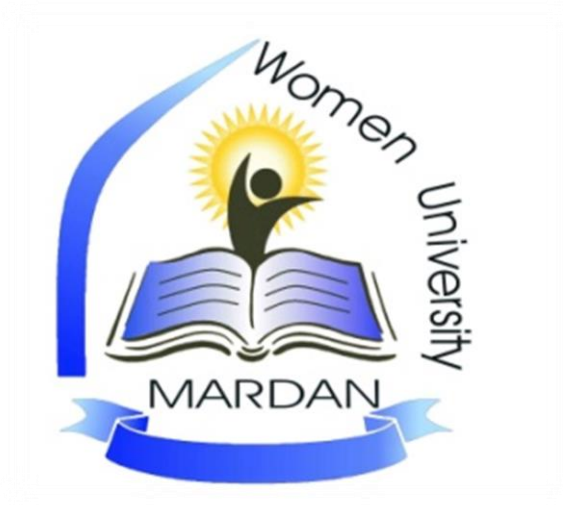


**Proposed Curriculum for
M.PHIL/PhD IN BOTANY
Department of Botany**



WOMEN UNIVERSITY MARDAN

SCHEME OF STUDIES FOR MPHIL/ MS AND PHD IN BOTANY

Duration for MPHIL/ MS AND PHD: 2 Semesters for Course work and 3-8 Semester research/thesis after course work, while for PHD 2 Semesters for Course work and 3-16 Semester research/thesis after course work. The subjects will be offered depending upon the expertise available in the University.

Courses: 24 Credit hours

Research/Thesis: 06 Credit hours

Total: 30 Credit hours

1st and 2nd Semester

The students will choose courses equal to 24 credit hours from the following courses:

Course Code	Course Title	Credit Hours
BOT-501	Horticulture-I	3
BOT-502	Plant Biotechnology	3
BOT-503	Food Technology	3
BOT-504	Ethnobotany	3
BOT-505	Plant Microbe Interaction	3
BOT-506	Edaphology	3
BOT-507	Stress Biology	3
BOT-508	Mushroom Biology	3
BOT-509	Plant Proteomics	3
BOT-510	Molecular Genetics	3
BOT-511	Allelopathy	3
BOT-512	Experimental Design and Data Analysis	3
BOT-513	Agricultural Botany and Evolution of Crop Plants	3
BOT-514	Mycosymbioses	3
BOT-515	Plant Cell and Tissue culture	3

3rd to 4th Semester: (Extendable up to 8th semester) for MPHIL
(Extendable up to 16th semester) for PHD

Course Code	Course Title	Credit Hours
Bot-599	Research project/thesis	6(0-6)

Semester-wise details are given in the following tables:

SEMESTER -I

S.No	Course Title	Course Code	Credit Hours
1.	Horticulture-I	BOT-501	03
2.	Ethnobotany	BOT-504	03
3.	Mushroom Biology	BOT-508	03
4.	Molecular Genetics	BOT-510	03
Total credit hours			12

SEMESTER -II

S.No	Course Title	Course Code	Credit Hours
1.	Food Technology	BOT-503	03
2.	Agricultural Botany and Evolution of Crop Plants	BOT-513	03
3.	Mycosymbioses	BOT-514	03
4.	Plant Cell and Tissue Culture	BOT-515	03
Total credit hours			12

OUTLINE OF COURSE FOR MPhil/MS IN BOTANY

Course Code	Course Title	Credit Hours
Bot-501	Horticulture-I	3

Course objectives:

The general Horticulture Principles are the main focus of this course along with topics of special interest that also highlight the current trends in Horticultural Science. The contents of this course will provide the students with an understanding of the growing and care of plants. It will also prepare them to undertake other advanced courses in Horticulture and to apply Horticulture knowledge in Allied Industries.

Course outline:

1. Horticulture; Introduction

Purpose, Key Terms, a Brief History, Divisions of Horticulture, Allied Horticultural Industries, Horticulture and Society, GIS and GPS Applications

2. Protecting Horticultural Plants

Plants as Pests, Animal Pests of Plants, Pest Control, Biological, Physical, Mechanical and Chemical Control, Greenhouse Pest Management

3. Plant Propagation

Sexual Propagation, Seed Formation, Seed Production and Certification Process, Quality Analysis, Viability and Longevity, Seed Dormancy, Improving Germination Capacity of Seeds, Transplantation, Cutting Propagation, Grafting, Budding, Layering, Specialized Underground Structures, *In Vitro* Propagation, Novel Propagation Methods

4. Topics of Special Interest

Growing Houseplants, Terrarium Culture, creation of Bonsai Plants, Controlled-Environment Horticulture

Books Recommended (Latest Editions):

1. Janick, J. *Horticultural Science*, 4th Ed. San Francisco: W. H. Freeman
2. Young, D. *Bonsai: The Art and Technique*. Englewood Cliffs, N. J.: Prentice-Hall.
3. Walls, I. G. *The Complete Book on the Greenhouse*. London: Wardlock.
4. Easton, V. *A Pattern Garden, the Essential Elements of Garden Making*. Timber Press Inc. Portland, Oregon
5. Geneve, R.L, Preece, J.E. and Merkle, S.A. *Biotechnology of Ornamental Plants*. CAB International, Wallingford, UK.
6. Jones, R. K. and D. M. Benson (Eds.). *Diseases of Woody Ornamentals and Trees in Nurseries*. APS Press, Minneapolis, MN.
7. Hartman, H.T. and Kester, D.E. *Plant Propagation*. Englewood Cliffs, N.J.:Prentice-Hall.

