FACULTY OF LIFE SCIENCES

SYLLABUS

Of

Botany For

Master of Science (Botany)

Semester (III – IV)

(Under Continuous Evaluation System)

Session: 2022-23

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR (Autonomous)

Kanya Maha Vidyalaya, Jalandhar

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

Master of Science (Botany) Semester-III
Session: 2022-23

Course Code	Course Type	Course Title	Hours/ week	Marks				Examination time (in Hours)
				Total	Ext.		CA	
					L	P		
MBTL-3071	C	Developmental Botany	3	50	40	-	10	3
MBTL-3072	C	Plant Molecular Biology	3	50	40	-	10	3
MBTL-3073	C	Plant Breeding and IPR	3	50	40	-	10	3
MBTL-3074	C	Plant Biochemistry	3	50	40	-	10	3
MBTL-3075	C	Applied Botany	3	50	40	-	10	3
MBTL-3076	C	Plant Morphogenesis	3	50	40		10	3
MBTP-3077	C	Botany Practicals I	6	75	-	60	15	3
MBTP-3078	C	Botany Practicals II	6	75	-	60	15	3
		Total		**450**				

Kanya Maha Vidyalaya, Jalandhar

SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO-YEAR DEGREE PROGRAMME

Master of Science (Botany) Semester -IV
Session: 2022-23

Course Code	Course Type	Course Title	Hours /week	Marks				Examination time (in Hours)
				Total	Ext.		CA	
					L	P		
MBTL-4071	C	Plant Anatomy	3	50	40	-	10	3
MBTL-4072	C	Structure and Metabolism of Plant Hormones	3	50	40	-	10	3
MBTL-4073	C	Plant Tissue Culture and Biotechnology	3	50	40	-	10	3
MBTL-4074	C	Analytical Techniques	3	50	40	-	10	3
MBTL-4075	C	Diversity and Biology of Angiosperms	3	50	40	-	10	3
MBTL-4076(Opt-A)	C	Hazardous Chemicals (Optional Paper)	3	50	40		10	3
MBTL-4076(Opt-B)	C	Immunology (Optional Paper)	3	50	40		10	3
MBTP-4077	C	Botany Practicals I	6	75	-	60	15	3
MBTP-4078	C	Botany Practicals II	4	75	-	60	15	3
MBTF-4079	C	Field Study	Satisfactory/ Not Satisfactory					
MBTD-4070	C	Research Techniques	3	Satisfactory/ Not Satisfactory				
		Total		**450**				

Student can opt only one paper from the two optional papers (i) MBTL-4076(Opt-A) and (ii) MBTL-4076(Opt-B)

Semester - III

Master of Science (Botany) Semester-III
(Session: 2022-23)
Developmental Botany
MBTL-3071

Course outcomes:

After passing this course the student will be able to:

CO1: Compare the function and morphology of pollen grains.

CO2: Understand various aspects related to fertilization and endosperm development.

CO3: Understand different aspects of embryo development.

CO4: Understand role of Embryology in Taxonomy and Plant Breeding.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Developmental Botany
MBTL-3071

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

Pollination:
Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods of overcoming
incompatibilities, intra-ovarian pollination, in vitro pollination.

Unit-II

Fertilization:
Heterospermy, differential behaviour of male gametes, discharge and movement of sperms, syngamy and triple fusion, post fertilization metabolic and structural changes in embryo sac.
Endosperm:
Types, ultrastructure, cellularization in nuclear endosperm, endosperm haustoria, their extension and persistence, function, storage, metabolites, endosperm culture.

Unit-III

Embryo:
Polarization of zygote, embryogenic types, histology and organogenesis of dicotembryos, organelles (undifferentiated) embryos, delayed and differentiation of embryo, structure, cytology and function of suspensor, physiological and morphogenetical relationship of endosperm and embryo, embryo culture for rescue of hybrid embryo. Polyembryony: Types, genetic and somatic, pollen embryos.
Apomixis:
Apospory, Parthenogenetic Development of Embryo, Importance. Seed: Growth and Development, Seed Appendages.

Master of Science (Botany) Semester-III
(Session: 2022-23)

Unit-IV

Embryology & Taxonomy:
Diagnostic embryological characters, Primitive and advanced characters, Role of embryology and palynology in taxonomy.
Role of Embryology in Plant Breeding:
Embryology of hybrids, disfunction of endosperm, arrested development of embryo.

Books Recommended

1. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms.Vikas Publishing House Pvt. Ltd, Delhi.
2. Dafni, A., Hesse, M., and Pacini, E. (2012). Pollen and pollination. Springer Science & Business Media.
3. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co.Ltd. Bombay.
4. Grossniklaus. U. (2019). Plant Development and Evolution. Academic Press
5. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd. Bombay – New Delhi.
6. Parihar NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II – Pteridophyta, Central Book Dept. Allahabad.
7. Raghavan, V. (2012). Developmental biology of flowering plants. Springer Science & Business Media.
8. Raghavan, V. (1997). Molecular embryology of flowering plants. Cambridge University Press.
9. Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publisher
10. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.
11. Timmermans M. C.P. (2010). Plant Development. Academic press.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Molecular Biology
MBTL – 3072

Course outcomes:

After passing this course the student will be able to:

CO1: Gain knowledge about RNA processing and DNA sequencing.

CO2: Understand different techniques related to molecular biology.

CO3: Understand the structures and purposes of Cloning Vehicles.

CO4: Gain knowledge about genetic cloning and genomics & proteomic techniques.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Molecular Biology
MBTL – 3072

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

The Law of DNA constancy and C-value paradox, DNA sequencing. Organization of transcriptional units; mechanism of transcription of prokaryotes and eukaryotes; RNA processing (capping polyadenylation, splicing, introns and exons); ribonucleo–proteins, structure of mRNA.

Unit-II

Recombinant DNA technology, host cell restriction, restriction endonucleases, DNA ligases, topoisomerases, gyrases and methylases. Cloning strategies, selection and screening of recombinant clones, genomic DNA and cDNA libraries, biological and physical containment of recombinant DNA clones. Agarose gel electrophoresis, Southern/Northern/ Western blotting.

