ANEXURE II

DEPARTMENT OF BOTANY
THE UNIVERSITY OF POONCH RAWALAKOT

PROPOSED CURRICULUM
FOR
M.Sc. 2 YEAR PROGRAM
In
Botany
w.e.f. Academic Session 2013-15

UNIVERSITY OF POONCH RAWALAKOT
AZAD KASHMIR
Website: www.upr.edu.pk

CURRICULUM FOR M.Sc. BOTANY
DEPARTMENT OF BOTANY
THE UNIVERSITY OF POONCH RAWALAKOT

Aims and Objectives of teaching at M.Sc. Botany

1. To equip the students of Botany with advanced knowledge about major disciplines of Botany. This will enable the young students to understand principles of organization and interrelation in the biological systems which are important for better planning and management of plant resources, environment, health and medicine, agriculture and population in the country.
2. To teach different methods of explorations /investigations /extracting information, organization of data and its utilization.
3. To inculcate habit of keeping abreast with latest knowledge, developments and to develop scientific aptitude.
4. To prepare the young generation to move shoulder to shoulder with other scientists of the world and meet the challenges of recent science and technology in the country.
5. To equip the students with modern technical information for taking up teaching research/managerial positions in various national and international organizations.
6. To prepare and train students for advanced studies and specialization in recently emerging important fields of Botany such as Plant Biochemistry and Molecular Biology, Biotechnology, Genetic Engineering and Environmental Bioremediation.

THE UNIVERSITY OF POONCH RAWALAKOT
Azad Jammu & Kashmir

List for M. Sc. Botany Program

A modified version of the scheme of studies for M.Sc. Botany is as under:-

Title of Degree Program:	Master of Science in Botany
Degree Abbreviation:	M.Sc.
Duration	4-6 Semester
Course Work:	57 Credits
Field Botany:	02 Credits
Thesis/Optional paper	06 Credits
Comprehensive Oral Examination:	S/U Basis
Total Credits:	65 Credits

Year-1
First Semester

Course Code	Course Title	Lecture Credit's
BOT-5101	Bacteriology and Virology	3(2-1)
BOT-5102	Diversity of Vascular Plants	3(2-1)
BOT-5103	Phycology and Bryology	3(2-1)
BOT-5104	Mycology and Plant Pathology	3(2-1)
BOT-5105	Cell Biology	3(2-1)
BOT-5106	Field Botany-I	1(0-1)
Total Credit Hour's		**16**

Second Semester

Course Code	Course Title	Lecture Credit's
BOT-5201	Plant Ecology-1	3(2-1)
BOT-5202	Genetics-I	3(2-1)
BOT-5203	Plant Systematics	3(2-1)
BOT-5204	Plant Biochemistry-I	3(2-1)
BOT-5205	Plant Physiology- I	3(2-1)
BOT-5206	Field Botany-II	1(0-1)
Total Credit Hour's		**16**

Years-II

Third Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-6301	Plant Ecology-II	3(2-1)
BOT-6302	Plant Biochemistry-II	3(2-1)
BOT-6303	Plant Anatomy	3(2-1)
BOT-6304	Molecular Biology	3(2-1)
BOT-6305	Biostatistics	3(2-1)
BOT-6406 *Optional	Thesis/*(Assigned in 3rd semester and assessed in 4th semester)* *Non Thesis students*	3(3-0)
Total Credit Hour's		**18**

Fourth Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-6401	Genetics-II	3(2-1)
BOT-6402	Biodiversity and Conservation	3(2-1)
Bot-6403	Plant Physiology-II	3(2-1)
BOT-6404	Principals of Biotechnology	3(2-1)
*BOT-6406 Optional	Thesis *Non Thesis students*	(06) 3(3-0)
Total Credit Hour's		**15**

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 1st SEMESTER

First Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-5101	Bacteriology and Virology	3(2-1)
BOT-5102	Diversity of Vascular Plants	3(2-1)
BOT-5103	Phycology and Bryology	3(2-1)
BOT-5104	Mycology and Plant Pathology	3(2-1)
BOT-5105	Cell Biology	3(2-1)
BOT-5106	Field Botany-I	1(0-1)
Total Credit Hour's		**16**

BOT-5101 Bacteriology and Virology

Aims and objectives

To understand the morphology, structure and economic importance of Viruses and Bacteria

Course Contents

a. Viruses

General features of viruses, viral architecture, classification, dissemination and replication of single and double – stranded DNA/RNA viruses. Plant viral taxonomy. Virus biology and virus transmission. Molecular biology of plant virus transmission. Symptomatology of virus-infected plants: (External and Internal symptoms). Metabolism of virus-infected plants. Resistance to viral infection. Methods in molecular virology.

b. Bacteria

History, characteristics and classification. Evolutionary tendencies in Monera (Bacteria, actinomycetes and cyanobacteria). Morphology, genetic recombination, locomotion and reproduction in bacteria. Bacterial metabolism (respiration, fermentation, photosynthesis and nitrogen fixation). Importance of bacteria with special reference to application in various modern sciences specially agriculture, biotechnology and genetic engineering.

Practical:

Viruses

Observation of symptoms of some viral infected plant specimens.

Bacteria, Actinomycetes and Cyanobacteria

1. Methods of sterilization of glassware and media etc.
2. Preparation of nutrient medium and inoculation.
3. Preparation of slides for the study of various forms, capsule/slime layer, spores, flagella and Gram-staining.
4. Growth of bacteria, subculturing and identification of bacteria on morphological and biochemical basis (using available techniques).
5. Microscopic study of representative genera of Actinomycetes and Cyanobacteria from fresh collections and prepared slides.

Recommended Books:

1. Black, J.G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
2. Prescott, L.M., Harley, J.P. and Klein, D.A. 2005. Microbiology McGraw Hill Companies, Inc.
3. Arora, D.R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
4. Ross F.C. 1995. Fundamentals of Microbiology. John Willey Co. New York.
5. Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens, The Haworth Press, Inc.
6. Hull R. Matthews, 2004, Plant Virology, Academic Press.
7. Tortora, G.J. ; Funke, B.R. and Case C.L. , 2004, Microbiology. Pearson Education.

BOT-5102 Diversity of Vascular Plants

Aims and objectives

To enable the students to understand and appreciate the biology and evolution of plant architecture

Course Contents:

Pteridophytes

Introduction, origin, history, features and a generalized life cycle. Methods of fossilization, types of fossils, geological time scale and importance of paleobotany. First vascular plant - Rhyniophyta e.g. *Cooksonia* General characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida *Psilotum*), Lycopsida (*Lycopodium, Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Ophioglossum, Dryopteris* and *Azolla/Marsilea*).

Origin and Evolution of seed habit

Gymnosperms:

Geological history, origin, distribution, morphology, anatomy, classification and affinities of Cycadofillicales, Bennettitales, Ginkgoales, Cycadales and Gnetales. Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.