8. Geneve, R.L, Preece, J.E. and Merkle, S.A. *Biotechnology of Ornamental Plants*. CAB International, Wallingford, UK.

Course Code	Course Title	Credit Hours
Bot-502	Plant Biotechnology	3

Course Objectives:

Course outline:

Importance of Biotechnology in Plant improvement, Biotechnology as a tool to supplement conventional systems of Plant improvement, tools of Biotechnology for plant improvement, In Vitro Technology, Micro propagation, Embryo Rescue, Haploid Development, Viral Free Plant material, Somaclonal variation, Methods of cell and tissue culture, callus culture, organogenesis, somatic embryogenesis, protoplast isolation and fusion, anther and pollen culture, Gene cloning, GMOs, Incorporation of Novel genes for tolerance against Biotic and Abiotic stresses, Genes for yield and quality improvement, Genes for Insect and disease Resistance. BT crops, herbicide Resistant crops, Ethical issues and public concerns regarding GMOs.

Recommended books:

1. Plant biotechnology by M. W. fowler, G. S. Warren and M. Moo-young, Elsevier Science
2. Plant Biotechnology, S. H. Mantell, Springer-Verlag, New York
3. Plant Tissue culture manual. K. Lindeseg Kluwer. Academic Publisher, The Netherlands
4. Principles of Tissue Engineering, R.P. Lanza, R. Langer and J. Vacantuy. Academic Press, California, USA.

Course Code	Course Title	Credit Hours
Bot-503	Food Technology	3

Course Objectives: To introduce the techniques and sources of food based constituents and development of food industry using various food processing procedures.

Introduction: Food Science, Food Technology, Relationship with other disciplines, career opportunities, Significance of Science and technology, Global and national food and nutrition situation

Food Industry: History and development, important food industries in Pakistan.

Food Sources: Plant sources, Animal sources, Marine sources.

Food constituents and their functions: Water, Carbohydrates, Lipids, Proteins, Vitamins, Minerals.

Food Spoilage Agents: Food Perish-ability, microorganisms, Enzymes, Pests, Physical factors.

Principles of food preservation: Prevention or delay of autolysis, microorganisms, Pests, Physical factors.

Postharvest handling and preparation of food for processing: Introduction, Preparation of raw materials, Storage and transportation of raw materials, Cleaning, sorting, Grading, size reduction, Blanching, sulphiting.

Processing Types: Heat processing, cold storage, Freezing, Concentration and condensation, Drying, Dehydration, use of chemical additives.

Fermented Foods: Bread, wine, vinegar, yoghurt, sausages, pickles.

Food irradiations: Principles, applications, equipments, safety aspects, Effects on food properties, detection method.

Recommended Books:

1. Potter, N.N. and Hotchkiss, J .11. 2007. Food Science. The AVI Pub. Co. Inc., Westport, Connecticut, USA. 2. Awan, J.A. 2005. Food science and technology. Unitech Communications, Faisalabad- Pakistan 3. Awan, J .A. and Rehman, S. U.2003 Food analysis manual. Unitech Communications, Faisalabad. 4. Awan, J.A. 2009. Food processing and preservation. Unitech Communications, Faisalabad, Pakistan. 5. Awan J.A. and Rehman, S.U. 2009. Food preservation manual. UNitech Communications, Faisalabad, Pakistan. 6. Rahman, M.S. 2007. Handbook of food preservation. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA. 7. Brennan, JG. 2006. Food processing handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany. 16 8. Fellow, P.J. 2005. Food processing technology: principles and practices, 2nd ed. CRC Press, Taylor & Francis Group, Boca Raton, Florida.

Course Code	Course Title	Credit Hours
Bot-504	Ethnobotany	3

Course Objectives:

The MS course in Ethnobotany is organized to enrich students regarding the Diversity and Importance of plants of their native areas. The students after completion of the syllabus will be able to understand the medicinal importance of plants and their usages in other aspects of the society. The students will explore the native as well as regional flora and collect the vegetation of that area.

Course outline:

Ethnobotany in Human Welfare; Food, Health-care Conservation, Bio-chemistry. Regional studies, Recent Trends and Socio-Economic Aspects, Importance Impact of Medicinal Plants on the Society and in Allied Sciences.

Medicinal Plants; Historical Perspectives;

Classification of Medicinal Plants.

Important Forage Plants, Fiber Producing Plants, Timber Plants, Pulses, Condiments, Cash Crops, Cereal Crops and Millets, Fumigants, Nuts and Masticating Plants, Toxic Plants, Hallucinogenic Plants, Aromatic Plants and Aromatherapy, Oil Producing Plants, Vegetables and Fruit Plants, Medical Plants (Therapeutic Plants for Cardiovascular System, Reproductive System, Respiratory System, Urinary Tract Infection, Gynecologic Disorders, Diabetes, Rheumatic Conditions and Degenerative Joint Diseases).