Unit-III

Cloning vehicles, plasmids, bacteriophages, viruses, cosmids, Ti-plasmid, CaMv plasmid, construction of plasmid vectors, M13 vectors, their use in cloning and sequencing, expression vectors, lysogeny and lytic cycles in bacteriophages.

Unit-IV

Genetic colonization of plants by Agrobacterium infection and tumour growth, Ti – plasmids, neoplastic transformation of plant cells, organization of T-DNA, nucleotide sequences of T-DNA. PCR, DNA fingerprinting by RAPDs and RFLPs.

Genomics and proteomics: Genetics and physical mapping of genes, molecular markers for transgenic plants, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Master of Science (Botany) Semester-III
(Session: 2022-23)

Books Recommended

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNATechnology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley &Sons. Inc.
5. Sambrook J &Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
6. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
7. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008)
8. Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Breeding and IPR
MBTL –3073

Course outcomes:

After passing this course the student will be able to:
CO1: Understand sources and types of genetic variation and explain their importance for plant improvement.

CO2: Understand historical evolution of plant breeding and different centers of origin.

CO3: Describe methods that are used in plant breeding.

CO4: Understand IPR (Intellectual property right)

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Breeding and IPR
MBTL –3073

Max. Marks- 50
Time: 3 hrs **Theory - 40**
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

Primary and secondary centres of diversity, utilization of wild plants in crop improvement, introduction and domestication as methods of plant breeding.
Types and introduction, vegetative sexual and apomictic, their effects on generating and fixing genotypic variation, male sterility and self-incompatibility mechanisms.

Unit-II

Breeding systems of crop species; systems of mating in sexually reproducing species and their genetic consequences. Breeding methods for self- and cross-pollinated crops; pureline and mass selection, recurrent selection and clonal selection.
Hybridization in self- and cross-pollinated crops. Inbreeding depression and hybrid vigor, genetic and physiological basis of heterosis, hybrid varieties, synthetic and composite varieties.

Unit-III

Breeding for disease resistance, classification of resistance, responses of the host to pathogens, variability systems of pathogenic fungi, breeding disease resistant varieties; multiline varieties.
Heritability, genetic advance, correlation of characters, path analysis, multiple comparison test, discriminant function and cluster analysis.

Unit-IV

Mutations, aneuploidy and polyploidy as methods of plant improvement, interspecific and intergeneric hybrids, role of genetic engineering.
Intellectual Property Rights: (IPR/TRIPS), International Intellectual Property System; Plant Variety Protection; the regular patent systems, trade secrecy, biosafety; laws and conventions related to intellectual property rights.

Master of Science (Botany) Semester-III
(Session: 2022-23)

Books Recommended

1. Agrawal, R.L. (1998). Fundamentals of Plant Breeding and Hybrid Seed Production Oxford and IBM Publ. Co. Pvt. Ltd., New Delhi.
2. Allard, R. W. (1981), Principles of Plant Breeding. John Wiley & Sons, N. York.
3. Anonymous (1997). National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
4. Bhandari, M.M. (1974). Practicals in Plant Breeding. A Manual cum practical record. Oxford and IBH Publ. Co. New Delhi.
5. Chopra, V.L. (Ed.) (2018). Plant Breeding: Theory and Practice. Oxfordand IBH Publ. Co. Pvt. Ltd., New Delhi.
6. Gupta SK. 2005. Practical Plant Breeding. Agribios
7. Poehlman, J.M. and Sleper, D.A. (1995). Breeding Field Crops (4th Edition) Panima Publishing Corporation, New Delhi.
8. Priyadarshan, P.M. (2019). Plant Breeding: Classical to Modern. Springer Singapore
9. Raghuvanshi, R.K., Chauhan, A.K.S and Sidhigui, B.A. (1995). Practical Excercises in Cytology, Genetics, Plant Breeding and Biostatistics (1st Edition). CBS Publishers and Distributors, New Delhi.
10. Roy Darbeshwar (2000). Plant Breeding - Analysis and Exploitation of Variation.Narosa Publishing House, New Delhi.
11. Sharma A.K. and Sharma A. (1999). Plant Breeding. Lecture Notes on Patents November 1999). Technology Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology (DST), Technology Bhavan, New Mehrouli Road, New Delhi.
12. Sharma, J.R. (1994). Principles and Practice of Plant Breeding, Tata McGraw Hill Publ.Comp. Ltd., New Delhi.
13. Singh, B.D. (2005), Plant Breeding - Principles and Methods, KalyaniPublishers,Ludhiana.
14. Singh, S.andPawar, I. S. 2006. Genetic Bases and Methods of Plant Breeding. CBS Publishers & Distributors
15. Stoskopf, N. C., Tomes, D. T., Christie, B. R., & Christie, B. R. (2019). Plant breeding: theory and practice. CRC Press.
16. Sundararaj, D.D. and Tulsidas G. (1993). Botany of Field Crops (2nd Edition), MacMillan India Ltd., New Delhi.
17. Vijendra Das L.D (1998). Plant Breeding. New Age International Publishers, New Delhi.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Biochemistry
MBTL – 3074

Course outcomes:

After passing this course the student will be able to:

CO1: Understand cellular chemistry and interactions.

CO2: Understand structure, metabolism of carbohydrates.

CO3: Describe structure, functions and metabolism of Lipids.

CO4: Understand kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory processes.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Biochemistry
MBTL – 3074

Max. Marks- 50
Time: 3 hrs **Theory - 40**
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

Cellular Chemistry: Covalent and non-covalent interactions, hydrogen bond, electrostatic interactions, hydrophobic interactions, Van der Walls forces and their significance, structure and properties of water and its biological significance, pH and its significance, pH scale, Handerson-Haselbach equation, buffers (inorganic and organic) and their importance, ATP-the energy currency, phosphorylation / dephosphorylation of proteins.

Unit-II

Metabolism of Carbohydrates: Overview of intermediary metabolism, carbohydrates and lipids of physiologic significance, glycolysis and oxidation of pyruvate, citric acid cycle, catabolism of acetyl- CoA, metabolism of glycogen, gluconeogenesis and control of the blood glucose, pentose phosphate pathway and other pathways of hexose metabolism like uronic acid fructose metabolism pathways.