Angiosperms:

Origin, general characteristics, Importance, and life cycle of angiosperms

Palynology:

An introduction to Neopalynology and Paleopalynology, its applications in botany, geology, archaeology, criminology, medicines, honey and oil and gas exploration.

Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.

Practical:

1. To study the morphological and reproductive features of available genera.
2. Study trips to different parts of Pakistan for the collection and identification of important pteridophytes, gymnosperms and angiosperms.

Recommended Books

1. Beck, C.B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York,
2. Foster, A.S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.
3. Jones, D. 1983. Cycadales of the World, Washington, DC.
4. Mauseth, J.D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.
5. Moore, R.c., W.d. Clarke and Vodopich, D.S. 1998. Botany McGraw Hill Company, USA
6. Raven, P.H. Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants, W.H. Freeman and Company Worth Publishers.
7. Ray, P.M. Steeves, T.A. and Fultz, T.A. 1998. Botany Saunders College Publishing, USA.
8. Taylor, T.N. and Taylor, E.D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.

BOT-5103 Phycology and Bryology

Aims and objectives

To understand the classification, morphology and economic importance of Algae and Bryophytes

Course Contents

Phycology

Introduction, general account, evolution, classification, biochemistry, ecology and economic importance of the following divisions of algae:Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

Bryology

Introduction and general account of bryophytes, classification, theories of origin and evolution. Brief study of the classes: Hepaticopsida, Anthoceropsida and Bryopsida.

Practical:

Phycology:

i. Collection of fresh water and marine algae.
ii. Identification of benthic and planktonic algae
iii. Section cutting of thalloid algae
iv. Preparation of temporary slides
v. Use of camera lucida/micrographs.

Bryology

Study of the following genera:

Pellia, Porella, Anthoceros and *Polytrichum.*

Recommended Books

1. Bold, H. C. and M.J. Wynne 1985. Introduction to Algae**:** structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs

2. Lee. R.E. 1999. Phycology. Cambridge University Press, U.K.

3. Dawson, E.Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.

4. Chapman, V.J. and D.J. Chapman. 1983. Sea weed and their uses. McMillan and Co. Ltd. London.

5. Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.

6. Schofield, W.B. 1985. Introduction to Bryology. Macmillan Publishing Co. London.

7. Hussain, F. and I. Ilahi. 2004. A text book of Botany. Department of Botany, University of Peshawar.

BOT-5104 Mycology and Plant Pathology

Aims and objectives

To introduce the students to Mycology and Diseases caused by Fungi.

Course Contents

Mycology

Introduction**:** General characters of fungi**,** Thallus, cell structure and ultrastructure of fungi. Reproduction: Asexual and sexual reproduction and reproduction structures, life cycle, haploid, heterokaryotic and diploid states. Fungal Systematics**:** Classification of fungi into phyla with suitable examples to illustrate somatic structures, life cycle and reproduction of Myxomycota, Chytridiomycota, Zygomycota (Mucrales) Oomycota (Peronosporales), Ascomycota (Erysiphales, Pezizales), Basidiomycota (Agaricales, Polyporales, Uredinales, Ustilaginales) and Deuteromycetes. Symbiotic relationships of fungi with other organisms (lichens and mycorrhiza) and their significance. Importance of fungi in human affairs with special reference to Industry and Agriculture

Pathology

Introduction and classification of plant diseases. Symptoms, causes and development of plant diseases. Loss assessment and disease control. Epidemiology and disease forecast. Important

diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. damping off, mildews, rusts, smuts, shisham dieback etc.

Practical:

Mycology

General characters and morphology of fungi. Study of unicellular and mycelial forms with septate and aseptate hyphae. Distinguishing characters of different phyla: study of suitable examples. Study of asexual and sexual reproductive structures in different groups of fungi. Study of some common examples of saprophytic, parasitic and air-borne fungi belonging to different phyla.

. **Pathology**

Identification of major plant pathogens under lab and field conditions, cultural studies of some important plant pathogenic fungi, application of Koch's postulates for confirmation of pathogencity. Demonstration of control measures through chemotherapeutants.

Recommended Books:

1. Agrios, G.N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A.R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M., 1996. Introductory Mycology, 4th ed. John Wiley & Sons.
4. Khan, A.G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
5. Mehrotra, R.S. and Aneja, K.R., 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.
6. Moore-Landecker, E., 1996. Fundamentals of Fungi. 4th edn. Prentice Hall Inc., New Jersey, USA.
7. Trigiano, R.N., Windham, M.T. and Windham, A.S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

BOT-5105 Cell Biology

Aims and Objectives

To understand the structure and functions of cell and main functions of all of the major organelles in eukaryotic cells

Course outline:

1. Introduction: cell theory, structure of plant cell, prokaryotes and Eukaryotes cell

2. Cell: Physio-chemical nature of plasma membrane and cytoplasm.

3. Ultrastructure of plant cell with a brief description and functions of the following organelles

a. Cell wall b. Endoplasmic reticulum c. Plastids

d. Mitochondria e. Ribosomes f. Dictyosomes

g. Vacuole h. Microbodies (Glyoxysomes and Peroxisomes)

4. **Nucleus**: Nuclear membrane, nucleolus, ultrastructure and morphology of chromosomes, karyotype analysis.

5. **Chromosomes:** Morophology and moleuclar structure of prokaryotic and eukaryotic chromosome, significance of histones and high mobility proteins in packing of chromosome and gene expression.

6. **Reproduction in somatic and embryogenic cell**: general description of mitosis, cytokinesis and significance of Mitosis, types of meiosis, the first meiotic division, genetic consequences of meiosis, cell cycle.

Practical

1. Cell structure in the staminal hair of *Tradescantia.*

2. Measurement of cell size

3. Microchemical detection of following in the structure of the plant cell. Protein, carbohydrate, cellulose, cutin, pectin.

4. Plastids in various plants. Spirogyra, *Hydrilla, Tradescantia, Daucus carrota, Arisaema, Solanum tubsrosum , Lycopersicon esculentum,* and *Citrus*.

5. Mitosis: Smear / squash preparation of onion roots.

6. Meiosis: Smear / squash preparation from anthers of plants such as oat, onion, wheat, maize

7. Germination of pollen grains of various vascular plants.

8. Demonstration of cell structure through photograph of electron microscope

Books Recommended

1. De. Robertis, E.P. and De. Robertis, E.M.F. Cell and Molecular Biology, 8th Edition, 2001, Holt Lea and Febiger, New Yark.

2. Lodish, H. Baltimor, D. Berk, A. Zipurshy, S.L. Matsudaira, P. Darnell, J. 2001. Molecular Biology of the Cell. Scientific American Books, W.H. Freeman and Company, New Yark.

3. Alberts, B., Bray, D. Lewis, J: Raff, M., Roberts, K and Watson, J.D 1994, Molecular Biology of the cell, Garland Publishing Inc.New Yark.

4. Darnell, Jr. J. Lodisch, H. and Balimore, D. 1990. Molecular Biology of the cells, Scientific American Inc.N.Y.

5. Swanson, C.P., Merz, T. and Young, W.J. 1990 (second edition) Cytogenetics : The chromosome in division, inheritance and evolution. Prentice-Hall Inc.