Elementary Knowledge of Crude Drugs: Preparation and Preservation; Classification of Active Ingredients (Flavonoids, Steroids and Alkaloids), Drug Designing, Sources of Vegetable Drugs – Biological, Geographical and Cultural, Production of Vegetable Drugs, Deterioration of Drugs and their Control Measures.

Non-Timber Forest Products (NTFP's): Indigenous Plant Knowledge and Plants based products, Plants in Traditional Human Culture, Traditional Plant Use, Ethno-Linguistics, Traditional Phytochemistry, Metabolic Engineering of Plant Natural Products.

Pharmacology; Routes of Drug Administration, Absorption and Distribution, Pharmacological activity of Morphine, Atropine, Ephedrine and Camphor etc., Chemotaxonomy of higher and Lower Plants and Distribution of certain Chemotaxonomical Group Constituents in Plant Kingdom like Alkaloids, Glycosides and Terpenoids.

Ethnobotanical Implication; Conservation and Management of Plant Resources. Importance of Wild relatives of Cultivated Plants.

Post-Harvest Technology in Medicinal Crops; Scope and Importance. Adulteration with reference to Plant Drugs, type of Adulterants and method of Adulteration,

Applications of Phytotherapy; Importance of Herbal Marketing. Biodiversity act and Intellectual Property Rights in the area of Medicinal Plants.

Books Recommended (Latest Editions):

1. Aktal, C.K. and Kapur, B.M. (1982). *Cultivation and utilization of Medicinal Plants*. RRL, CSIR, Jammu-Tawi.
2. Bremness, L. (1990). *Herbs (Reader's Digest Home Handbooks)*. Readers Digest, USA. pp.: 240. ISBN: 9780895773555.
3. Wijeskera, R.O.B. (1991). *The Medicinal Plant Industry*. CRC Press, Boston, London-Nagar, Delhi – 110032.
4. Chaudhary, R.D. (1996). *Herbal Drug Industry*. (1st Ed.), Eastern Publication, New Delhi.
5. Cotton, C.M. (1996). *Ethnobotany: Principles and Applications*. (1st Ed.), John Wiley and Sons. pp. 424.

6. Jain, S.K. (1996). *Ethnobiology in Human Welfare*. Deep. Pub. A/3/27A DDA Flats Pashim Vihar, New Delhi.
 7. Vogel, H.G. and Vogel, W.H. (1997). *Drug Discovery and Evaluation–Pharmacological Assays*. Springer-New York.
 8. Harborne J.B. (1998). *Phytochemical Methods. A Guide to Modern Technique of Plant Analysis*. (3rd Ed.). Chapman & Hall, UK.
 9. Wilson, K. and Walker, J. (1999). *Principles and techniques of Practical Biochemistry*. Cambridge University Press.
 10. Hardman J.G. and Limbird, L.E. (2001). *Goodman Gillman’s The Pharmacological basis of therapeutics*. (10th Edition) McGraw Hill press New York.
 11. Schultes, R.E., Hofmann, A. and Ratsch, C. (2001). *Plants of the gods: Their Sacred, Healing, and Hallucinogenic Powers*. (2nd Ed), Healing Arts Press. pp. 208.
 12. Buhner, S.H. (2002). *The Lost Language of Plants: The Ecological Importance of Plant Medicines to Life on Earth*. (1st Ed.), Chelsea Green Publishing Company. pp. 325.
 13. Mukherjee P.K. (2002). *Quality Control of Herbal Drugs*. (1st Ed.), Business Horizons Pharmaceutical Publisher, Delhi. pp. 228.
 14. Buhner, S.H. (2004). *The Secret Teachings of Plants: The Intelligence of the Heart in the Direct Perception of Natures*. (1st Ed), Bear and Company, pp. 336. ISBN: 9781591430353.
 15. Ratsch, C. and Hofmann, A. (2005). *The Encyclopedia of Psychoactive Plants: Ethnopharmacology and its Applications*. (1st Ed.), Park Street Press. pp. 944.
 16. Harborne J.B. (2006). *Phytochemical Methods*. (2nd Ed.), Chapman and Hall. London.
 17. Telander, T. (2007). *Edible Wild Plants: A Falcon Field Guide*. (2nd Ed). Falcon Field Guide Series. pp. 104. ISBN:9780762774210.
 18. Montgomery, P. (2008). *Plant Spirit Healing: A Guide to Working with Plant Consciousness*. (2nd Ed), Bear & Company. pp. 248.
 19. Bremness, L. (2009). *The Essential Herbs Handbook: More Than 100 Herbs for Well-Being, Healing, and Happiness*. Watkins Publishing Co. pp. 288. ISBN:978184483801.
- Journals Sources:**
- i- Journal of Ethnobiology and Ethnomedicines.
 - ii-Ethnobotanical Leaflets.
 - iii-Ethnobotanist.
 - iv- Pakistan Journal of Botany.
 - v- Ethnobotany Research & Applications.

Course Code	Course Title	Credit Hours
Bot-505	Plant Microbe Interaction	3

Course Objectives:

This course is an advanced study of the interactions between plants and microorganisms, with emphasis on symbiotic microorganisms and plant pathogenic microorganisms but also with other microorganisms that can provide a benefit to the plant.