Unit-III

Lipid Metabolism: Biosynthesis of fatty acids, oxidation of fatty acids, ketogenesis, metabolism of fatty acids, ketogenesis, metabolism of acylglycerols and sphingolipids, lipid transport and storage, cholesterol, synthesis, transport and excretion, integration of metabolism and provision of tissue fuels.

Unit-IV

Enzymology: Introduction to enzymology, history of enzymes, nomenclature and classification.
Specificity of enzymes: group specificity, absolute specificity, stereochemical specificity. Mechanism of enzyme catalysis: Activation energy, Nature of active sites, enzyme-substrate complex, induced fit hypothesis, strain and distortion theory.
Enzyme Kinetics: Michaelis-Menton Equation, Lineweaver-Burk plot. Regulation of enzyme activity and concentration: Brief account of enzyme induction and repression, covalent modification, isoenzymes and allosteric enzymes

Master of Science (Botany) Semester-III
(Session: 2022-23)

Books Recommended

1. Bowsher, C., Steer, M., & Tobin, A. (2008). Plant biochemistry. Garland Science.
2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants. John Wiley & Sons.
3. Heldt, H. W., andPiechulla, B. (2010). Plant biochemistry. Academic Press.
4. Lubert, S., Berg, J., Tymoczko, J, andGatto, G. (2019). Biochemistry, ninth edition.Macmillan Publishers.
5. Murray, R. K., Granner, D. K., Mayes, P. A., and Rodwell, V. W. (2014). Harper's illustrated biochemistry. Mcgraw-hill.
6. Nelson, D. L., Lehninger, A. L., and Cox, M. M. (2017). Lehninger principles of biochemistry. Seventh Edition. Macmillan.
7. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Principles of biochemistry, 5th Edition, Global Edition. John Wiley & Sons.
8. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry: life at the molecular level. John Wiley & Sons.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Applied Botany
MBTL – 3075

Course outcomes:

After passing this course the student will be able to:

CO1: Demonstrate knowledge of the value of plants in our everyday lives.

CO2: Understand commercial use of different forest products.

CO3: Describe various industrial plant products.

CO4: Understand chemical processing of different products in Applied Botany.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Applied Botany
MBTL – 3075

Max. Marks- 50
Time: 3 hrs **Theory – 40**
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

Food Plants: History and nature of food plants, major and minor cereals, legumes and pulses, vegetables, fruits and nuts. Extraction of sugar from sugarcane. Flow diagram of the process with a critical study of the steps involved, problems faced by the sugar industry in India. By-products of sugar industry, distillation of alcohol and other products with special reference to distilleries in Punjab. Food adjuncts: Spices condiments and other flavoring agents, beverages, fumitory and masticatory materials; functional foods.

Unit-II

Forest Products: Wood & Oak. Physical characteristics of Indian woods, methods of seasoning and chemical treatment of specialized use, fireproofing of the wood. Industrial manufacturing of packing material and plywood and the classifications of plywoods according to their use. Some important commercial woods: *Dalbergia spp., Shorea robusta, Tectona grandis, Cedrus deodara*, Bamboo-the 'greengold' of India.

Unit-III

Industrial Plant Products: Essential oil yielding plants of India, their use in perfumery, vegetable oils, fats and waxes, starches and other cellulose products. Manufacturing of paper and board from raw plant material. Manufacturing of crude and high-quality paper, recycled paper; bio fuel producing plants.

Fibres: Different types of fibre yielding plants, classification of fibres, physical and chemical processes involved in the manufacturing of fibre.

Unit-IV

Rubber and Latex Products: The Rubber Plants of India, latex yielding plants, Extraction of Raw Rubber and its Chemical Processing for the Manufacturing of Finished Rubber. Sources of gums and resins and their classifications according to their chemical nature. Extraction of the raw resin and down the line processing for terpentine and other products. Sources of natural dyes and tannins in India and their extraction methods, merits and limitations of plant-based dyes.

Master of Science (Botany) Semester-III
(Session: 2022-23)

Books Recommended

1. Ambasta, S. P. (1994). The Useful Plants of India (3rd Ed.). Publications & Information Directorate, New Delhi.
2. Brown, H. P. (1989). An Elementary Manual on Indian Wood Technology (Reprinted). International Book Distributors, Dehra Dun, India.
3. Joshi, S. G. (2000). Medicinal Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Kochhar, S. L. (1998). Economic Botany in the Tropics. MacMillan India Limited, Delhi.
5. Pandey, B. P. (1984). Economic Botany (3rd Ed.). S. Chand & Company Ltd., New Delhi.
6. Seidemann, J. (2005). World spice plants: economic usage, botany, taxonomy. Springer Science & Business Media.
7. Trotter, H. (1982). The Common Commercial Timbers of India and Their Uses. The Controller of Publications, Delhi.
8. Wickens, G.E. (2004) Economic Botany: Principles and Practices, Springer, ISBN 978-0-7923-6781-9.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Morphogenesis
MBTL – 3076

Course outcomes:

After passing this course the student will be able to:

CO1: Learn about morphogenesis and organogenesis in plants.

CO2: Understand differentiation in plants.

CO3: Describe plant regeneration processes and tissue relationships.

CO4: Understand different factors affecting plant morphogenesis.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Plant Morphogenesis
MBTL – 3076

Max. Marks- 50

Time: 3 hrs **Theory - 40**

CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

Unit-I

Correlation: Physiological and genetic correlations.
Polarity: Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes, physiological manifestations of polarity, developmental patterns.

Unit-II

Symmetry: Inorganic and organic symmetries, radial symmetry bilateral symmetry, dorsi-ventral symmetry, development of symmetry.
Differentiation: Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.

Unit-III

Regeneration: Regeneration in lower plants, regeneration in higher plants, reconstitution, restoration, reproductive regeneration.
Tissue Mixtures: Stock – scion interrelations, chimeras, somatic mutations.

