gene transfer methods: particle bombardment, electroporation,
UNIT-3- *18 Hours*	**Unit-3- Principles, methods and applications of genetic transformation:** *Agrobacterium* biology and biotechnology; Plant - *Agrobacterium* interactions; Direct gene transfer methods: particle bombardment, electroporation,
UNIT-4- *18Hours*	**Unit-4-**PEG-mediated and floral-dip; marker and reporter genes; case studies of transgenic traits in plants; marker-free transgenics; transgene silencing; environmental, social and legal issues.
UNIT-5- *18Hours*	**Unit-5-Plant resource utilization**: World centres of primary diversity and secondary centres of cultivated plants; crop domestication genes; Uses and introduction to current research paradigms in major cereals, oilseeds, legumes, medicinal plants, forest trees and non-alcoholic beverages.

LABORATORY WORK (MBT213)	1. Preparation of different types of standard tissue culture media. 2. Establishment of aseptic cultures following appropriate sterilization procedures using seeds. 3. Preparation of competent cells and *Agrobacterium* transformation by electroporation. 4. *Agrobacterium tumefaciens*-mediated transformation of tobacco. 5. Visualization of GFP or YFP in transgenic *Arabidopsis*. 6. Morphological and histochemical features of major cereals, oilseeds, legumes, forest trees, non-alcoholic beverages and medicinal plants. 7. Analysis of crude extracts from medicinal plants using HPLC. 8. Evaluation of a transgenic phenotype (viz., Herbicide resistance) under containment conditions in the field.

SUGGESTED READINGS	1. Adrian S, Nigel WS, Mark RF (2008). Plant Biotechnology: The genetic manipulation of Plants, Oxford University Press. 2. Buchanan B, Gruissem G and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA. 14 3. Butenko RG (2000) Plant Cell Culture, University Press of Pacific. 4. Davies PJ (2004) Plant Hormones, Kluwer Academic Publishers, Netherlands. 5. Halford N (2006) Plant Biotechnology - Current and future applications of genetically modified crops, John Wiley and Sons, England. 6. Wickens GE (2004) Economic Botany: Principles and Practices, Springer, ISBN 978-0-7923-6781-9.

M.Sc (BOTANY)	IIND SEMESTER
COURSE CODE: MBTB 01	**COURSE TYPE : ECC**

COURSE TITLE: FOREST AND ENVIRONMENTAL LAWS

CREDIT: 06	**HOURS : 90**
THEORY: 06	**THEORY: 90**

MARKS : 100
THEORY: 70 CCA : 30

OBJECTIVE:

- Understands the concept and place of research in concerned subject
- Gets acquainted with various resources for research
- Becomes familiar with various tools of research
- Gets conversant with sampling techniques, methods of research and techniques of analysis of data
- Achieves skills in various research writings
- Gets acquainted with computer Fundamentals and Office Software Package .

UNIT - 1 18 Hrs

EVOLUTION OF FOREST AND WILD LIFE LAWS

a) Importance of Forest and Wildlife
b) Evolution of Forest and Wild Life Laws
c) Forest Policy during British Regime
d) Forest Policies after Independence.
e) Methods of Forest and Wildlife Conservation.

UNIT - 2 18 Hrs

FOREST PROTECTION AND LAW

a) Indian Forest Act, 1927
b) Forest Conservation Act, 1980 & Rules therein
c) Rights of Forest Dwellers and Tribal
c) The Forest Rights Act, 2006
d) National Forest Policy 1988

UNIT - 3 18 H rs

WILDLIFE PROTECTION AND LAW

a) Wild Life Protection Act, 1972
b) Wild Life Conservation strategy and Projects
c) The National Zoo Policy

UNIT - 4 18 Hrs

CHAPTER – BASIC CONCEPTS

a. Meaning and definition of environment.
b. Multidisciplinary nature of environment
c. Concept of ecology and ecosystem
d. Importance of environment
e. Meaning and types of environmental pollution.
f Factors responsible for environmental degradation.

CHAPTER– INTRODUCTION TO LEGAL SYSTEM

a. Acts, Rules, Policies, Notification, circulars etc
b. Constitutional provisions on Environment Protection
c. Judicial review, precedents
d. Writ petitions, PIL and Judicial Activism

CHAPTER – LEGISLATIVE FRAMEWORK FOR POLLUTION CONTROL LAWS

a) Air Pollution and Law.
b) Water Pollution and Law.
c) Noise Pollution and Law.

