- **M. Sc. in BOTANY** **FACULTY OF SCIENCE**
- **FOURTH 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 Third semester examination irrespective of any number of back/ arrear papers	MBT 401	CCC	IN VITRO TECHNOLOGIES AND INDUSTRIAL APPLICATIONS	5	4	2	00	3	00
	MBT 411	CCC	IN VITRO TECHNOLOGIES AND INDUSTRIAL APPLICATIONS (PRACTICAL)	2	00	00	3	00	3
	MBT 402	CCC	REPRODUCTIVE BIOLOGY OF FLOWERING PLANTS	5	4	2	00	3	00
	MBT 412	CCC	REPRODUCTIVE BIOLOGY OF FLOWERING PLANTS (PRACTICAL)	2	00	00	3	00	3
	MBT 403	CCC	MOLECULAR INTERACTIONS OF PLANTS WITH SYMBIONTS, PATHOGENS AND PESTS	5	4	2	00	3	00
	MBT 413	CCC	MOLECULAR INTERACTIONS OF PLANTS WITH SYMBIONTS, PATHOGENS AND PESTS (PRACTICAL)	2	00	00	3	00	3
	MBT 421	SSC/PRJ	DISSERTATION	6	00	00	9	00	4
	MBT D01	ECC/CB	ADVANCED GENETICS AND PLANT BREEDING	6	4	3	00	3	00
	MBT D02	ECC/CB	AGRICULTURAL ECOLOGY – PRINCIPLES AND APPLICATIONS						
	MBT D03	ECC/CB	ADVANCED PLANT SYSTEMATICS						
	MBT D04	ECC/CB	CONTEMPORARY CONCEPTS AND METHODS IN CELL BIOLOGY						
	MBT D05	ECC/CB	PLANT PHYSIOLOGY AND BIOCHEMISTRY						
				TOTAL= 33					

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBT401			**COURSE TYPE: CCC**
COURSE TITLE: **IN VITRO TECHNOLOGIES AND INDUSTRIAL APPLICATIONS**			
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-**To provide students with an overview of plant tissue culture techniques, their potential in the production of propagative material and interaction with industries) • Micropropagation (via organogenesis and embryogenesis) of floricultural, agricultural and pharmaceutical crops: Orchids, Chrysanthemum, Gerbera, Carnation, Anthurium, Bamboos, *Spilanthes, Stevia, Psoralea*, Chickpea and elite tree species of national importance
UNIT-2- *18Hours*	**Unit-2-** • Production of virus free plants through meristem culture in orchids and fruit trees. • Germplasm conservation *in vitro.* • Germplasm conservation *in vivo*
UNIT-3- *18 Hours*	**Unit-3-** Variations: Somaclonal and gametoclonal variations, spontaneous, genetic and epigenetic variations. • Culture systems: Differentiated, undifferentiated, physiological, biochemical and molecular role of minerals and growth regulators in understanding differentiation of organs under *in vitro* conditions.
UNIT-4- *18Hours*	**Unit-4-•** Problems in Plant Tissue Culture: contamination, phenolics, recalcitrance. • Problems in establishment of regenerated plants in nature: hardening, association of mycorrhiza and rhizobia. • Factors responsible for *in vitro* and *ex vitro* hardening.
UNIT-5- *18Hours*	**Unit-5-.•** Use of bioreactors in secondary metabolite production and scale up automation of plant tissue culture. • Recent applications of tissue culture techniques and biotechnology in the introduction of economically important traits in horticultural, agricultural and medicinal plants. • Interactions, training and workshops in Biotech industries and placements.