Course Outline:

1. Introduction

It includes description of microorganisms (Fungi, Bacteria, Algae and Virus) involved in plant microbe interaction, types of interactions, significance of plant microbe interaction.

2. Mutualistic Interactions

It includes nitrogen fixing symbiosis, rhizosperic bacteria and mycorrhizal associations, significance of symbiotic association in crop improvement, symbiotic interactions under extreme environments.

3. Parasitic Interactions

It includes description of pathogenic microorganisms, interactions between plants and pathogenic fungi, bacteria and viruses, defense reaction of the host plant to these pathogenic microorganisms.

4. Fungal Endophytes and Plant Growth

It includes description of endophytic fungi, mechanism of plant endophyte interaction, types of hormones secreted by endophytes, significance of endophytic associations under stress, utility of endophytes as bio-fertilizers.

5. Endophytic Fungi Isolation and Identification

It includes procedure of endophytic fungi isolation from the host plant, analysis of exogenous hormones, molecular identification techniques, phylogenetic analysis.

Recommended Books:

1. Advances in molecular Genetics of Plants Microbe interactions (Daniels, M.J., Downie, J.A. and Osbourn, A.E.)
2. Recognition in Microbe-Plant symbiotic and Pathogenic Interactions (Lugtenberg, B)
3. Biotechnology of Plant Microbe interaction (Nakas, J.P. and Hagedon, C.)

Course Code	Course Title	Credit Hours
Bot-506	Edaphology	3

Objectives

This course is designed to introduce the concept and importance of soil science for agriculture students at graduate level.

Course Outline

1. Definition of earth, geology and soil science; Disciplines of soil science.
2. Soil forming rocks and minerals: Types and their formation.
3. Weathering of rocks and minerals: Parent materials
4. Soil formation: Processes and factors affecting
5. Soil profile and its description
6. Physical, chemical and biological properties of soil

7. Introduction to soil classification and land use capability classes
8. Soil organic matter: Sources, composition and significance
9. Elements essential for plant growth
10. Organic and inorganic fertilizers
11. Salt-affected and waterlogged soils
12. Soil and water conservation
13. Soil and water pollution

Books Recommended

1. Bashir, E. and R. Bantel. 2001. Soil Science. National Book Foundation, Islamabad.
2. Brady, N.C. and R.R. Weil. 2007. The Nature and Properties of Soils. 14th Ed. Pearson Education, Upper Saddle River, NJ, USA.
3. Singer, M.J. and D.N. Munns. 2002. Soils- An Introduction. 5th Ed. 13 Prentice-Hall, Inc., Upper Saddle River, NJ, USA.
4. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.

Course Code	Course Title	Credit Hours
Bot-507	Stress Biology	3

Objectives

This course is designed to introduce the concept and studies on stress biology on various plants and to convey the importance of these stresses on physiological activities of plants to students at graduate level.

Course Outline:

- 1- Introduction and terminology. Physical stress and strain; Biological stress and strain; stress injury; stress resistance and kind of stress tolerance.
- 2- Low temperature stress (Chilling): chilling stress; chilling injury chilling resistance and mechanism of chilling resistance; freezing stress; freezing resistance type, measurement and change; factors related to freezing tolerance; theories of freezing injury and resistance; molecular basis of freezing injury and tolerance.
- 3- High temperature stress: occurrence of heat injury, protective substances; heat tolerance; heat avoidance; molecular aspects of thermotolerance; relationship between thermotolerance and low temperature tolerance.
- 4- Mechanical stress: effect of mechanical perturbation on growth of plant, anatomical changes, resistance, avoidance; role of ethylene in mechanical resistance. Oxidative stress; antioxidant and reactive oxygen species.

- 5- Water stress: Drought injury; classification of adaptation of water stress; drought avoidance; drought tolerance; mechanism of drought tolerance; measurements of drought tolerance. Waterlogging: causes of water logging; effects of waterlogging on plant growth.
- 6- Salt stress: causes of salinity; extent and their occurrence in Pakistan. Salt resistance; ion stress; control measures, soil management, use of salt tolerance plants.
- 7- Biotic stress: types, Effects of biotic stresses on plant growth, control measures.

Recommended Books:

- 1- Chakraborty, U. and Chakraborty, B. 2005. Stress Biology. Narosa Publishing House.
- 2- Jenks, M. and Wood, A. 2007. Plant Desiccation tolerance. Blackwell Publ.
- 3- Ashraf, M., Harris, P. J. C. 2005. Abiotic stresses: Plant resistance through Breeding and Molecular Approaches. Blackwell Publishers.
- 4- Smirnoff, N. 2004. Antioxidants and Reactive Species in Plants. Blackwell Publishers, Oxford, UK.
- 5- Takabe, T. and Rai, A. K. 2006. Abiotic Stress Tolerance in Plants: Towards the Improvement of Global Environment and Food. Springer.

Course Code	Course Title	Credit Hours
Bot-508	Mushroom Biology	3

Objectives

This course is designed to introduce the basic concept and importance of edible mushrooms and their cultivation strategies to the students at graduate level. The students will be able to learn the commercialization and industrial linkages of different products prepared from mushrooms.