UNIT - 5 **18 Hrs**	**CHAPTER- LEGISLATIVE FRAMEWORK FOR ENVIRONMENT PROTECTION** a) Environment Protection Act & rules there under b) Hazardous Waste and Law c) Principles of Strict and absolute Liability. d) Public Liability Insurance Act e) Environment Impact Assessment Regulations in India **CHAPTER – ENVIRONMENTAL CONSTITUTIONALISM** a. Fundamental Rights and Environment i) Right to Equality …….Article 14 ii) Right to Information ……Article 19 iii) Right to Life ……..Article 21 iv) Freedom of Trade vis-à-vis Environment Protection b. The Forty-Second Amendment Act c. Directive Principles of State Policy & Fundamental Duties d. Judicial Activism and PIL
SUGGESTED READINGS	Bharucha, Erach. Text Book of Environmental Studies. Hyderabad : University Press (India) Private limited, 2005. Doabia, T. S. Environmental and Pollution Laws in India. New Delhi: Wadhwa and Company, 2005. Joseph, Benny. Environmental Studies, New Delhi: Tata McGraw-Hill Publishing Company Limited, 2006. Khan. I. A, Text Book of Environmental Laws. Allahabad: Central Law Agency, 2002. Leelakrishnan, P. Environmental Law Case Book. 2nd Edition. New Delhi: LexisNexis Butterworths, 2006. Shastri, S. C (ed). Human Rights, Development and Environmental Law, An Anthology. Jaipur: Bharat law Publications, 2006. Environmental Pollution by Asthana and Asthana, S,Chand Publication Environmental Science by Dr. S.R.Myneni, Asia law House Gurdip Singh, Environmental Law in India (2005) Macmillan. Shyam Diwan and Armin Rosencranz, Environmental Law and Policy in India – Cases, Materials and Statutes (2nd ed., 2001) Oxford University Press. **JOURNALS :-** Journal of Indian Law Institute, ILI New Delhi. Journal of Environmental Law, NLSIU, Bangalore. **MAGAZINES :-** Economical and Political Weekly Down to Earth.

M.Sc (BOTANY)			**IIND SEMESTER**
COURSE CODE: MBTB 02		**COURSE TYPE: ECC/CB**	
COURSE TITLE: SYSTEMATICS, EVOLUTION AND ENVIRONMENTAL SCIENCE			
CREDIT:6		**HOURS:90**	
THEORY: 6	**PRACTICAL:0**	**THEORY:90**	**PRACTICAL: 00**
MARKS			
THEORY: 100 (30+70)		**PRACTICAL:00**	

OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.

UNIT-1- *18 Hours*	**Unit-1-Systematics and Evolutionary Biology:** History of developments in taxonomy: Linnaean to post-Linnaean era; Systematics - concepts and components; Botanical Nomenclature; Evolutionary ecology-concepts and principles; Microevolution - theory and concepts; Species and speciation; Phylogenetic systematics;
UNIT-2- *18Hours*	**Unit-2-** Macroevolution - inferring phylogenies; Diversity and classification of flowering plants; Taxonomic evidence - structural and biochemical; Molecular systematics;
UNIT-3- *18 Hours*	**Unit-3-** Diversity and classification of flowering plants; Biological diversity-concepts and applications; Diversity- patterns, indices and applications.
UNIT-4- *18Hours*	**Unit-4- Environmental Science:** Introduction to Environmental Science and Sustainability, Environmental laws, Ecosystems and living organisms,
UNIT-5- *18Hours*	**Unit-5-**Major ecosystems of the world and India, Human health and environmental change, Population issues, the search for fuels, natural resources and their management, applications of GIS and RS technology in environmental studies, the future of planet earth.

SUGGESTED READINGS	1. Angiosperm Phylogeny Group (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436. 2. Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition) 3. Crawford DJ (2003) Plant Molecular Systematics. Cambridge University Press, Cambridge, UK. 4. Cronquist A (1981). An integrated system of classification of flowering plants. Columbia University Press, New York. 5. Hollingsworth PM, Bateman RM and Gornall RJ (1999). Molecular systematics and Plant Evolution. Taylor and Francis, London. 6. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. SinauerAssociaes, Inc., Massachusetts. 7. Nei M and Kumar S (2000) Molecular Evolution and Phylogenetics. Oxford University Press, New York. 8. Raven PH, Begr LR, Hassenzahl DM (2008) Environment. 6th edition. John Wiley & Sons, Inc., New York. 9. Semple C and Steel MA (2003) Phylogenetics. Oxford University Press, Oxford. 10. Simpson MG (2006) Plant Systematics. Elsevier, Amsterdam. 11. Stuessy TF (2008) Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York. 12. Swafford DL (2001) PAUP*. Phylogenetic analysis using parsimony (* and other methods), version 4. Sinauer Associates, Sunderland.