LABORATORY WORK (MBT411)	1. Development of regeneration protocols employing direct and indirect organogenesis / somatic embryogenesis in economically important horticultural and/or medicinal plants. 2. Control of phenolics in recalcitrant tissues under culture conditions. 3. Study of various physico-chemical factors (pH, light, hormones, etc.) on in vitro growth and development of tissues or organs, rooting of regenerants, in vitro and ex vitro hardening, potting and acclimatization in natural conditions. 4. Shoot-tip meristem culture for raising virus-free plants in tomato / tobacco. 5. *Agrobacterium rhizogenes*mediated development of hairy root cultures. 6. Isolation of bioactive compounds from medicinal plants using column chromatography and TLC. 7. Preparation of synthetic seeds for germplasm conservation using somatic embryos or other propagules
SUGGESTED READINGS	1. Herman EB (2008) Media and Techniques for Growth, Regeneration and Storage 2005-2008. Agritech Publications, New York, USA. 2. Pierik RLM (1999) *In Vitro* Culture of Higher Plants. Kluwer Academic Publishers. 3. Prakash J &Pierik RLM (1991) Horticulture - New Technologies and Applications (Current Plant Science and Biotechnology in Agriculture). Kluwer Academic Publishers. 4. George EF, Hall MA and Geert-Jan De Klerk (2008). Plant Propagation by Tissue Culture (3rd Edition), Springer, Netherlands. 5. **Journals**: Plant Cell, Tissue and Organ Culture, Plant Cell Reports.

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBT402			**COURSE TYPE: CCC**
COURSE TITLE: **REPRODUCTIVE BIOLOGY OF FLOWERING 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-Modes of Reproduction:** An overview- **Flower development**: Regulation of floral architecture and diversification; Floral organogenesis; Pollination regulation of flower development
UNIT-2- *18Hours*	**Unit-2- Male gametophyte**: Sporophyte-gametophyte interaction during micro- and megasporogenesis; interaction of mitochondrial and nuclear genes; male specific cytokinesis; tapetal development and pollen-coat formation; asymmetric division, cell fate and polarity; sperm dimorphism; male germ unit: cytology and 3-d structural organization; pollen biotechnology; manipulation of sperm cells; male-sterility; induction; mechanism of action and breeding; transformation of pollen; embryogenic development of pollen grains. **Female gametophyte**: Regulation of pistil and ovule development; megasporogenesis and megagametogenesis: developmental pathways, gene function and organization.
UNIT-3- *18 Hours*	**Unit-3- Pollen-pistil interaction and double fertilization**: Pollen tube guidance; recognition and rejection reaction, barriers to gene flow; signal transduction at the level o f stigma style and ovules, double fertilization: origin, mechanism and *in vitro* fertilization; preferential fertilization; pistil activation and ovule penetration.
UNIT-4- *18Hours*	**Unit-4-Plant-pollinator interactions and breeding systems**: Plant-pollinator interaction: floral display, attractants and rewards, pollen load, temporal details and foraging behaviour, pollinator and pollination efficiency, physicochemical aspects of pollination; pollination energetics, gene flow, applied pollination ecology; phenology; mating systems: diversity and quantitative estimation; differential reproductive success; resource allocation; pollen:ovule ratio; sibling rivalry, ovule abortion.
UNIT-5- *18Hours*	**Unit-5-.Fruit biology:** Development biology and diversity of fruit types, fruit abortion in relation to resource allocation, dispersal and gene flow. **Seed biology:** Embryogenesis and embryonic pattern formation; endosperm development and differentiation; ultrastructure and cytology; seed development: pattern, regulation of gene expression and imprinting; agamospermy and parthenocarpy, pseudogamy and autonomous development of endosperm; Embryo and endosperm culture.