BOT-5106 Field Botany-I

Aims and Objectives

The basic objective of this course is to acquaint the students with natural flora and fauna in various regions through field trips.

Teaching Methodology

It will involve organizing botanical excursions and visits to various locations pertaining to the courses being taught in 1st semester. The students will have to go for field study trip to the place of the choice of the course incharge(s) and prepare a field report. The team of accompanying teachers will evaluate the level of academic interest, team-spirit, cooperativeness, discipline and other non-scholastic attributes, apart from the Field Report submitted by the students. The senior most teacher in the group will act as Convener of this course and will be responsible to submit the final award to departmental examination committee.

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 2nd SEMESTER

Second Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-5201	Plant Ecology-1	3(2-1)
BOT-5202	Genetics-I	3(2-1)
BOT-5203	Plant Systematics	3(2-1)
BOT-5204	Plant Biochemistry-I	3(2-1)
BOT-5205	Plant Physiology- I	3(2-1)
BOT-5206	Field Botany-II	1(0-1)
Total Credit Hour's		**16**

BOT-5201 Plant Ecology I

Aims and objectives:

To understand the role and interaction of plants with their environment.

Course Contents:

1. Introduction: history and recent developments in ecology
2. Soil: Nature and properties of soil (Physical and Chemical). Water in the soil-plant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion
3. Light and temperature: Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,
4. Carbon dioxide: Stomatal responses, water loss and CO_2-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO_2 concentration. Functional significance of different pathways of CO_2 fixation. Productivity: response of photosynthesis to environmental factors, C and N balance
5. Water: Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants, Water status in soil., Water and stomatal regulation, Transpiration of leaves and canopies.

7. Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress

8. Wind as an ecological factor.

9. Fire as an ecological factor.

Practical:

1. Determination of physico-chemical properties of soil and water.
2. Measurements of light and temperature under different ecological conditions.
3. Measurements of wind velocity.
4. Measurement of CO_2 and O_2 concentration of air and water.
5. Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.
6. Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem pressure potential, leaf area and rate of CO_2 exchange in plants in relation to various environmental conditions.

Recommended Books:

1. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag
2. Bazzaz, F.A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press
3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
4. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag
5. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
6. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.
7. Smith, R. L. 2004. Ecology and field Biology. Addision Wesley Longman, Inc., New York.
8. Barbour, M.G., Burke, J.H and Pitts, W.D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.
9. Smith R.L. 1998 Elements of Ecology. Harper & Row Publishing.
10. Townsend. C.R. Begon. M and J.L Harper. 2002 Essentials of ecology. Blackwell Publishing.
11. Gurevitch. J. Scheiner, S.M. and G.A Fox. 2006 The Ecology of Plants\. Sinaur Asssoicate Inc.

BOT-5202 Genetics -I

Aims and objectives

To understand the nature and function of genetic material.

Course Contents

Extensions of Mendelian Analysis : Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.

Linkage I: Basic Eukaryotic Chromosome Mapping : The discovery of linkage, recombination, linkage symbolism, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,

Linkage II: Special Eukaryotic Chromosome Mapping Techniques : Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.

Gene Mutation :Somatic versus germinal mutation, mutant types, the occurrence of mutations, mutation and cancer, mutagens in genetic disorder, mutation breeding. Evolutionary significance of mutation.

Recombination in Bacteria and their Viruses : Bacterial chromosome, bacterial conjugation, bacterial recombination and mapping the *E.coli* chromosome, bacterial transformation, bacteriophage genetics, transduction, mapping of bacterial chromosomes, bacterial gene transfer.

The Structure of DNA : DNA: The genetic material, DNA replication in eukaryotes, DNA and the gene.

The Nature of the Gene : How genes work, gene- protein relationships, genetic observations explained by enzyme structure, genetic fine structure, mutational sites, complementation.

DNA Function : Transcription, translation, the genetic code, protein synthesis, universitality of genetic information transfer, eukaryotic RNA.

The Extranuclear Genome : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochrondrial genes in yeast, extragenomic plasmids in eukaryotes.

Developmental Genetics:Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.

Population Genetics: Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

Practical:

1. Numerical problems

a. Arrangement of genetic material:

i. Linkage and recombination.
ii. Gene mapping in diploid.
iii. Recombination in Fungi.
iv. Recombination in bacteria.
v. Recombination in viruses.

b. Population Genetics:

i. Gene frequencies and equilibrium.
ii. Changes in gene frequencies,

2. Blood group and Rh-factor

3. Drosophila

i. Culture technique

ii. Salivary gland chromosome

4. Fungal genetics

Sacchromyces culture techniques and study.

5. Studies on variation in maize ear size and colour variation

6. Bacterial Genetics.

i. Bacterial cultural techniques, Gram staining (E. coli, B. subtilis)
ii. Transformation.
iii. Conjugation.

Recommended Books:

1. Gelvin, S,B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
2. Pierca, B.A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
3. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D.C.
4. Klug, W.S. and Cummings, M.R. 1997. Concepts of Genetics, Prentice Hall International Inc.
5. Roth Well, N.V. 1997. Understanding Genetics, second edition, Oxford University Press Inc.
6. Gardner, E.J., 2004. Principles of Genetics, John Willey and Sons, New York.
7. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.
8. Griffiths A.J.F: Wessler, S.R; Lewontin, R.C, Gelbart, W.M; Suzuki, D.T. and Miller, J.H., 2005, Introduction to Genetic Analysis, W.H. Freeman and Company.
9. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
10. Hartl, D.L. and Jones, E.W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbary, USA.
11. Hedrick, P.W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

BOT-5203 Plant Systematics

Aims and objectives

To know floral composition/ system of classification focusing on identification, classification, description nomenclature and flora writings, monographs.

Course Contents

Introduction: Importance and relationship with other sciences, Phases of plant taxonomy. Origin and radiation of angiosperm, their probable ancestors, when, where and how did the angiosperms evolve; the earliest fossil records of angiosperms. Concept of Species : What is a species? Taxonomic species, Biological species, Micro and macro species, Species aggregate., Infra specific categories. Speciation: Mechanism of speciation, Mutation and hybridization Geographical isolation, Reproductive isolation, Gradual and abrupt. Variation : Types of variation, Continuous and discontinuous variation, Clinal variation. Systematics and

Genecology / Biosystematics: Introduction and importance, Methodology of conducting biosystematics studies, Various biosystematics categories such as ecophene, ecotype, ecospecies, coenospecies and comparium. Taxonomic Evidence: Importance and types of taxonomic evidences: anatomical, cytological, chemical, molecular, palynological, geographical and embryological. Nomenclature : Important rules of botanical nomenclature including effective and valid publication, typification, principles of priority and its limitations, author citation, rank of main taxonomic categories, conditions for rejecting names. Classification: Why classification is necessary? Importance of predictive value. Brief history, Different systems of classification with at least one example of each (Linnaeus, Bentham and Hooker, Engler and Prantl, Bessey, Cronquist, Takhtajan, and Dahlgren.