Course Outline:

Introduction, what are mushrooms?, ecological importance of mushrooms and fungi in general, collection and classification of mushrooms, justification for the term Mushroom Biology, impact of Mushroom Biology on Human welfare

Mushroom Science

Definition, contributing fields (microbiology, fermentation, and environmental engineering).

Mushroom Cultivation Technology

Concept, Phases of mushroom technology

Mushroom Biotechnology

Non-green Revolution

Nutritional and Medicinal Attributes of Mushrooms

Proteins, Essential amino acids, fats, vitamins, carbohydrates and fibers, minerals. Medicinal effects of mushrooms.

Substrate and Mycelial Growth

Introduction, nutritional requirements for mushroom growth, preparation of substrate (composting).

Mushroom Formation

Introduction, development of fruiting bodies, primordial formation and development.

Effects of Pests and Diseases in Mushrooms

Outdoor and indoor cultivation of mushrooms

Economic Importance of Mushrooms

Recommended Books

1. Miles, P. G., & Chang, S. T. (2004). *Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact*. CRC press.
2. Cheung, P. C. (Ed.). (2008). *Mushrooms as functional foods*. John Wiley & Sons.
3. BISWAS, S., Datta, M., & Ngachan, S. V. (2011). *Mushrooms: A Manual for cultivation*. PHI Learning Pvt. Ltd.

Course Code	Course Title	Credit Hours
Bot-509	Plant Proteomics	3

Course Outline:

Introduction to proteomics, its tasks, challenges and application, Protein Extraction, Preparing Cellular and Subcellular Extracts and their quantification, Fractionation of complex samples of proteins by chromatographic and electrophoretic techniques, identification and characterization of Post-translation modifications, types, importance, favorable sites (consensus sequences) for these modifications, electrophoresis (1D-PAGE & 2D-PAGE), gel and membranes staining and their computability with subsequent analytical techniques, analyzing gel images, preparation of samples and identification of proteins by Mass Spectrometry and N-terminal sequencing, Collecting, processing of MADI-TOF MS spectral data, and protein identification by MS, Protein quantification by MS, Bioinformatics for Proteomics (identification, structural and functional domains search including signal peptides & target peptides and interactions of proteins)

Recommended Books

1. Plants proteomics (2007). J. Samaj and J. Thelen Eds.
2. Gel electrophoresis of proteins: a practical approach (1998).BD. Hames, Ed.
3. Proteome and protein analysis (2000).R.M.Kamp et al,Eds.
4. Proteome research :new frontiers in functional genomics (1997).M.R Wilkins et al,Eds.
5. 2-dimensional proteome analysis protocols (1999).A.J.Link,Ed.
6. Proteome research two-dimensional gel electrophoresis and identification methods (2000).T.Rabilloud,Ed.
7. Electrophoresis in practice, 2nd Edition (1997). Westermeyer,R.

8. Proteomics in functional genomics (2000).P.Jolles and H.Jornvall,Eds.
9. Proteome research: Mass Spectrometry (2001).P.James,Ed.
10. Protein Sequencing and Identification Using Tandem Mass Specrometry (2000).M.Klinter and NE.Sherman
11. Essential of Genomics and Bioinformatics (2002)C.W.Sense, Ed.
12. Proteins and Proteomics:A Laboratory Manual (2003).R.J.Simpson
13. Puryfying Proteins for Proteomics:A Laboratory Manual (2004).R.J.Simpson,Ed.
14. Liningers Principles of biochemistry, 4th Ed DV Nilsson, MMCox, WH Freeman and company 2005.

Course Code	Course Title	Credit Hours
Bot-510	Molecular Genetics	3

Introduction

Historical development and scope of molecular genetics; the concept of paired genes: Mendel's findings, inheritance pattern of Mendelian genes in mono and dihybrid cross. Chromosomal theory of inheritance and the concept of paired genes, the Johnson's concept of gene and genotype. The concept of genes in populations; (a) multiple alleles Blood Groups in man and coat color in Himalayan Rabbits (b) polygenic inheritance, skin color in man and grain color in wheat.

The molecular basis of genetics

Structure of DNA, clarification of DNA as genetic material, The Griffith experiments, the experiments of Avery, Macleod and McCarty, the Hershey and Chase experiments, theories of DNA Replication; fine structure of gene; RNA slicing. DNA stability.

Viral Genetics

Basic features of viruses, lytic and lysogenic replication of λ phage; gene organization of λ phage; linear and circular forms of λ DNA; general features of M13 phage; the attraction of M 13 as cloning vehicle, viruses as cloning vehicles for other organisms, general features of hepatitis B virus (HBV), λ and M13 viruses; the prion hypothesis and bovine spongiform encephalopathy (BSE).

Bacterial Genetics

Structure of a bacterial cell, plasmids; size and copy number, different types of plasmids. Diversity in bacteria, eubacterial genes, comparative genome organization of *Escherichia coli*, *Salmonella typhimurium* and *Bacillus subtilis*, introduction to Archaea. Plasmids and bacterial sex. Bacterial transposons

Genetics of eukaryotes

Introduction and cellular organization in eukaryotes, the nuclear genome, organization of nuclear genome, packaging of DNA into chromosomes, chromosome morphology, telomeres, the cell cycle organellar genetic systems, mitochondrial genomes of man and fungi, chloroplast genome. Gene for Gene concept.