LABORATORY WORK (MBT412)	1. Study of developmental aspects of reproduction using *Arabidopsis* mutants. 2. Isolation of embryo sacs and visualization of post-fertilization stages with the help of fluorescence and confocal microscope. 3. Study of micro- and megasporogenesis using Nomarski interference microscope. 4. Microtomy of resin-embedded and wax-embedded material. 5. Determination of mating systems using Isozymes/DNA markers. 6. Study of pollination syndromes and plant-pollinator interaction. 7. Measuring floral sex allocation based on biomass. 8. Assessment of floral rewards: quantitative and qualitative analysis of nectar and pollen. 9. Assessment of attraction of insects to artificial flowers and determining pollination energetics. 10. Demonstration of in-situ expression of anther/ovule specific genes. 11. Induction of somatic embryos using a suitable plant material. 12. Study of types of embryo sacs during apomictic development by employing ovule-clearing method.
SUGGESTED READINGS	1. Barrett SCH (2008) Major Evolutionary Transitions in Flowering Plant Reproduction. Univ. of Chicago Press. 2. Faegri K & van der Pijl L (1979) The Principles of Pollination Ecology. Pergamon Press, Oxford. 291 pp. 3. Harder LD & Barrett SCH (2006) Ecology and Evolution of Flowers, Oxford Univ. Press. 4. O'Neill SD & Roberts JA (2002) Plant Reproduction, Sheffield Academic Press. 5. Raghavan V (1997) Molecular Embryology of Flowering Plants, Cambridge Univ. Press. 6. Raghavan V (2000) Developmental Biology of Flowering Plants, Springer Verlag, New York. 7. Richards AJ (1986) Plant Breeding System, George Allen and Unwin, UK. 8. Scott RJ and Stead AD (2008) Molecular and Cellular Aspects of Plant Reproduction. Society for Experimental Biology, Seminar Series 55. 9. Shivanna KR and Johri BM (1985) The Angiosperm Pollen: Structure and Function. New Delhi, India: Wiley-Eastern. 10. Shivanna KR and Rangaswamy NS (1992) Pollen Biology: A Laboratory Manual, Springer- Verlag, Berlin. 11. Shivanna KR (2003) Pollen Biology and Biotechnology. Enfield, New Hampshire, U.S.A.: Science Publishers.

M.Sc (BOTANY)		**IVTH SEMESTER**	
COURSE CODE: MBT403		**COURSE TYPE: CCC**	
COURSE TITLE: **MOLECULAR INTERACTIONS OF PLANTS WITH SYMBIONTS, PATHOGENS AND PESTS**			
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**-1. Introduction to biotic interactions with plants.
UNIT-2- *18Hours*	**Unit-2-**2. Recent advances in plant-fungi, plant-insect and plant-nematode interactions: Stages of pathogenesis
UNIT-3- *18 Hours*	**Unit-3-** 3. Recent advances in symbiotic interaction with plant with special references to mycorrhiza and plant interaction.
UNIT-4- *18Hours*	**Unit-4-**4. Recent advances in parasitic interaction between plants and parasitic plants.
UNIT-5- *18Hours*	**Unit-5-**.Engineering for the production of resistance plants to pathogens and pests.
LABORATORY WORK (MBT413)	1. Study on susceptible and resistance interactions at cellular and biochemical levels between plants and pathogens, and between plant and pests. 2. Investigation of infection cycle of a plant parasitic nematode (e.g., root knot nematode, *Meloidogyne incognita*) in susceptible and resistant tomato roots in the absence and presence of resistance genes (Mi gene). 3. Estimation of activity of phenylalanine ammonia lyase in healthy and disease leaves. 4. Detection of plant viruses from infected leaf tissues using ELISA and Western Blot. 5. Computer-based study of a multigene family pathogenicity gene from the Nem databases. 6. Field visit to show diseases on crop plants

SUGGESTED READINGS	1. Williamson VM, Kumar A (2006) Nematode resistance in plants: the battle underground. *Trends in Genetics* 22: 396–403. 2. Davis EL, Hussey RS, Baum TJ (2004) Getting to the roots of parasitism by nematodes. *Trends in Parasitology* 20: 134–141. 3. Plant Nematology (2006) Edited by Perry and Moens, CABI. *Plant virology and insect-plant interactions:* 4. Induced responses to herbivory by R Karban and IT Baldwin (1997) Chicago University Press, Chapter 3, pg47-100. 5. Mathew's Plant Virology by Roger Hull (2001) Academic Press, NY. *Plant-fungi interactions:* 6. *Plant resistance mechanisms (SAR, ISR)* - Strange RN, (2003) Introduction to Plant Pathology, John Wiley & Sons, USA. 7. *Signal transduction; Molecular diagnostics; Transgenic approaches for crop protection* - Dickinson M, (2003) Molecular Plant Pathology, Bios Scientific Publishers, London.