Brief introduction of Numerical taxonomy. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm: Apiaceae (Umbelliferae), Juncaceae, Arecaceae (Palmae), Lamiaceae (Labiatae), Asclepiadaceae, Liliacea, Asteraceae (Compositae), Magnoliaceae, Boraginaceae, Malvaceae, Brassicaceae (Cruciferae), Myrtaceae, Cannaceae, Orchidaceae

Capparidaceae, Papaveraceae, Caryophyllaceae, Poaceae (Gramineae), Casuarinaceae, Ranunculaceae, Chenopodiaceae, Rosaceae, Convolvulaceae, Salicaceae, Cucurbitaceae, Scrophulariaceae, Cyperaceae, Solanaceae, Euphorbiaceae, Trochodendraceae, Fabaceae (Leguminosae), Winteraceae.

Practical:

1. Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan
2. Preparation of indented and bracketed types of keys
3. Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.
4. Study of variation pattern in different taxa.
5. Submission of properly mounted and fully identified hundred herbarium specimens at the time of examination
6. Field trips shall be undertaken to study and collect plants from different ecological zones of Pakistan.

Recommended Books:

1. Ali, S.I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi
2. Ali, S.I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Greuter,W., McNeill, J., Barrie, F.R., Burdet, H. M., Demoulin, V., Filguerras, T.S., Niclson, D.H. Silva, P.C., Skog, J.E., Trehane, P.,Turland, N.J. & Hawksworth, D.L.,(eds.) 2000
4. Davis, P.H. & Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London

6. Nasir, E. & Ali, S.I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold..
8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh
9. Jones, S. B. and Luchsinger, A.E. 1987. Plant Systematics. McGraw Hill, Inc. New York.
10. Naik, V.N. 2005. Taxonomy of Angiosperms. Tata McGraw Hill Publishing Company, New Delhi.

BOT-5204 Plant Biochemistry-I

Aims and objectives:

To elucidate the structure and role of primary metabolites in plants

Course Contents:

Carbohydrates:

Occurrence and classification. A general account of ribose, deoxyribose, xylulose, xylose, D-glucose, D-galactose, D-mannose, cellobiose, sucrose, maltose, trehalose, pentosans, fructosans, starch, cellulose, hemicellulose, amino sugars, derived acids and alcohols, glycosides, mucilages, pectins and lignins.

Lipids:

Occurrence, classification. Structure and chemical properties of fatty acids, triglycerides, phospholipids, glycolipids, sulpholipids, waxes and sterols.

Proteins:

Amino acids and their structure. Electro chemical properties and reactions of amino acids. Classification of proteins. Primary, secondary, tertiary and quaternary structure of proteins. Protein targeting. Protein folding and unfolding. Transport, storage, regulatory and receptor proteins. Protein purification. Protein sequencing. Biological role.

Nucleic Acids:

General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Chemical synthesis of oligonucleotides and DNA sequencing. DNA restriction enzymes. Properties of DNA polymerase I, II and III.

Enzymes:

Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Enzyme kinetics. Nature of active site and mode of action. Allosteric enzymes and feedback mechanism.

Practical:

1. Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
2. To determine the Rf value of monosaccharides on a paper Chromatogram.

3. To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophotometrically.
4. To determine the saponification number of fats.
5. To extract and estimate oil from plant material using soxhlet apparatus.
6. Analysis of various lipids by TLC methods.
7. To estimate soluble proteins by Biuret or Lowry or Dye-binding method.
8. To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.
9. To determine the Rf value of amino acids on a paper chromatogram.
10. Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.
11. To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source.
12. To determine the PKa and isoelectric point of an amino acid.

Recommended Books:

1. Conn E E. and Stumpf P.K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Lehninger, A L. 1998. Principles of Biochemistry. Worth Publishers Inc.
3. Voet, D., Voet J.G. and Pratt, C.W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.
4. Zubay G,..2003, Biochemistry, MacMillan Publishing Co., New York.
   Mckee, T. and Mckee, J.R. 1999. Biochemistry – An Introduction. WCB/McGraw-Hill, New York, Boston, USA.
5. Abdes, R.H. Frey, P.A. and Jencks W.P. 2004, Biochemistry, Jones and Bartlet, London.
6. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
7. Bowsher, C. 2008. Plant Biochemistry. Campbell, M.K. and F. Shawn. 2008.Biochemistry 6th Edition.

BOT-5205 Plant Physiology-I

Aims and objectives

To provide comprehensive knowledge on some vital functions and mechanisms of plants.

Course Contents

Photosynthesis: History of photosynthesis. Nature and units of light. Determination of oxygenic and anoxygenic photosynthesis. Ultrastructure of thylakoid vesicle. Various pigments and photosynthetic activity. Ultrastructure and composition of photosystem-I and II. Absorption and action spectra of different pigments. Mechanism of photosynthesis - light absorption, charge separation or oxidation of water (water oxidizing clock), electron and proton transport through thylakoid protein-pigment complexes. Photophosphorylation and its mechanism. CO_2 reduction (dark reactions) - C_3 pathway and Photorespiration, Regulation of C_3 pathway, C_4 pathway and its different forms, C_3-C_4 intermediates, CAM pathway. Methods of measurement of photosynthesis.

Respiration: Synthesis of hexose sugars from reserve carbohydrates. Mechanism of respiration- Glycolysis, Differences between cytosolic and chloroplastidic glycolysis, Oxidative decarboxylation, Krebs cycle, Regulation of glycolysis and Krebs cycle, Electron transport and oxidative phosphorylation. Aerobic and anaerobic respiration. Energetics of respiration. Pentose phosphate pathway. Glyoxylate cycle. Cyanide resistant respiration.

Translocation of Food: Pathway of translocation, source and sink interaction, materials translocated, mechanism of phloem transport, loading and unloading.

Leaves and Atmosphere: Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation.

Assimilation of Nitrogen, Sulphur and Phosphorus: The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

Practical:

1. To determine the volume of CO_2 evolved during respiration by plant material.
2. To determine the amount of O_2 used by respiring water plant by Winkler Method.
3. Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.
4. To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties.
5. To categorize C_3 and C_4 plants through their anatomical and physiological characters.
6. To regulate stomatal opening by light of different colours and pH.

Recommended Books:

1. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

2. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
3. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
4. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
5. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
6. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
7. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.
8. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
9. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
10. Barton, w. 2007. Recent Advances in Plant Physiology

BOT-5206 Field Botany-II

Aims and objective

The basic objective of this course is to acquaint the students with natural flora and fauna in various regions through field trips.

Teaching Methodology:

It will involve organizing botanical excursions and visits to various locations pertaining to the courses being taught in 2nd semester. The students will have to go for field study trip to the place of the choice of the course incharge(s) and prepare a field report. The team of accompanying teachers will evaluate the level of academic interest, team-spirit, cooperativeness, discipline and other non-scholastic attributes, apart from the Field Report submitted by the students. The senior most teacher in the group will act as Convener of this course and will be responsible to submit the final award to departmental examination committee.