Unit-IV

Abnormal Growth: Abnormal development of organs, production of new types of organized structures, amorphous structures.
Morphogenetic Factors: Introduction to factors-light, water temperature, physical factors, genetic factors and chemical factors in general.

Master of Science (Botany) Semester-III
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Books Recommended

1. Ainsworth C (2006) Flowering and its Manipulation, Annual Plant Reviews, Vol. 20. Blackwell Publishing, Oxford, U.K. 2. Brown TA. (2002) Genomes, BIOS Scientific Publishers Ltd, Oxford, UK.
2. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.
3. Davies, J. (2013). Mechanisms of morphogenesis. Academic Press.
4. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.
5. Lyndon, R. F. (2012). Plant development: the cellular basis (Vol. 3). Springer Science & Business Media.
6. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms.
7. Raghavan, V. (1997). Molecular embryology of flowering plants. Cambridge University Press.
8. Raghavan, V. (2012). Developmental biology of flowering plants. Springer Science & Business Media.
9. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.
10. Wardlaw, C. W. (1952). Morphogenesis in plants. London: Methuen.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Botany Practicals I
MBTP-3077

(Based on MBTL-3071, MBTL-3072 and MBTL-3073)

Course Outcomes:

After passing this course the student will be able to:

CO1: Perform immobilization of enzymes.

CO2: Wide application of enzymes and their future potential.

CO3: Perform different experiments based on plant pollination.

CO4: Understand embryology of dicot and monocot plants.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Practical-I
MBTP-3077
(Based on MBTL-3071, MBTL-3072 and MBTL-3073)

Max. Marks- 75
Time: 6 hrs **Practical – 60**
CA – 15

Instructions for the Paper Setters: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Suggested Practical's from MBTL-3071

1. Examination of the following with the help of hand sections, dissections and prepared longitudinal, transaction of Flowers: Transmitting tissue/canal in the stigma and style, Various types of flowers and placentation, Special types of flowers with emphasis on vasculature of androecium and gynoecium.
2. Study from permanent preparations, development and structure of anther, pollen, ovules, megasporogensis, embryo sac, endosperm and embryo.
3. Study of microsporogensis and gametogenesis in sections of anther.
4. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescentia, Brassica, Petunia*, *Solanum melongena).*
5. Test for pollen viability using strain and in vitro pollination. Pollen germination using hanging drops, sitting drop culture and suspension culture.
6. Estimating percentage and average pollen tube length in vitro.
7. Field study of several types of flowers with different pollination mechanisms (wind, insects, bird pollination)

Suggested Practical's from MBTL-3072

1. Identification of the parts of bright- field microscope and demonstration of its use and care.
2. Perform basic microbiological techniques such as sterile plating and isolation of single colonies.
3. Isolation of DNA from biological samples.
4. Characterization of isolated DNA using agarose gel electrophoresis.
5. Graph and analyze agarose gel data.
6. Genetic transformation of bacteria.
7. Screening and selection of transformants.
8. Demonstration of PCR technique.
9. Spectrophotometric estimation of DNA.
10. Demonstration of DNA sequencing technique.

Suggested Practical's from MBTL-3073

1. Floral biology in self- and cross-pollinated species,

2. Selfing and crossing techniques.
3. Numerical exercises on probability and biostatistics
4. Maintenance of experimental records;
5. Learning techniques in hybrid seed production
6. To study Breeders kit.
7. Studies on centres of origin of various useful crops.
8. To study Vegetative Propagation in – Potato, Onion bulb, Sugarcane, Ginger.
9. To perform exploration for determination of male sterility.
10. To perform Field exploration for determination of Dichogamy, Heterostyly and Dioecy.
11. To estimate Pollen viability in *Zea mays* and *Hibiscus*.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Botany Practicals II
MBTP-3078
(Based on MBTL-3074, MBTL- 3075 and MBTL-3076)

Course outcomes:

After passing this course the student will be able to:

CO1: Understand concept of gene, gene cistron relationship in prokaryotes and eukaryotes.

CO2: Understand types of DNA damage, DNA repair pathways.

CO3: Exhibit clear and concise communication of scientific data.

CO4: Understand different techniques related to molecular biology.

Master of Science (Botany) Semester-III
(Session: 2022-23)
Botany Practicals II
MBTP-3078
(Based on MBTL-3074, MBTL- 3075 and MBTL-3076)

Max. Marks- 75
Time: 6 hrs **Practical - 60**
CA – 15

Instructions for the Paper Setters: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Suggested Practical's based on MBTL-3074

1. Preparation of the solutions of different concentrations. Preparation of the inorganic and organic buffers of different conc. and pH.
2. Preparation of the standard curve of protein and determine the protein content in unknown samples by Lowry's method.
3. Estimation of the protein content in given plant sample by Bradford's method
4. Estimation of the protein content in given plant sample by Biuret's method
5. Estimation of the carbohydrates in given plant sample Anthrone's reagent.
6. Estimation of the carbohydrates in given plant sample Dubois's method
7. Estimation of the activity of enzyme catalase
8. Estimation of the activity of enzyme peroxidase.
9. Preparation of the standard curve of proline and determine the proline content in unknown samples by Bates's method.
10. SDS-PAGE for soluble proteins extracted from the given plant material and comparison of their profile by staining with Coomassie brilliant blue.