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBTD01			**COURSE TYPE: ECC/CB**
COURSE TITLE: **ADVANCED GENETICS AND PLANT BREEDING**			
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**-1. **Origin and history of crop plants**: Plant domestication - morphological, agronomic and genetic features accompanying domestication of plants, agro-biodiversity, genetic erosion.
UNIT-2- *18Hours*	**Unit-2- Biological diversity and genetic variation**: Kinds and patterns of variation, variation and variability; genetics, utilization and analysis of genetic variation; qualitative and quantitative traits and their genetics, polygenic inheritance, partitioning of genotypic variance, inbreeding heterosis, recent development in quantitative genetics. Variation in population, genetic structure of population.
UNIT-3- *18 Hours*	**Unit-3- Genetic system and breeding methods**: Reproduction and breeding systems in plants. Recombination, genetic control and manipulation of breeding systems including male sterility and apomixis. Selection and breeding strategies for self-pollinated, cross-pollinated and clonally propagated crop plants, breeding for crop quality, biotic and abiotic stresses, gene pyramiding for multi-trait incorporation.
UNIT-4- *18Hours*	**Unit-4- Sources of variation**: Plant genetic resources-genetic consideration on PGR management and conservation, utilization of gene pools in breeding programs; Access and ownership of PGR-changing paradigms and their implications. Chromosome manipulation, induced mutations, polyploidy, somatic hybridization, somaclonal variation, novel sources of variation**;** molecular markers and construction of linkage maps; QTL mapping; map-based cloning, synteny, MAS (marker assisted selection), tagging of agronomically important traits.
UNIT-5- *18Hours*	**Unit-5-**.**Plant genome and crop improvement**: Cytogenetics and its role in evolution and improvement of crops such as wheat, maize, sugarcane, *Brassica* etc.; location and mapping of genes on chromosomes, molecular cytogenetics. Genome analysis – modern approaches, biochemical and molecular tools for the analysis of plant genome including protein and DNA based techniques; structural and functional genomics in relation to crop improvement. **World food demand vis-à-vis availability**: Food availability – International and Indian scenario, national and international agencies for agricultural R&D, green revolution, IPR and post-CBD changing paradigms.
SUGGESTED READINGS	1. Acquaah G (2007). Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. USA. 2. Allard RW (1999). Principles of Plant Breeding (2nd Edition), John Wiley and Sons, ISBN 0471023094, 9780471023098. 3. Hartl and Jones (2007). Genetics – Analysis of Genes and Genomes, 7th edition, Jones and Barlett publishers. 4. Hartwell, Hood, Goldberg, Reynolds, Silver, Veris (2006). Genetics – From Genes to Genomes, 3rd edition, McGraw Hill. 5. Lewin B (2008). Genes IX, Jones and Barlett Publishers, ISBN-10: 0763740632. 6. Ram J. Singh (2002). Plant Cytogenetics, 2nd edition, CRC Press. 7. Simmonds (1995). Evolution of Crop Plants (2nd Edition) Longman. 8. Strickberger (2008). Genetics, 3rd Edition, Pearson (Prentice Hall).