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 3rd SEMESTER

Third Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-6301	Plant Ecology-II	3(2-1)
BOT-6302	Plant Biochemistry-II	3(2-1)
BOT-6303	Plant Anatomy	3(2-1)
BOT-6305	Molecular Biology	3(2-1)
BOT-6305	Biostatistics	3(2-1)
BOT-6405 *Optional	Thesis/*(Assigned in 3rd semester and assessed in 4th semester)* *Non Thesis students*	3(3-0)
Total Credit Hour's		**18**

BOT-6301 **Plant Ecology -II**

Aims and Objectives

To provide comprehensive knowledge of population, community, ecosystem ecology and its relevance to mankind.

Course Contents

1. The plant community: discrete and continuum concepts with modern synthesis.
2. Community attributes: leaf Spectra, life form distribution pattern, Periodicity, Phenology, Fidelity, Constency, Raunkiaer law of frequency, Homogeneity and Heterogeneity, age class etc.
3. Species diversity concepts.
4. Plant community structure.
5. Plant community dynamics (succession):
6. Method of sampling of plant community: quardrat, line intercept, Point centered quarter methods.

7. Quantitative community description: Gradients analysis, ordination techniques and classification.

8. Productivity, measurement, energy flow and efficiency.

9. Flora of Azad Jammu and Kashmir.

Practical

1. Measurement of plant biomass and net primary productivity.

2. Measurement of water relation components: conductance.

3. Measurement of radiation, temperature, humidity and wind velocity.

4. Soil texture and structure. Measurement of plant biomass and net primary productivity.

5. Seed dispersal, seed bank, germination and reproductive allocations.

6. Community attributes.

7. Reconnaissance survey of different local communities.

8. Detailed sampling of local vegetation including gradient, ordination, and classification.

9. Study of local ecosystem.

Books Recommended:

1. Schultz J.C. 2005. Plant Ecology, Springer-Verlag .

2. Townsend C.R. Begon. M and J.L. Harper 2002. Essentials of Ecology, Blackwell Publishing,

3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag

4. Gurevitch, et al., 2002.The Ecology of Plants, Sinauer Associates, Inc.

5. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, The Benjamin-Cumming Publishing Co.

6. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers,

7. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.

8. Hussain, S. Pakistan Manual of Plant Ecology,

9. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad

10. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.

BOT-6302 Plant Biochemistry-II

Aims and Objectives

To explicit the fundamentals of metabolic energy, Metabolism and Plant constituents.

Course Outline

1. Bioenergetics: Energy, laws about energy changes. Oxidation and reduction in living systems.

2. Metabolism:

i. Biosynthesis, degradation and regulation of sucrose and starch. Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.

ii. Replication of DNA. Reverse transcription. Biosynthesis of DNA and RNA.

iii. Components of protein synthesis. Genetic code, protein synthesis: initiation, elongation and termination.

3. Alkaloids: Occurrence, physiological effects, chemical nature with special reference to solanine, nicotine, morphine, theine and caffeine. Aflatoxins, their nature and role.

4. Terpenoids: Classification: monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis.

5. Vitamins: General properties and role in metabolism.

Practicals:

1. Separation of soluble proteins by polyacrylamide gel (PAGE) electrophoresis.
2. Separation of nucleic acids by gel electrophoresis.
3. To estimate the amount of vitamin C in a plant organ (orange, apple juice).
4. To determine potential alkaloids in plants.
5. To estimate terpenoids in plants.

Recommended Books:

1. Conn E. E. and Stumpf, P.K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Albert L. Lehninger, 1998. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D. Voet J.G. and Pratt, C.W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith; E L., Hill; R. L., Lehman; R. I., Lefkowits, R J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay. G. 2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth,. J.M., Strichbury T. and Scaife, J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.

8. Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.

9. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.

10. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

BOT-6303 Plant Anatomy

Aims and Objectives:

To provide comprehensive knowledge about internal organization and anatomy of vascular plants.

Course Contents

1. The plant body and its development: fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.

Meristematic tissues: classification, cytohistological characteristics, initials and their derivatives.

2. Apical meristem: Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.

3. Leaf: types, origin, internal organization, development of different tissues with special reference to mesophyll, venation, bundle-sheaths and bundle-sheath extensions. 4. Enlargement of epidermal cells.

Vascular cambium: Origin, structure, storied and non-storied cell types, types of divisions: additive and multiplicative; cytoplasmic characteristics, seasonal activity and its role in the secondary growth of root and stem. Abnormal secondary growth.

4. Origin, structure, development, functional and evolutionary specialization of the following tissues: Epidermis and epidermal emergences, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem with special emphasis on different types of woods, Periderm.

5. Secretory tissues: Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.

6. Anatomy of reproductive parts:

- Flower
- Seed
- Fruit

7. Economic aspects of applied plant anatomy
8. Anatomical adaptations
9. Molecular markers in tree species used for wood identification.

Practicals:

1. Study of organization of shoot and root meristem, different primary and secondary tissues from the living and preserved material in macerates and sections, hairs, glands and other secondary structures.

2. Study of abnormal/unusual secondary growth.

3. Peel and ground sectioning and maceration of fossil material.

4. Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides.

Recommended Books

1. Dickison, W.C. 2000. Integrative plant anatomy. Academic Press, U.K.
2. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
3. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
4. Metcalf, C.R. and Chalk, L. 1950. Anatomy of the Dicotyledons. Clerondon Press. Oxford.
5. Anon. Manual of Microscopic Analysis of Feeding Stuffs. The American Association of feed Microscopists.
6. Vaughan, J.G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.
7. Metcalfe, C.R. 1960. Anatomy of the Monocotyledons. Gramineae. Clerondon Press, Oxford.
8. Metcalfe, C.R. 1971. Anatomy of the Monocotyledons.V. Cyperaceae. Clerondon Press, Oxford.
9. Cutler, D.F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford.
10. Cutler, D.F. 1978. Applied Plant Anatomy. Longman Group Ltd. England
11. Raymond, E.S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
12. Eames, A.J. and L.H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat Mac-Graw Hill Publishing Company Limited, New Delhi.

BOT -6304 Molecular biology

Aims and Objectives

To disseminate the knowledge of molecular basis of life.

Course Contents:

1. Nucleic Acids: DNA-circular and superhelical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA
2. Proteins: Basic features of protein molecules. Folding of polypeptide chain, α-helical and β-secondary structures. Protein purification and sequencing.
3. Transcription: Enzymatic synthesis of RNA, transcriptional signalsTranslation: The genetic code. The Wobbling, polycistronic and monocistronic RNA. Overlapping genes.
4. Gene regulation in Eukaryotes: Differences in genetic organization and prokaryotes and eukaryotes. Regulation of transcription, initiation, regulation of RNA processing, regulation of nucleocytoplasmic mRNA transport, regulation of mRNA stability, regulation of translation, regulation of protein activity.
5. Plant Omics: Transcriptomics; DNA libraries, their construction, screening and application. Microarray of gene technology and its application in functional genomics.