Recent developments in Genetics

Introduction to the: stem cell technology, Bt-genes, RR genes, Genomics, proteomics, bioinformatics,

Books Recommended

1. Dimmoock, N. J., A. J. Easton and K. N. Leppard. 2002. Introduction to modern virology, pp 177-185, 312-350.
2. Brown, T. A. 1990. Gene cloning; an introduction. Chapman and Hall, London, Newyork, Tokyo, Melbourne, Madras, pp 17-48.
3. Klug, W. S., and M. R. Cummings. 2003. Concepts of Genetics. Pearson Education. 413-441.
4. Brown, T. A. 1992. Genetics: a molecular approach. Chapman and Hall, pp 219- 289.

Course Code	Course Title	Credit Hours
Bot-511	Allelopathy	3

Course objectives:

It will help to test the effects of different concentrations of the allelopathic agent produced by different plants. Students will determine if the concentration affects the germination and growth of seeds of the target species. They will also test the effects of the extract of different roots on the germination and growth of some economically important seeds. They will determine which part of the plant produces allelopathic substances. To discuss the ecological implications of allelopathy.

Course Outline:

1. Introduction, Scope, History, reality and future of Allelopathy, Bioassay, useful tools for the study of Allelopathy
2. Basic pathways for the origin of Allelopathic compounds.
3. Roles of Allelopathy in Agriculture, Allelopathic Effects of Microorganisms on Plants, Allelopathic Effects of Plants on Microorganisms, Allelopathic Effects of Microorganisms on Microorganisms
4. Allelopathy in the Biological Control of Weeds, Suggested Methods for Biological Weed Control Using Allelopathy, Weed Control by Plants, Cultural Practices and General Weed Control, Biological Control of Specific Weeds, Weed Control by Microorganisms, Potential or Present Herbicides from Plants and Microorganisms,
5. Allelopathy in Bacterial and Fungal Diseases of Plants, Allelopathy in the Development of Plant Pathogens, Allelopathy and the Promotion of Infections, Crop Rotation and Plant Diseases

6. Allelopathy in the Biological Control of Plant Diseases: Host Plants AM, Control of Plant Pathogens by Plants, Control of Plant Pathogens by Microorganisms: Host Plants AM
7. Allelopathy in the Biological Control of Plant Diseases: Hosts Plants NZ
8. Ecological relationship and Allelopathy, Allelopathic Effects of Woody Plants, Allelopathic Effects of Herbaceous Angiosperms.

Suggested Books:

1. Anonymous. 1983. Killer plants: Getting plants to turn on each other. *The Economist*, 87(7290), 104.
2. Cox, P.A. and M. J. Balick. 1994. The ethnobotanical approach to drug discovery. *Scientific American*, 265, 82-87.
3. Dutton, G.1993. Yo buddy—Outa my space! *American Horticulturist* , 72 (3), 5-6.
4. Kozlov, A. 1991. Weed woes. *Discover*, 11, 24.
5. Latta, J. and H. Wright. 1995. Allelopathy in seeds. *Journal of Biological Education*, 29(2), 123-128.
6. Massey, A. B. 1925. Antagonism of the walnuts (*Juglans nigra* L. and *J. cinerea* L.) in certain plant associations. *Phytopathology* , 15, 773-784.
7. Miller, G. T. 1991. *Environmental Science. Sustaining the Earth* , 3rd ed. Belmont, CA: Wadsworth Publishing Company.
8. Piper, K. 1992. The seedy side of sunflowers. *Horticulture*, 70(10), 24. Ricklefs, R.E. 1990. *Ecology*, 3rd ed. New York: W. H. Freeman and Company.
9. Towle, A. 1989. *Modern Biology* . New York: Holt, Rinehart & Winston.
10. Weiss, R. 1991. Root words. *Science News* , 139(10), 188-189.

Course Code	Course Title	Credit Hours
Bot-512	Experimental Designs and Data Analysis	3

Course Objectives:

To make students self-sufficient in designing the methodology and completing their statistical analyses at the end of their research work.

Introduction to statistics:

Definition, characteristics, importance and limitations, Population, Sample, variables, qualitative and quantitative variables, continuous and discrete variables.

Frequency distribution and Probabilities

Formation of frequency table from raw data, Application of probability to simple events.

Graphic Presentation of Data

Line graph, Histogram, Polygon, Ogive, Bar chart and Pie chart.

Measurement of variability

Arithmetic Mean, Median, Mode, Range, Mean deviation, Variance, Standard deviation, coefficient of variation, semi-interquartile range.

Standard Distributions

Binomial, Poisson and Normal distributions, their properties and application

T-Test

Basic ideas, confidence limits of means, significant difference of means.

Chi square Test

Basic ideas, testing of fit to ratio, testing association (contingency table).

F-Test

Introduction and application in analysis of variance, multiple range tests.