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBTD02			**COURSE TYPE: ECC/CB**
COURSE TITLE: **AGRICULTURAL ECOLOGY – PRINCIPLES AND APPLICATIONS**			
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**-Soil type and classification; soil properties and environmental factors; Nitrogen in agroecosystems; fertilizer elements in the environment; Macro and micronutrients and their availability to crops; Decomposition: beneficial soil organisms; Plant succession and competition.
UNIT-2- *18Hours*	**Unit-2-**Weed ecology and management; Distribution and sampling of agricultural pests; introduction to insects; Population dynamics; pesticides and the environment; Traditional knowledge systems and agrodiversity management;
UNIT-3- *18 Hours*	**Unit-3-** Plant disease and environment; integrated pest management; plant-parasitic nematodes; Host plant resistance and conservation of genetic resources; Cropping systems and agro-ecosystems in the landscape;
UNIT-4- *18Hours*	**Unit-4-**crop rotation and cover crops; Intercropping; conservation tillage; Mulches and organic amendments; Dry-land agriculture, irrigation and salinity;
UNIT-5- *18Hours*	**Unit-5-**.Tropical agro-ecosystems; intensive agriculture; Impact of GMOs on crop biodiversity and agroecology; Impact of agricultural policies on crop biodiversity and agroecology; Human population growth; sustainable agriculture; Agroecology: the future perspective.
SUGGESTED READINGS	1. Gliesmann, S.R. (2006). Agroecology: The Ecology of Sustainable Food Systems. Technology & Engineering. 2. Gliesmann, S.R. (2006). Field and Laboratory Investigations in Agroecology. Technology & Engineering. 3. Paul A. Wojtkowski, P.A. (2004). Landscape agroecology, Haworth Press, Inc., New York. 330 pp. 4. Warner, K.D. (2007). Agroecology in Action: Extending Alternative Agriculture Through Social Networks. The MIT Press, Cambridge, Massachusetts, USA, 291 pp.

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBTD03			**COURSE TYPE: ECC/CB**
COURSE TITLE: **ADVANCED PLANT SYSTEMATICS**			
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-Plant systematics:** The Components of systematics, Major objectives of systematics; Relevance to society and science. **Taxonomic History:** Natural systems to cladistics: Natural systems; Phyletic systems; Phenetics; Cladistics.
UNIT-2- *18Hours*	**Unit-2- Botanical Nomenclature:** Kinds of names; International Code of Botanical Nomenclature, Names according to rank; Citation of authors; Priority; Type method; Naming a new species; Legitimacy; Synonyms
UNIT-3- *18 Hours*	**Unit-3- Classification:** The components of classification; Characters and their states; Sources of characters; Evaluation of characters. **Systematic evidence:** Morphology, Anatomy and ultrastructure; Embryology; Palynology; Cytology; Phytochemistry.
UNIT-4- *18Hours*	**Unit-4- Molecular Systematics:** Plant genomes: nuclear, mitochondrial, chloroplast; Molecular markers; Generating molecular data: restriction site mapping, gene sequencing; Analysis of molecular data: alignment of sequences, methods of phylogeny reconstruction. **Phylogenetics:** The nature of phylogeny; How we depict phylogeny?; The importance of homology, Polarizing characters of homology; Rooting Trees; The problem of homoplasy.
UNIT-5- *18Hours*	**Unit-5-**. **The plant systematics community:** Professional organizations; Work environment; Activities; The role of field studies; The role of the herbarium. **Introduction to the angiosperms:** General characteristics; Evolutionary history; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids.

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. Crawford, D.J. 2003. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK. 3. Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia University Press, New York. 4. Judd, W.S., C.S. Campbell, E.A. Kellogg, P.F.Stevens and M.J. Donoghue 2002. Plant Systematics: A phylogenetic Approach. Sinauer Associates, Inc., Massachusetts. 5. Maheshwari, J.K. 1963. The Flora of Delhi, CSIR, New Delhi. 6. Nei, M. and S. Kumar 2000. Molecular Evolution and Phylogenetics. Oxford University Press, New York. 7. Radford, A. E., W.C. Dickison, J.R. Massey and C.R. Bell 1974. Vascular Plant Systematics. Harper and Row, New York. 8. Semple, C. and M.A. Steel 2003. Phylogenetics. Oxford University Press, Oxford. 9. Simpson, M.G. 2006. Plant Systematics. Elsevier, Amsterdam. 10. Stuessy, T.F. 2009. Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York.