6. Proteomics; structural and functional proteomics. Methods to study proteomics 7. Metabolomics; methods to study metabolomics; importance and application of metabolomics.

8. Bioinformatics and computational biology. Levels, scope, potential and industrial application of bioinformatics and computational biology.

Practical:

Following techniques will be used for the i\solation and analysis of different components:
Extraction of RNA, DNA and proteins
Electrophoreses: One and two dimensional
Purification of proteins, RNA and DNA.
Amplification using PCR.
Northern, Western and Southern Blotting.

Recommended Books:

1. Cullis, C.A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.

2. Gibson, G. and S.V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.

3. Gilmartin, P.M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.

4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W.H. Freeman & Co., New York.

5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4th edition. Jones and Bartlett Publishers, Massachusetts.

6. Watson, J.D. et al. 2004. Molecular Biology of the Gene. Peason Education, Singapore.

7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.

8. Weaver, R.F. 2005. Molecular Biology. Mc|Graw Hill, St. Louis.

BOT-6305 Biostatistics

Aims and Objectives

The objective of this course is to equip the students with statistical concepts and methods: The emphasis will be on learning how to collect, summarize, analyze, and interpret real-world data in a practical manner.

Course Contents

1. **Introduction and scope:** Definition: Characteristics, importance and limitations, population and samples.

2. **Frequency distribution and probabilities**: Formation of frequency table from raw data, histograms. Applications of probabilities to simple events.

3. **Measures of central tendencies and dispersion**: Arithmetic mean, median, mode, range, variance and standard deviation, standard error of the mean, mean deviation, semi-interquartile range.

4. **Tests of significance**: Introduction:

1- t-test: Basic idea, confidence limits of means, significant difference of means.

2- X2 – test: Basic idea, testing goodness of fit to a ratio, testing association (contingency table).

3- F-test: Introduction and application in analysis of variance.

4- L.S. D. test, Dancunn Multiple Range Test (for comparison of individual means).

5. **Design of experiment**: Concept of design, principles of experiment, planning of an experiment, replication and randomization, Field plot technique, Layout and analysis of completely randomized design, randomized complete block design, Latin square, factorial design, treatment comparison.

6. **Correlation and regression:** Brief account of correlation and regression.

Lab Outlines:

1. Probability of simple events.
2. Data collection, arrangement of data in frequency table.
3. Calculation of mean from group and ungrouped data.
4. Calculation of variance and standard deviation from grouped and ungrouped data.
5. T-test.
6. X2 – test.
7. Analysis of variance – one factor design
8. Analysis of variance – two way analysis
9. Analysis of variance – for latin square
10. Analysis of variance – for factorial design.
11. Correlation.
12. Linear Regression.

Books Recommended

1- Bailey. N.T.J. 1994. Statistical Methods in Biology, Cambridge University Press. 2- Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press. 3- Wonnacott, T.H. and Wonnacott, R.J. 1990. Introductory Statistics, John Willey and Sons.

LIST OF ELECTIVE COURSES FOR M.Sc-4 YEARS PROGRAM IN BOTANY 3rd SEMESTER

Course code	Course Title	Credit Hrs.
BOT-6306	Plant Pathology	3(2-1)
BOT-6307	General Biotechnology	3(2-1)
BOT-6308	Biological techniques	3(2-1)
BOT-6309	Industrial and Microbial Biotechnology	3(2-1)
BOT-6310	Energy Plantation and Bio-fuels	3(2-1)
BOT-6311	Biodiversity and Climate Change	3(2-1)
BOT-6312	Principles and Applications of Bioremediation	3(3-0)
BOT-6313	Bioinformatics	3(1-2)
BOT-6314	Agriculture Biotechnology	3(3-0)
BOT-6315	Research Methodology	3(2-1)
BOT-6316	Applied Computer	3(2-1)
BOT-6317	Ethnobotany	3(2-1)
BOT-6318	Salinity and Water loging	3(2-1)

BOT-6306 Plant Pathology

Aims and Objectives

1. To study selected microbial plant diseases and their importance for economy.

2.To identify fungal and bacterial diseases of plant. To develop the strategies for the control of plant diseases.

Course contents

Study of major microbial plant diseases. Importance of plant diseases in Pakistan. Nature and clasifcation of plant diseases. Etiology and symptoms of plant diseases of field crops, fruits and vegetables. Fungal diseases: Rusts, Smuts, Wilts and Rot rots. Bacterial diseases: Blights, Cankers, Leaf spots and Rots. Viral diseases: Mosaics, Dwarfs, Stunts, Yelows, Leaf curl, Witches Brom, Ring spots and Wilts' Quarantine, eradication and International Plant Protection. Cultural practices in disease control, chemical control. Resistant varieties. Future problems and prospects of Plant Microbiology.

Practical

1. Sample colection, isolation and identifcation of plant pathogen (farms, orchards, nurseries).
2. Field trips.

Recommended Books

1. Nautiyal , C.S., Dion, P., (Editor), V. L. Chopra , V.L., 208. Molecular Mechanisms of Plant and Microbe Coexistence.1st Editon. Springer- Verlag New York, LC.
2. Aneja K. R. 209. Experiment in Microbiology: Plant Pathology & Biotechnology. New Age Int. Pvt. Ltd.74
3. Narayanasamy, P., 2010. Molecular Biology in Plant Pathogenesis and Disease Management: Microbial Plant Pathogens. 1st Editon. Springer-Verlag New York, LC
4. Chen, J., 201. Experimental Plant Virology. 1st Editon. Springer- Verlag New York, LC
5. Van Regenmortel M. H. V. and Fraenkel-Conrat H. 2013 The Plant Viruses. Springer.

BOT-6307 General Biotechnology

Aims and Objectives

To understand the basic techniques and principles of tissue culture and DNA Recombinant Technology

Course Contents

Restriction and modification system: Types, Enzyme, classification, Nomenclature, Genetics and applications. Cloning Vectors: Plasmids (Bacterial and yeast), Viruses (Ca, MV, SV40, BPV) phages (Lambda, Mu, M13). Cosmids and phagmids. Cutting and joining of DNA: Isolation and purification of DNA, Ligation of DNA molecules, blunt ends and cohesive termini. Cloning Strategies; selection and characterization molecules, verification and amplification of desired genes, Gene Banks, PCR, RFLP, DNA sequencing techniques, DNA cloning, Southern blotting, Northern blotting, western blotting, site specific mutagenesis. Protein engineering. Applications of recombinant DNA technology with comprehensive theoretical know-how macromolecules of desired characters for transgenic.