Suggested Practical's based on MBTL-3075

To study economic importance, distribution, centres of origin of following specimens:

1. Study of morphology and microchemical tests for stored food material for cereals: Wheat
   (*Triticum aestivum),* Rice (*Oryza sativa),* Maize *(Zea mays)*
2. Study of morphology and microscopic study of fibres: Cotton (*Gossypium sp.),* Jute (*Corchorus capsularis*), Flax (*Linum usitatissimum)* Sugar yielding plant: Sugarcane (*Saccharum officinarum)*
3. Study of morphology of oil yielding plants: Groundnut (*Arachis hypogea*), Mustard (*Brassica sp),* Coconut (*Cocos nucifera*), Castor (*Ricinus communis),* Soyabean (*Glycine max)* and performing tests for oil.
4. Study of morphology and alkaloid present in spices: Ginger (*Zingiber officinale),* Turmeric (*Curcuma longa),* Coriander (*Coriandrum sativum),* Clove (*Eugenia aromaticum*), Black Pepper (*Piper nigrum),* Cinnamon (*Cinnamomum zeylanicum*)
5. Study of morphology and medicinal value for medicinal plants: Amla (*Emblica officinalis),* Bahera (*Terminalia belerica),* Harhar (*Terminalia chibula),* Sarpagandha

(*Rauwolfia serpentine)*, Ashwgandha (*Withania somnifera*), Liquorice (*Glycyrrhiza glabra)*, Poppy (*Papaver somniferum*), Arjuna (*Terminalia arjuna)*

6. Study of morphology and nutrition value for pulses: Green Gram (*Phaseolus aureus)*, Black Gram (*Phaseolus mungo)*, Pigeon Pea (*Cajanas cajan)*, Kidney Bean *(Phaseolus vulgaris)*
7. Study of morphology of plants producing fruits Citrus (*Citrus sp)*, Apple (*Malus pumila)*, Mango (*Mangifera indica)*, Banana (*Musa sapientum)*, Pineapple (*Ananas comosus)*, Grapevine (*Vitis sp)*
8. Vegetables: Potato (*Solanum tuberosum*), Radish (*Rapahnus sativus*), Turnip (*Brassica rapa*)
9. Study of morphology of Beverages: Tea (*Thea sinensis*), Coffee (*Coffea arabica*) and knowledge of processing method.

Suggested Practical's based on MBTL-3076

1. Emasculation, bagging, hand pollination to study pollen germination, seed set and fruit development.
2. Study of cleistogamous flowers and their adaptations.
3. Study of nuclear and cellular endosperm through dissection and staining.
4. Isolation of zygotic globular, heart shaped, torpedo stage and mature embryos from suitable seed.
5. Study of seed dormancy and methods to break dormancy
6. Study the primitive and advanced characters of plants in angiosperms
7. Study various methods of asexual reproduction and vegetative reproduction
8. Study effects light, gravity, humidity temperature on plants
9. To study effect of bending on plant morphogenesis.

Semester - IV

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Plant Anatomy
MBTL –4071

Course outcomes:

After passing this course the student will be able to:

CO1: Compare anatomy of primary and secondary growth in roots as well as shoots.

CO2: Understand anatomy of different types of wood and their commercial utilization.

CO3: Understand floral, fruit and seed anatomy.

CO4: Understand anatomy of plant parts in relation to habitat.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Plant Anatomy
MBT L –4071

Max. Marks- 50
Time: 3 hrs **Theory - 40**
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

The Shoot and Root System: Primary structure and basic vasculature, the root-stem transition, secondary growth in stems and roots, the origin of cambium and its activity, anamalous secondary growth, polycyclic vasculature, secondary meristems, origin and function, the role of pericycle, phellogen, phellem, phelloderm, distribution of sclerenchyma in leaves, stem and roots.

Nodal Anatomy: Types of nodes in dicots and monocots, the node-internode transition, formation of leaf and branch traces.

UNIT-II

Histology of Wood: Growth rings, types and ultrastructure of tracheids, vessels and wood rays, longitudinal parenchyma and its arrangement, grain and texture, knots, formation of resin cavities and tyloses, anatomy and chemistry of lignification, physical and anatomical features of common hard and soft woods of India, importance of density and weight in commercial utilization of woods.

UNIT-III

Floral Anatomy: The anatomy of floral axis and the whorls, the leaf origin of carpel, evidences from anatomy of essential and accessory whorls.

Fruit and Seed Anatomy: Gross and ultrastructural surface features of the fruits and seeds, role

In taxonomy, internal anatomy of dicot and monocot seeds, organ and cellular anatomy of typical monocot and dicot seeds.

UNIT-IV

Laticifers and Lenticels: Types and distribution, anatomy in relation to physiological roles

Functional Anatomy: Anatomy of leaf in relation to photosynthesis and transpiration, modification of the root stem and leaf anatomy in relation to habit and habitat with special reference to aquatics, nitrogen fixers, xerophytes parasites and mycorrhizas.

Master of Science (Botany) Semester-IV
(Session: 2022-23)

Suggested Readings:

1. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
2. Crang R., Lyons-Sobaski S., & Wise R. (2018). Plant anatomy: a concept-based approach to the structure of seed plants. Springer.
3. Cutler DF, Botha CEJ, Stevenson DW (2007). Plant Anatomy - An Applied Approach, Blackwell Publishing, USA
4. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
5. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
6. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Structure and Metabolism of Plant Hormones
MBTL – 4072

Course outcomes:

After passing this course the student will be able to:

CO1: Understand the history and role of different types of plant hormones in growth and development of plants.

CO2: Understand the mechanism of common plant hormones, bioassays and their commercial use.

CO3: Understand biosynthesis, action and uses New class plant hormones.

CO4: Relate microbial association with the production of growth regulators.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Structure and Metabolism of Plant Hormones
MBTL – 4072

Time: 3 hrs **Max. Marks-50**

Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

General Features of Plant Hormones, their Analysis, and Quantitation: Discovery of auxin and other hormones, characteristics of plant hormones, hormone vs plant growth regulator, hormonal responses to a physiological state, bioassays, hormone extraction, analysis, and quantitation, determination of hormone synthetic pathways, regulation of hormone levels (hormonal homeostasis).

Auxins: Structure of auxins, physiological roles of IAA, IAA biosynthesis in higher plants, regulation of IAA levels (IAA homeostasis), inhibitors of IAA action, other naturally occuring auxins, synthetic auxins, structural diversity of auxins.

UNIT-II

Gibberellins: Discovery, structure of gibberellins (GAs) in higher plants, physiological roles of GAs in higher plants, terpenoid pathway, biosynthesis of GAs, regulation of GA levels in the plant, endogenous levels, why are there so many GAs?, other substances with GA-like activity.