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBTD04			**COURSE TYPE: ECC/CB**
COURSE TITLE: **CONTEMPORARY CONCEPTS AND METHODS IN CELL BIOLOGY**			
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-Infective particles and life forms**: prions, viroids, origin and evolution of various life forms, cell theory vs. cell body concept, multicellularity vs. supracellularity. **Cell Wall**: temporal and spatial dynamism in structure, structural and functional roles, *in planta* and *ex planta* uses, cell wall biotechnology
UNIT-2- *18Hours*	**Unit-2-Biological membranes**: from PLP model to Dynamically Structured Mosaic Model, transport through membranes, membranes as sites and routes of intra- and inter-organism and environment interactions **Cytoplasmic components**: Endomembranes, organellar architecture, protein sorting and vesicular traffic
UNIT-3- *18 Hours*	**Unit-3- Biopolymers**: Structural and functional aspects of cytoskeleton and associated motor molecules, their role in cell organization and movement, interaction among cytoskeletal elements, genomics, proteomics and bioinformatics of plant cytoskeleton; cytoskeleton in agrobiotechnology
UNIT-4- *18Hours*	**Unit-4-Nucleus**: detailed structure of nuclear pore complex and nuclear lamina, nuclear transport; chromatin subunit structure: from DNA to metaphase chromosome, histone code, states of chromatin during replication and transcription, heterochromatization as a method of gene regulation **Cell turnover**: cell division, cell cycle controls, breakdown of cell cycle control: cancer vs. Plant tumors, programmed cell death.
UNIT-5- *18Hours*	**Unit-5-.Cells to tissues**: Cell polarity, cell fate determination, integration of plant cells in tissues. **Introduction to methods in plant cell biology**: optical and electron microscopy, fluorescent probes, flow cytometry, transient expression, microinjection and micromanipulation, electrophysiological methods, plant histology, immunocytochemistry, *in situ* hybridization, cell fractionation and organelle isolation .

SUGGESTED READINGS

Books:

1. Alberts B, Johnson A, Lewis J, Raff Martin, Roberts K and Walter P. (2007). MolecularBiology of the Cell. Garland Publ., New York.
2. Bonifacino JS, Dasso M, Harford JB, Liipincott-Schwartz J and Yamada KM. (2004). ShortProtocols in Cell Biology. John Wiley & Sons, New Jersey.
3. Bregman AA. (1987). Laboratory Investigations in Cell Biology. John Wiley & Sons, NewYork.
4. Buchanan et al. 2002. Biochemistry & Molecular Biology of Plants 1st edition, AmericanSociety of Plant Physiologists: Chapter 4, pp. 160-201 & Chapter 5, pp. 202-256.
5. Hawes C and Satiat-Jeunemaitre B. (2001). Plant Cell Biology: Practical Approach. Oxford University Press, Oxford.
6. Karp G. (2008). Cell and Molecular Biology: Concepts and Experiments. John Wiley &Sons.
7. Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H and MatsudaireP (2008). Molecular Cell Biology. WH Freeman & Co., New York.
8. Ruzin SE (1999). Plant Microtechnique and Microscopy. Oxford Univ. Press, Oxford.
9. Wischnitzer S. (1989). Introduction to Electron Microscopy. Pergamon Press, New York.

Research papers / Reviews:

1. Aguzzi, A. et al. (2007) Molecular mechanisms of prion pathogenesis. Ann. Rev. Path.:Mech. Dis. 3: 11-40.
2. Baluska F. et al. (2004) Eukaryotic cells and *cell bodies:* cell theory revised. Ann. Bot. 94:9-32.
3. Boxma, B. et al. (2005) An anerobicmitochondtion that produces hydrogen. Nature 434:74-79.
4. Delwiche CF (1999). Tracing the thread of plastid diversity through tapestry of life. Amer.Nat. 154:S164-177.
5. Dobson CM (2005). Structural biology: prying the prions. Nature 435: 747-749.
6. Gruenbaum Y. et al. (2003). The nuclear lamina and its functions in the nucleus. Int. Rev.Cytol. 226: 1-62.
7. Meagher, B. et al. (1999) "The evolution of new structures: clues from plant cytoskeletalgenes. TIG, 15:7, 278-284.
8. Moerschbacher B. (2002). The plant cell wall – structural aspects and biotechnologoicaldevelopments. Pp. 445-477. In: Oksman-Caldentey, K-M. andBarz, W.H. PlantBiotechnology and Transgenic Plants. Marcel Dekker, Inc. New York.
9. Raven JA and Allen JF (2003). Genomics and chloroplast evolution: what did cyanobacteria do for plants? Genome Biol. 4(3): Art No. 209.
10. Rose A. et al. (2003). The plant nuclear envelope. Planta. 218: 327-336.
11. Smith and Raikhel (1999). Protein targeting to the nuclear pore: what can we learn fromplants?" Plant Physiol. 119:1157-1163.
12. van der Giezen et al. (2005) "Mitochondrion-derived organelles in protists and fungi". Int.Rev. Cytol. 244:175-225.
13. Vereb, G. et al. (2003) Dynamic, yet structured: the cell membrane three decades after theSinger-Nicolson model. Proc. Nat. Acad. Sci. USA 100: 8053-8058.
14. Wasteneys GO and Yang Z (2004) New views on plant cytoskeleton. Plant Physiol. 136:3884-3891.

M.Sc (BOTANY)			**IVTH SEMESTER**
COURSE CODE: MBTD05			**COURSE TYPE: ECC/CB**
COURSE TITLE: **PLANT PHYSIOLOGY AND BIOCHEMISTRY**			
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-Stress physiology**: Plant responses to abiotic stresses, mechanisms of abiotic stress tolerance, water deficit and drought tolerance, salinity stress, metal toxicity, freezing and heat stress. **Oxidative and nitrosative stress and antioxidative strategies**: Nitrosative and oxidative stress - causes and effects, nitric oxide biosynthesis and metabolism, NO mediated signaling, markers of nitrosative stress, NO crosstalk with other hormones, antioxidant mechanisms.
UNIT-2- *18Hours*	**Unit-2-Secondary metabolites and their biotechnological aspects**: Natural products (secondary metabolites), their range and ecophysiological functions. Overview of terpenoidal, alkaloidal, and phenolic metabolites and their biosynthesis. Molecular approaches and biotechnological applications. Metabolic engineering in the production of pharmaceuticals.
UNIT-3- *18 Hours*	**Unit-3- Physiology of seed development, maturation, dormancy and germination**: Hormonal regulation of seed development, events associated with seed maturation, factors regulating seed dormancy, mechanisms of mobilization of food reserves during seed germination. **Fruit development and ripening**: Stages of fruit development and their regulation, biochemical and related events during fruit ripening in chimacteric and non-climacteric fruits, physiology and biochemistry of fruit abscission, post-harvest changes, production of transgenic fruits.
UNIT-4- *18Hours*	**Unit-4-Programmed cell death (PCD)**: Concept of PCD and its types in plants during vegetative and reproductive stages. Developmental and stress-induced PCD. Plant senescence and its characteristics. Leaf and flower senescence. Altered metabolism during senescence and its regulation. The oxidative stress and the anti-oxidative strategies. Hormonal modulations. Environmental, genetic and molecular regulations.
UNIT-5- *18Hours*	**Unit-5-. Sensory physiology**: Biochemical and biophysical mechanisms of sense of touch, 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. **Chemical defence**: Biochemical mechanisms of plants' chemical war against other plants and animals. Plant responses to herbivory; constitutive defence mechanisms; induced phytochemical responses; biochemical mechanisms of allelopathty.
SUGGESTED READINGS	Journals: Annual Review of Plant Biology, Critical Reviews in Plant Science, Current Opinion in Plant Biology, Trends in Plant Science.