Practicals

1. Isolation of plasmids and chromosomal DNA from bacteria and yeast.
2. Screening of bacteria for plasmids by electrophoresis of total cell lysate.
3. Gel electrophoresis of plasmids DNA chromosomal DNA & RNA.
4. Comparing plasmids of different molecular weights using Molecular Weights markers.

Recommended Books

1. Rehm, J.J. 1998. Fundamentals of Biotechnology, VCH Publishers, N.Y.
2. Lee, B.H. 1996. Fundamentals of Food Biotechnology, VCH Publishers, N.Y.
3. Pirt, J.B. 1975. Microbes and Cell Cultivation, Blackwell Scientific Publishers, London.
4. Bailey, J.E. and Ollis, D. F., 1986. Biochemical Engineering Fundamentals, McGraw Hills.
5. Watson, J.D., Tooze, J. and Kurta, D.T. 1983. Recombinant DNA-A short Course, Scientific American Books, New York.
6. Old, R.W. and Primrose, S.B. 1989. Principles of gene manipulation. 4th edition, Blackwell Scientific Publishers, London.
7. Molecular cloning, 1989. A Laboratory manual, 2nd edition, Cold spring Harbor Laboratory.

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BOT-6308 Biological Techniques

Aims and Objectives

To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences

Scientific drawing -Purpose and principle, Basic understanding on principle and uses of the following:

Course Contents

Microscopy: Principles of light microscopy. Magnification, Resolution, Contrast. Types of microscopy, Bright field (Compound Microscope), Scanning microscopy, Eyepiece micrometers, Camera Lucida Phase Contrast Dark field Interference microscope, Electron microscope. **Micrometery and Morphometry**: Use of stage and ocular micrometer. Calibration of ocular micrometer. Size measurement (length, width, diameter). **Standard system for weight, length, volume :** Calculations and related conversions of each:- Metric system- length; surface; weight - Square measures- Cubic measures (volumetric)- Circular or angular measure-

Concentrations- percent volume; ppt; ppm - Chemical molarity, normality - Temperature- Celsius, centigrade, Fahrenheit. Preparation of stock solutions of various strengths. **Specimen preparation for optical microscopy**: **Microtomy:** Fixation, embedding, Section cutting (transverse, longitudinal section, mounting and staining. Sections in paraffin and cryosections. **Extraction techniques:** Centrifugation, Ultra centrifugation, cell fractionation, filtration, Distillation, Use of Soxhalet and Rotary evaporator for extraction. **Separation Techniques:** Chromatography: Principle, applications, types, thin layer, paper, column, gas, ion exchange chromatography. Electrophoresis: Principle, applications, types. **Spectrophotometery:** Principle, applications, types, visible spectrum, UV spectrum, atomic absorption. **Basic principles of Sampling and Preservation:** Sampling soil organisms, Invertebrates, Aquatic animals, Mammals, Estimation of population size, Preservation of dry and wet specimens. Preservation techniques – Taxidermy - Rearing techniques, Laboratory and field.

Recommended Books

1. Dean, J. R. Extraction methods for environmental analysis. 1999. John Wiley And Sons Ltd. UK.
2. Curos, M. Environmental sampling and analysis: Lab Manual. 1997. Crc Press Llc. USA.
3. Curos, M. Environmental sampling and analysis: For Technician. 1997. CRC Press LLC. USA.
4. Cheesbrough, M. District laboratory practice in tropical countries. Part i. 1998. University Press Cambridge, UK.
5. Cheesbrough, M. District laboratory practice in tropical countries. Part ii. 1998. University Press Cambridge, UK.
6. Slingsby, D. and Cock, C. Practical ecology. 1986. Mcmillan Education Ltd. London.

BOT-6309 Industrial and Microbial Biotechnology

Aims and Objectives

To make students familiar with the applications of biotechnology in the practical field to enhance the productivity at industrial side.

Course Contents

Application of biotechnology in industry; biotechnology of raw ore processing (bioleaching of sulphides, carbonates, silicates etc.) accumulation of metals by microbial cells, biopulping, biofuels, microbial enhanced oil recovery; application in agriculture, food and livestock products; biofertilization; production of cheese, probiotics, bread, single cell protein, citric acid, amino acid, acetic acid, production in drinks; microbial enzymes in industry, enzyme immobilization. Significance of Industrial Microbiology, Classification of microorganisms, fermentation principles, Culture techniques, Measurement and control of microbial processes, Introduction of probiotics. Introduction to industrial biotechnology, Biotechnology in textile, Chemical, Food, Pharmaceuticals, Agricultural industries, Industrial biocatalysts, Industrial waste, Industrial strain improvement, Screening for new metabolites, Recombinant DNA technology, Substrates for industrial fermentation, Regulation of primary and secondary metabolism, Design and development of industrial bioreactors, Problems and possibilities in fermentation scale up procedure, Bioreactors, Fermentors and controls, Bioenergy and Biofuels, Product recovery and refinement.

Practicals

Screening of enzymes of industrial significance, enzyme immobilization; Production of cheese, yogurt, citric acid, amino acid and acetic acid.

Recommended Books

1. Old R.W. and S. B. Primrose. Principles of Gene Manipulation, An introduction to Genetic Engineering (4th Edition). Blackwell Scientific Publications. 1994.
2. Setlow J. K., Genetic engineering; Principles and methods. Kluwer Academic Publishers 2000.
3. Nicholl. D. S.T., An introduction to Genetic Engineering, Cambridge University Press, 2000.
4. Yount L., Genetic Engineering, Gale group, 2002.
5. Sambrook J., D. W. Russell, J. Sambrook, Molecular Cloning: A laboratory Manual 93-Volume Set), Cold Spring Harbor Laboratory press, 2002.
6. Brown T.A., An introduction to Gene Cloning and DNA analysis: 4th Edition Blackwell Science Inc. 2001.

BOT-6310 Energy Plantation and Bio-Fuels

Aims and Objectives

To develop understanding regarding the prospects and possibilities of raising bioenergy plantations, bio-fuel production, and conversion technologies.

Course Contents:

Introduction and advantages of energy plantations. Global overview of energy and biomass consumption patterns. Energy and biomass consumption patterns in Pakistan. Environmental impacts of biomass energy. Basic concepts of forest production ecology; the biomass production potential of a forest ecosystem; production of energy wood at special short-rotation plantations; use of residual biomass from traditional forestry operations for energy; harvesting and transportation logistics of energy wood production.A brief introduction to bio-energy conversion technologies; utilization of bio-energy with reference to the global carbon cycle and climatic change, especially with regard to CO_2 emissions and carbon storage; and the role of bio-energy in Pakistan and other countries, especially its potential for the development of rural areas. Assessment of bio-energy programs in Pakistan. Power generation from energy plantation, biomass gasification-producer gas. High Density Energy Plantations (HDEP).Land and biomass availability for sustainable bio energy. Bio-fuels introduction, Tree Born Oils (TBO's), potentials and advantages, bio-diesel trans-esterification, Important bio-fuel species and their silvicultural management. Overview of the markets for wood biomass for energy production globally and within the Pakistan this includes the supply, quantity, demand, and consumption as well as consumer market aspects. Fundamentals of the policies that have impacts on the supply and consumption of the energy wood; wood based fuels; and/ or bio-energy and bio-fuels' markets **,** Need for research and development on environment friendly and socio economically relevant technologies. Energy from plants-problems and prospects. Petro-crops. Criteria for evaluation of different species for energy plantation. Advanced energy technologies in the production of bio-fuels

Practical:

Identification of important fuel woods and petro-crops. Study of different properties of bio fuels used in Pakistan. Determination of calorific value, moisture and ash content in biomass. Study of energy consumption pattern in rural and urban areas through survey. Visit to nearby Bio-energy units.