Experimental Designs

Principles of experimental design, planning of an experiment, replication and randomization. Field plot technique layout and analysis of completely randomized and randomized complete block design, Latin square design, treatment comparison, and factorial design.

Regression and Correlation analysis

BOOKS RECOMMENDED

1. Chudhry, S.M. and S. Kamal.1996.Intruduction to statistical theory Part-1.sixth edition. Markazi kutub khana, Urdu bazaar, Lahore, pp 1-10, 13-48, 57-81, 93-126, 185-233 457-478.
2. Chudhry, S.M. and S.Kamal.1996.Intruduction to statistical theory Part-II.sixth edition. Markazi kutub khana, Urdu bazaar, Lahore, pp 123-161, 169-187, 239-265, 273-290, 295-334, 347-380 419-46.
3. Negi, K.S.2004. Biostatistacs.1st Edition (Revised) Virender Kumar Arya AITBS Publishers & distributors (Regd.). Dehli, India.pp 1-8, 23-38, 99-115.
4. Gomez, K.A. and A.A.Gomez.1984. Statistical Procedures for Agricultural Research. John Veley & sons, Inc.USA, pp7-130, 187-241, 357-424.
5. Levin, R.I. and D.S.Ruubin. 1997. Seventh Edition. Prentice Hall of India Private Limited, New Dehli, pp8-33, 69-126,402-451, 568-615, 646-695.

Course Code	Course Title	Credit Hours
Bot-513	Agricultural Botany and Evolution of Crop Plants	3

Course Outline:

1. Basic concept in Agricultural Botany.
2. Morphology classification and evolution of crop plants.
3. Relevance of Botany to Agriculture
4. Plant Physiology of crops
5. Cereals Plants
6. Legumes/Pulses
7. Roots and Tubers
8. Sugar Crops
9. Oil Crops
10. Vegetable Crops
11. Fiber Crops
12. Beverages and Stimulant Crops
13. Medicinal Plants
14. Other Crops

Textbooks and References

Baranov, V.D. Ustimenko, G.V.(1994). Mir Kulturnih Rasteniyi. Misl., P.381.

Cobley, L.S. and Steele, W.M. (1976). An Introduction to the Botany in the Tropics, Second Edition. Longman Group Limited.

Dutta, A. C.(2000). Botany for Degree Students Oxford University Press 10th Edition.

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Ebukanson and Bassey: (1992). About Seed Plants. Baraka Press and Publishers LTD.

Green, D.J., Stout, G.W.(2004). Biological Science, 3rd Edition. Cambridge University Press

James, W.O.(1975). An Introduction to Plant Physiology Seventh Edition, Oxford University Press. P.181

Kochhar, S. L. (2001). Economic Botany in the Tropics Second Edition, Macmillan India LTD

Murkin, B.M. Naumova, L.G. and Muldashev, A.A. (2000). Vissheye Rasteniyе. M. Logos P.264.

Pandey, S. N. Sinha, B.K.(2003). Plant Physiology Third Edition, Vikas Publishing House PVT LTD. P.581

Course Code	Course Title	Credit Hours
Bot-514	Mycosymbioses	3

Course objectives:

The course is organized to provide an adequate knowledge about Mycosymbioses including Mycorrhizae, Lichens etc. This course will help to study different diseased plants and their pathogens. Importance of antagonistic fungi against pathogens as Biological control.

Course outline:

Mycorrhizae: Definition, Kinds and Evolution of Mycorrhizae, Fungi Forming Mycorrhizae, Endomycorrhiza, Ectomycorrhiza, Sources of inoculum. Mycorrhizae as Biocontrol.

Lichens: Classification, Nature of this association, The Mycobiont, The Photobiont, Lichen Synthesis, Lichen Phylogeny and Evolution, Ecology and Mycosociology of Lichens, Lichens as Bioindicators.

Neutralistic Fungi: Neutralism, Neutralistic fungi and their role in Ecology. Mycodeterioration, Recycling and Succession.

Antagonistic Fungi: Antagonism, Antagonistic Fungi, some common Diseases caused by these Fungi, Antagonism as Biological Control of Fungi and other Pathogens.

Books Recommended (Latest Editions):

1. Agerer, R. *Colour Atlas of Ectomycorrhizae*. Einhorn-Verlag Eduard Wiesenberger. Institute for Systematics Botanic University Munchen, Germany.
2. Carlile, M. J., Watkinson, S. C. and Gooday, G. W., *The Fungi*, Academic Press, London.
3. Kendrick, B. *The Fifth Kingdom*. 3rd edition, Focus Publishing, R. Pullins Company. Newburyport MA 01950, USA.
4. Ahmad, S., Iqbal, S.H. and Khalid, A.N. *Fungi of Pakistan*. Sultan Ahmad Mycological Society of Pakistan, Lahore.
5. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1995). *Introductory Mycology*. John Wiley and Sons, INC. New York.
6. Brandret, M., Mchille, L. and Peterson, L. *Practical Methods in Mycorrhizal research*. Mycologue Publications.
7. Allen, M.F. *The Ecology of Mycorrhizae*. Cambridge University Press, New York.
8. Harley, J.L. and Smith, S. E. *Mycorrhizal Symbiosis*. Academic Press, London.
9. Dix, N.J. and Webster, J. *Fungal Ecology*. Chapman Hall, London.