Cytokinins: Discovery, biological functions and bioassays, structure of cytokinins, occurrence of cytokinins in the cytoplasm and as components of tRNA, relative distribution of natural cytokinins among plants, biosynthesis in higher plants, regulation of cytokinin levels, synthetic compounds with cytokinin like activity, cytokinin antagonists (anticytokinins).

UNIT-III

Brassinosteroids: Discovery, structure and distribution, physiological roles and bioassays, biosynthesis of brassinolide, synthesis mutants and their wild-type genes, inhibitors of brassinosteroid biosynthesis, brassinosteroid structure and biological activity regulation of castasterone and brassinolide levels.

Abscissic Acid: Discovery, structure and occurrence in plants and fungi, physiological roles of abscisic acid (ABA), biosynthesis of ABA, carotenoid and/or ABA synthesis, mutants, ABA synthesis inhibitiors, regulation of ABA levels.

Ethylene: Discovery as a hormone, structure, distribution, and internal concentrations, physiological roles and bioassays, biosynthesis in higher plants, ethylene synthesis mutants, regulation of ethylene levels in the plant, synthetic compounds that produce ethylene, inhibitors of ethylene action.

UNIT-IV

Jasmonates and other Defense-Related Compounds: Introduction, discovery, distribution, and
structure of jasmonates, physiological roles of jasmonates, biosynthesis of jasmonic acid (JA), JA synthesis mutants, JA synthesis inhibitors, regulation of endogenous levels of JA.

Microbial Synthesis of Plant Hormones: Microbial associations with plants, infection by *Agrobacterium*, tumor induction by *Pseudomonas*, microbial genes involved in IAA and CK biosynthesis, expression of bacterial genes in higher plants, biology of genetic transformation by *A. tumefaciens*, production of plant hormones by other microorganisms.

Suggested Readings:

1. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). *Biochemistry and molecular biology of plants*. John Wiley &Sons.American Society of Plant Physiologists, Maryland.
2. Davies, P. J. (Ed.). (2004). Plant hormones: biosynthesis, signal transduction, action! Springer Science & Business Media.
3. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism.Longman, Essex.
4. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, NewYork.
5. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.
6. Hopkins, W. G. (2007). Introduction to plant physiology 4th edition. John Wiley & Sons, Inc., NewYork.
7. Lodish, H., Berk, A., Zipursky, S.l., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). Molecular Cell Biology. W.H. Freeman and Company, New York.
8. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). Plant physiology and development, Sinauer Associates Inc

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Plant Tissue Culture and Biotechnology
MBTL – 4073

Course outcomes:

After passing this course the student will be able to:

CO1: Understand the concept of cytogenetics, differentiation in cell and tissue culture and mechanism, advantage and disadvantages of micro-propagation.

CO2: Understand the mechanism of production of disease resistant, herbicide resistant and pathogen free plants.

CO3: Describe the role of tissue culture in the production of different types of transgenic plants.

CO4: Explain role of plant tissue culture and biotechnology in different fields of human interest.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Plant Tissue Culture and Biotechnology
MBTL – 4073

Max. Marks- 50

Time: 3 hrs **Theory - 40**

CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

Introduction and Historical aspects of Tissue Culture, Micropropagation: Stages, Types, Cytogenetics and differentiation in cell and tissue culture, plant regeneration from callus, shoot apex culture and anthers. Somatic embryogenesis, usefulness, hardening of micropropagated plantlets, advantages and disadvantages, application of the technique in crop improvement.

UNIT-II

Somaclonal variations and isolation of useful mutants at cellular level, disease resistance, herbicide resistance and salt tolerance. Production of pathogen free plants through tissue culture. Production of artificial seeds, their use and application.

UNIT-III

Techniques for the production of transgenic plants: Concept, vector less transgenosis, gene targeting tools, crop improvement through transgenics, benefits and risk of producing transgenic plants, commercialization of transgenics. Cell culture and secondary metabolites like cinnamic acid, shikonin, flavonoids and related compounds production.

UNIT-IV

Cryobiology of plant cell cultures and establishment of plant banks, freeze preservation technology, factors influencing revival of frozen cells and future prospects. Terminator technology, verminator technology, apprehensions and challenges. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

Master of Science (Botany) Semester-IV
(Session: 2022-23)

Suggested Readings:

1. Bhojwani, SS and Dantu, PK (2013) Plant Tissue Culture: An introductory text, Springer
   Publications.
2. George, F.E., Hall, M., Klerk G. J (2008) Plant propagation by Tissue culture 3rd editionVolI, Springer Publications.
3. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
4. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, Butter Worths, London.
5. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, And Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
6. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Analytical Techniques
MBTL – 4074

Course outcomes:

After passing this course the student will be able to:

CO1: Understand working of different microscopes.

CO2: Understand the basics of the major analytic techniques including sample preparation, standardization and data analysis of each technique.

CO3: Understand working of different spectroscopic techniques.

CO4: Understand theory and practice of different blotting techniques.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Analytical Techniques
MBTL – 4074

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

Principles and application of light, phase contrast, fluorescence scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.

UNIT-II

Principles and applications of gel filtration, ion-exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid chromatography (HPLC), electrophoresis and electrofocussing, ultra-centrifugation (velocity and density gradient).

UNIT-III

Principles of biophysical methods used for analysis of biopolymeric structure, X-ray diffraction fluorescence UV/CD, visible Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) spectroscopy, hydrodynamic methods, Atomic absorption and plasma emission spectroscopy.

UNIT-IV

Principles and techniques of nucleic acid: hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and Western blotting techniques; Polymerase chain reaction.

Suggested Readings:

1. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology -Basic Experiments in Gene Manipulation.2nd Ed. Benjamin Publ. Co.
2. Principles of Electroanalytical Methods. John Wiley and Sons Ltd., Chichester England.
3. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold
4. Spring Harbor Lab. Press. Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley andSons Ltd., Chichester, England.
5. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
6. Wilson K. and Walker J. (Eds.) (2012). Practical Biochemistry: Principles and Techniques,Cambridge University Press, U.K. Riley, T. and Tomilson, C. (198)

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Diversity and Biology of Angiosperms
MBTL – 4075

Course outcomes:

After passing this course the student will be able to:

CO1: Learn about different systems of classification with their merits and demerits.

CO2: Understand principles of plant nomenclature, origin of angiosperms and phylogeny.

CO3: Understand the role of various fields of biology in plant taxonomy.

CO4: Understand the concept of taxonomic tools, aspects related to phytogeography and local plant diversity.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Diversity and Biology of Angiosperms
MBTL – 4075

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

Historical perspective of plant classification, phenetic versus phylogenetic system; cladistics in
taxonomy, relative merits and demerits of major system of classification, a study of hylogenetic system of classification after Engler & Prantl, Bessey, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne.

UNIT-II

Principles of plant nomenclature; salient features of the International code of Botanical Nomenclature, working knowledge of botanical latin, important herbaria of the World. Origin of angiosperms; interrelationships of dicots and monocots; Phylogeny of Ranales, Amentiferae, Centrospermae, Tubifilorae and Helobiales and their treatment in the modern systems of classification.

UNIT-III

Principles of plant taxonomy, alpha taxonomy vs modern taxonomy; chemotaxonomy, cytotaxonomy, numerical taxonomy, anatomy, palynology and embryology in relation totaxonomy. Biosystematic approach to taxonomy, biosystematic categories parameters in biosystematic analysis with particular examples of taxonomic problems; taxonomic study of agamic, hybrid and polyploid complexes; phylogenetic trees.

UNIT-IV

Taxonomic tools: Herbarium; floras; serology; electrophoresis; nucleic acid hybridization; computers and GIS. Concepts of phytogeography and its relevance, phytogeographic regions of the world and India, approaches to phytogeography, principles and practices; factors determining vegetational types, endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socioeconomic importance.

Master of Science (Botany) Semester-IV
(Session: 2022-23)

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. Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London 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,
4. Cambridge, UK.: Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun
5. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger. Co., New York.
6. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. Sinauer Associaes, 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

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Hazardous Chemicals
(Optional Paper)
MBTL-4076 (Opt-A)

Course outcomes:

After passing this course the student will be able to:

CO1: Understand different types of hazardous chemicals and how we can expose to them.

CO2: Understand control measures that reduce the risk associated with hazardous chemicals.

CO3: Manage hazardous chemicals effectively.

CO4: Describe the processes involved in hazardous waste treatment.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Hazardous Chemicals
(Optional Paper)
MBTL-4076 (Opt-A)

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

Physical Properties of Chemicals: Vapour pressure, vapour density, solubility, octanol/water partition, coefficient odor.
Toxic Properties: Absorption and excretion detoxification and bioactivation, common terms used for toxicology.
Target Organs: Injury to liver, kidney, immune system, respiratory tract, skin, eyes, nervous system, cardiovascular system, carcinogens and teratogens.
Combustible and Explosive Properties: Flashpoint and autoignition temperature of some chemicals, explosive properties.

UNIT-II

Aldehydes: Acrolein.
Alkaloids: Nicotine, Morphine, Heroin, LSD, Colchichine.
Amines: Ethylenimine, aniline, benzidine, O-toluidine, Phenylhydrazine.
Azodyes: Acid Yellow 3, Sudan orange, acid red 18, acid blue-9, acid green-3.
Chlorohydrins: Ethylene, chlorohydrin.
Nitriles: Acrylonitrile, acetonitrile.
Cyanides: HCN, Sodium cyanide, potassium cyanide, cyanogen.
Organic Isocyanates: Methyl isocyanate.

UNIT-III

Dioxins: 2,3,7,8 – Tetrachlordibenzo-p-dioxin (TCDD).
Epoxy Compounds: Ethylene dioxide.
Halogenated Hydrocarbons: Chloroform, carbon tetrachloride, dichlorobenzene.
Aromatic Hydrocarbons: Benzene, Xylene.
Polynuclear Aromatics: Benzo -α- pyrene, Benzo - α- anthracene.
Toxic Gases: Arsine, Mustard Gas, Phosgene.
Explosives: Nitroexplosives – Nitroglycerine, dynamite, Nitrocellulose, 2,4,6-Trinitrotoluene, Picric acid

Master of Science (Botany) Semester-IV
(Session: 2022-23)
UNIT-IV

Pesticides: Structure, LD50/ LC50, health hazards and exposure limit of following pesticides:
Carbamates: Aldicarb, Carbaryl, Carbofuran, Methiocarb.
Organochlorines: Aldrin, Dieldrin, Endrin, Heptachlor, Chloradane, Endsulphan, DDT,Methoxychlor, Lindane.
Organophosporus Pesticides: Parathion, Dichrolophos, Monocrotophos, Chloropyriphos.
Herbicides: 2,4 D, 2,4, T, Silvex, Atrazine, Metribuzin, Monouron, Diuron, Paraquat,Tribunil, Alchlor

Suggested Readings:

1. Patnaik, P. (1999). A Comprehensive Guide to the Hazardous Properties of Chemical Substances. Wiley, New York.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Immunology
(Optional Paper)
MBTL-4076(Opt-B)

Course outcomes:

After passing this course the student will be able to:

CO1: Understand history and principles of immunology.

CO2: Conceptualize how the antigen is processed.

CO3: Understand the working of antibodies.

CO4: Understand the cells and tissues of the immune system.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Immunology
(Optional Paper)
MBTL-4076(Opt-B)

Time: 3 hrs **Max. Marks- 50**
Theory - 40
CA – 10

Instructions for the Paper Setters:

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

UNIT-I

An Overview of the Immune System: Historical perspective, an introduction to the immune system – innate and adaptive immunity. Immuno deficiencies: secondary immunodeficiency disorders.

UNIT-II

Antigens and Antigen Recognition: Antigens: prerequisites for immunogenicity, relative immunogenicity of different types of molecules, Molecules that enhance immunogenicity. Activators of lymphocytes: antigens, super antigens, mitogens. Antigen recognition by cells of innate immunity & adaptive immunity.