Course Code	Course Title	Credit Hours
Bot-515	Plant Cell and Tissue Culture	3

INTRODUCTION:

Introduction to plant cell and tissue culture. Plant tissue culture, plant breeding, plant genetic engineering and crop improvement. Tissue culture in agriculture, forestry, biotechnology and industry.

EXPLANT PREPARATION AND SELECTION STRATEGIES:

Explant genotype, size, age, quality, location and season. Sterilization of explants. Methods for virus eradication.

CULTURE FACILITIES AND STERILE TECHNIQUES:

The basic laboratory layout and equipment. Sterilization of glassware, equipments and working area.

MEDIA COMPONENTS AND PREPARATION:

Inorganic nutrients, organic nutrients, vitamins, amino acids, carbohydrates, gelling agents, antibiotic, plant hormones, complex organic supplements. Preparation of MS media from commercial packages and from stock solution. Contamination and its disposing. Safety in the laboratory.

INITIATION AND MAINTENANCE OF CALLUS:

Origin and types of callus. Role of callus in embryogenesis, organogenesis and cell culture. Initiation and propagation of callus cultures. Monitoring the growth of callus. Genetic transformation of callus. Sub-culturing of callus. Organogenesis (Rooting and Shooting). Deflasking or Acclimatization.

PRODUCTION OF VIRUS FREE PLANTS:

Disease elimination by tissue culture. Disease elimination by chemotherapy. Disease elimination by thermotherapy. Virus detection and Diagnosis.

TYPES OF CULTURE:

Initiation, maintenance, growth characters and uses of cell suspension culture. Isolation, purification, culturing and uses of protoplast culture. Introduction of anther and microspore culture. Pollen culture. Haploid for plant breeding and genetics. Factors affecting the success of anther culture. Organ and embryo culture. Culturing of Hairy roots, Minitubers and Microtubers. Callus culture, Meristem culture, and fern spore culture.

SOMACLONAL VARIATION:

Origin, mechanism and uses of somaclonal variation. Somaclonal variations for salt, herbicide, drought, nematodes and disease tolerance. Somaclonal variations in major crops.

SOMATIC HYBRIDIZATION AND GERMPLASM CONSERVATION:

Protoplast fusion and hybridization. Somatic hybrids plants and their regeneration. Germplasm conservation, methods for germplasm conservation. Cryopreservation. Artificial seeds.

WIDE HYBRIDIZATION BY EMBRYO RESCUE:

Pollination and fertilization. Embryo rescue technique. Practical application.

PLANT HORMONES:

Uses of plant hormones in tissue cultures. Auxins, Cytokinins, Gibberellins, Florigen and Abscisic acid.

GENETIC ENGINEERING:

Genetic engineering of cultured animal plant cells, Genetically modified organisms.

RECOMMENDED BOOKS:

1. John, H.D. and L.W. Roberts. Plant tissue culture. Second edition. Cambridge University Press Cambridge. 1985.
2. Smith.R.H. Plant Tissue Culture Techniques and experiments. Second edition. Academic press 2000.
3. Evans, D.E. J.O.D. Coleman and A. Kearns. Plant Cell Culture. BIOS Scientific Publishers London.
4. Chopra V.L., V.S.Malik and S.R. Bhat. Plant Biotechnology. Oxford IBH Publishers New Delhi.
5. Attege, C.R and B. Kristiansen.2001. Basic Biotechnology, Cambridge University, Press UK.

List of the proposed courses for MS/ MPhil and PhD

1. Plant taxonomy and Biosystematics
2. Principles and Practice of Plant Conservation
3. Meiotic Configuration and Genetic Analysis
4. Chromosome Technology: Theory and Practice
5. Environmental Botany
6. Vegetation Analysis
7. Recent Development in Plant Physiology
8. Advances in Plant Ecology

9. Freshwater Algae
10. Hands-on Computer and Access to Botanical Data Bases
11. Advances in Cell Biology
12. Allelopathic Interactions
13. Advances in Microbiology
14. Pollution Ecology
15. Biology of Weeds
16. Ecology of the Denuded Soils
17. Ecology and biodiversity of Temperate forest
18. Mycorrhizal Association
19. Advanced Molecular Biology
20. Ethnopharmacology and Pharmacognacy
21. Recombinant DNA Technology
22. Paleontology and Aerobotany
23. Molecular Cytogenetics
24. Limnology
25. Phytogeography of Pakistan
26. Molecular Phylogenetics
27. Medicinal Plants
28. Application of Ethnobotany in Plant Conservation
29. Intensive Study in the Specialization Courses
30. Recent Trends of Research in Cyanobacteria
31. Agrostalogy of Northern Pakistan
32. Evolution of Lower Vascular Plants
33. Advances in Plant Ecology
34. Phytogeography and Phylogenetics
35. Survey of the Recent ICBN Issues
36. Bryology and Evolutionary Trends of Higher Plants
37. Pteridology
38. Safety Consideration of the Advanced Lab Technology
39. Bioethics
40. Salinity and waterlogging
41. Bioinformatics Tools and Technologies
42. Biology of halophytes
43. Weed Ecology
44. Biotechnology