UNIT-III

Antibodies: Gamma globulins; structure, bifunctional property of antibodies, determining bifunctionality, cross reactivity, Antigen antibody interactions: primary interactions, secondary interactions. Classification of antibodies: Isotypes, Allotypes, properties & biological functions of antibody isotypes, IgG, IgE, IgM, IgD, IgA, Monoclonal antibodies

UNIT-IV

Cells and Tissues of Immunity: Lymphoid tissues: primary & secondary lymphoid tissues, cells of innate immunity: phagocytes, antigen presenting cells, natural killer cells, Eosinophils, mast cells and basophil, B- cells, secondary immune responses. The major histocompatibility complex, antigen process and antigen presentation, complement.The immune system in Health & Disease, specially AIDS.

Books Recommended

1. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). Roitt's essential immunology. John Wiley & Sons.
2. Goldsby, R.A. Kindt, T.J., Oxborne B.A., Kuby, J. (2003). Immunology. W.H. Freemen &Company, New York.
3. Punt, J., Stranford, S. A., Jones, P. P., & Owen, J. A. (2019). Kuby immunology. Macmillan Learning
4. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Botany Practicals I
MBTP -4077

(Based on MBTL-4071, MBTL-4072 and MBTL-4073)

Course outcomes:

After passing this course the student will be able to:

CO1: Develop skills of dissection, formation of temporary and permanent slides.

CO2: Understand commercial applications of plant growth hormones.

CO3: Perform bioassays of plant growth regulators.

CO4: Study the functions and operations of various instruments used in PTC

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Botany Practicals I
MBTP -4077

(Based on MBTL-4071, MBTL-4072 and MBTL-4073)

Time: 6 hrs **Max. Marks-75**

Practical – 60
CA – 15

Instructions for the Paper Setters: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Suggested Practicals based on MBTL-4071

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
3. Study of secretory structures (nectaries and laticifers).
4. Study of leguminous roots with different types of nodules.
5. Anatomical studies of young and mature stem of *Helianthus*.
6. Comparative anatomy of dicot and monocot root, stem and leaf
7. To study anomalous stem behaviour in stem (*Mirabilis jalapa, Nycthanthus, Boerhaavia diffusa, Bignonia, Dracaena.)*
8. Study of anatomical features in xerophytes e.g. (leaf of *Nerium*. stem and leaf of *Calotropis*, phyllocladode of *Ruscus*.)
9. Study of anatomical features in hydrophytes e.g. (*Nelumbo* petiole, *Hydrilla* stem and leaf, *Eichhornia* petiole, leaf lamina, *Typha*)
10. To study anatomy of storage roots of e.g. (*Raphnus sativa, Beta vulgaris*)
11. To study anatomy of halophytes e.g. (*Chenopodium* stem)
12. To study permanent tissues slides.

Suggested Practical's based on MBTL-4072

1. Study the effect of IAA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
2. To study the effect of IBA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
3. Study the effect of Gibberellins on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
4. Study the effect of Cytokinin on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
5. Estimation of the catalase activity by Aebi's Method.
6. Study of bioassays of Auxins, Gibberellins, Cytokinin, Ethylene, Absicisic Acid and Brassinosteroids.
7. Study of antagonistic effect of cytokinin/ethrel on senescence behavior of leaves of different field crops.

Suggested Practical's based on MBTL-4073

1. To study the functions and operations of various instruments used in PTC like Laminar Air Flow, Autoclave, incubators, oven, Distillation unit, Weighing balance, pH meter
2. Laboratory design set up of PTC lab Sterilisation techniques
3. Different types of Enclosures used in PTC
4. Preparation of stock solutions and media preparation
5. Selection, preparation and inoculation of explant Synthetic Seed Production
6. Micropropagation and its different steps. Significance of growth hormones in culture
7. Induction of callus from different explants Anther culture and ovary culture

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Botany Practicals II
MBTP -4078

(Based on MBTL-4074 and MBTL-4075)

Course outcomes:

After passing this course the student will be able to:

CO1: Understand and perform experiments based on different analytic techniques.

CO2: Identify different plants using identification keys.

CO3: Understand role of herbarium in plant taxonomy.

CO4: Understand diagnostic features of different families.

Master of Science (Botany) Semester-IV
(Session: 2022-23)
Botany Practicals II
MBTP -4078
(Based on MBTL-4074 and MBTL-4075)

Time: 4 hrs **Max. Marks- 75**
Practical – 60
CA – 15

Instructions for the Paper Setters: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Suggested practicals based on MBTL-4074
(Experiments based on following techniques):

1. Paper Chromatography
2. Thin Layer chromatography
3. Column chromatography
4. Gel Filtration Chromatography
5. Ion Exchange Chromatography
6. Affinity Chromatography
7. Electrophoresis: PAGE and SDS-PAGE
8. UV-Vis Chromatography
9. Demonstration of PCR
10. Centrifugation
11. Flourescent Microscopy

Suggested Practicals based on MBTL-4075

Description of specimen from representatives of locally available families. This list is indicative only

- Ranunculaceae: *Ranunculus, Delphinium,*
- Brassicaceae: *Brasssica, Iberis*
- Malvaceae: *Hibiscus*
- Rutaceae: *Murraya, Citrus*
- Fabaceae: *Lathyrus, Cassia, Acacia, Mimosa*
- Rosaceae: *Rose, Prunus*
- Asteraceae: *Helianthus, Ageratum, Sonchus*
- Apiaceae: *Corriandrum, Foeniculum*
- Apocynaceae: *Vinca, Nerium, Thevetia*
- Asclepiadaceae: *Calatropis*
- Solanaceae: *Petunia, Solanum, Datura*
- Euphorbiaceae: *Euphorbia, Phyllanthus*
- Lamiaceae: *Ocimum, Salvia*
- Chenopodiaceae: *Chenopodium*
- Liliaceae: *Asparagus, Asphodelus*
- Poaceae: *Triticum, Avena*

1. Location of key character and use of keys at family level.

2. Field trips within and around the campus; compilation of field note and preparation of herbarium sheets of such plant, wild or cultivated as are abundant.
3. Training in using flora and herbaria for identification of specimen described in the class
4. Comparison of different species of a genus and different genera of family to calculate similarity coefficients.