Recommended Books

1. Donald L. Klass. 2010. Biomass for Renewable Energy, Fuels, and Chemicals. Amazon Publishers
2. Snelder, D.J. & Lasco. R. 2008. Small Holder Tree Growing for Rural Development and Environmental Services. Springer Publisher.
3. Kumar V. 1999. *Nursery and Plantation Practice in Forestry*. Scientific Publications.
4. Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.
5. Chaturvedi AN. 1994. *Technology of Forest Nurseries*. Khanna Bandhu
6. William, B. R. & Gowen. 1994. Forest Resources and Wood based biomass. Oxford and IBH New Delhi.

BOT-6311 Biodiversity and Climate Change

Aims and Objectives

To equip the students with knowledge and importance of biodiversity and climate change and learn skills and techniques to conserve biodiversity and mitigate global warming and climate change.

Course Contents

Definition of biodiversity and its scope. Factors affecting biodiversity of flora and fauna (human population, industrialization and unsustainable land uses). Biodiversity status of flora and fauna in various zones/regions. Threatened and endangered mammals, birds, and plant species in Pakistan. Biodiversity rich areas and hotspots. Conservation and management strategy for biodiversity in Pakistan. Ecosystem based adaptation. The concept of climate change and its harmful effects. Causes of climatechange. Climate change assessment and predictions. Recommended actions to reduce global warming and climate change.

Practical

Field: Visit different sites to assess the status of biodiversity.

Filed: Visit to biodiversity conservation projects.

Field: learning various methods to reduce global warming.

Recommended Books

1. IUCN (1996): Sarhad Provincial Conservation Strategy, Government of NWFP.

2. Khattak, A.K. (2006): Resource Management Plan for Palas Forests, Lower Kohistan Forest Division, NWFP Forest Department.

BOT-6312 Principles & Applications of Bioremediation

Aims and Objectives

To equip the students with the knowledge of biological techniques to overcome different types of environmental pollution

Course Contents

Introduction to biodegradation and bioremediation.Types and nature of recalcitrants, xenobiotics.Types and mechanisms of biodegradation and bioremediation.Bioremediation of organic polutants (hydrocarbons, PCBs, PAHs, halogenated compounds, plastics, dyes, herbicides and pesticides). Bioremediation of heavy metals. Various methods and technologies used for emediation. Role of enzymes in bioremediation. Factors efecting bioremediation. Aerobic and anaerobic degradation pathways of contaminants. Microbial ecology and metabolism. Microbial community dynamics during bioremediation. Molecular strategies used to explore the role of microbes in bioremediation.

Recommended Books:

1. Environmental Microbiology, 2nd Editon, Mitchel, T., G. J-Dong. John Wiley & Sons, Inc., Hoboken, New Jersey (2010).

2. Bioremediation: Aplied Microbial Solutions for Real-World Enviornment Cleanup by Ronald M. Atlas and Jim Philp (205).

3. Environmental Biotechnology. Concepts and Aplications. Jordening H.-J., J. Winter. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim (205).

4. Biodegradation and Bioremediation- Vol 2. Singh and Ajay Springer- Verlang Berlin and Heidelberg GmbH & Co. Kg, Germany (204).

5. Biodegradation and Biocatalysis. Wacket, L. P., C. D Hershberger. ASM Pres, American Society for Microbiology, N. W. Washington, DC (201).

BOT-6313 Bioinformatics

Aims and Objectives

To familarize students with biological data mining from online databases and the use of various bioinformatics tols for extracting and procesing biological data.

Course Contents

Introduction; bio-computing; biological databases - types and retrieval of nucleic acid (or genomic) or protein sequence information; sequence alignment - pairwise, multiple; phylogenetics; in silco identifcation of protein motifs and domains; structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules; identifcation of genes and promoter regions within genomes; networks; strategies for whole genome sequencing and asembly.

Recommended Books

1. NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc.

2. Bioedit, Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treview, Alscript, Genetic Analysis Software, Phylip, MEGA4.0 etc.

Recommended Books:

1. Claverie JM and Notredame C, 206. Bioinformatics for Dummies. 2nd Editon; Wiley Publishing.

2. Xiong J, 206. Esential Bioinformatics. 1 st Editon; Cambridge University Pres.

3. Xia X, 207. Bioinformatics and the Cel: Modern Computational Aproaches in Genomics, Proteomics and Transcriptomics. 1st Editon. Springer31

4. Mathura V and Kangueane P, 209. Bioinformatics: A Concept-Based Introduction. Springer

5. Mount DW, 204. Bioinformatics Sequence and Genome Analysis. 2nd Editon; Cold Spring Harbor Laboratory Pres.

6. Sperschneider V, 208. Bioinformatics: Problem Solving Paradigms. Springer.

BOT-6314 Agriculture Biotechnology

Aims and Objectives

To acquaint students with techniques and skils employed for producing transgenic crops.

Course Contents

Agriculture biotechnology and its aplications in crop improvements; cel and plant tisue culture methodology; improvement of plants via plant cel culture; plant molecular biomarkers;

direct and indirect methods of plant and animal transformation: gene gun method of transformation, Agrobacterium mediated transformation, chloroplast transformation and polyethylene glycol (PEG) mediated transformation; transgenic crops with herbicide, biotic and abiotic stres resistance; problems related to transgenic plants; geneticaly modified organisms (GMOs); field evaluation and commercialization of GMOs; possible efects of releasing GMOs into the environment; bio-fertilzers, bio-pesticides and their types; non-symbiotic nitrogen fixers; present and future prospects of biofertilzers.

Practical

Preparation of Murashige and Skog medium and stocks of macronutrients, micronutrients, and hormones; selection of ex-plant, medium preparation and calus induction; culturing Agrobacterium and using it to infect plant calus; selection of trans formant's; regeneration of plantlets and aclimatization; plant DNA extraction and PCR for detecting introduction of oreign DNA into plants.

Recommended Books

1. Qaim M, 2010. Agricultural Biotechnology in Developing Countries: TowardsOptimizing Benefits for Por. Springer

2. Kemp Ken F, 2010. Genetic Modifcation of Plants: Agriculture, Horticulture and Forestry (Biotechnology in Agriculture and Forestry). Springer.

3. Heren RV, 2012. Introduction to Agricultural Biotechnology. 2nd Editon; Delmar Cengage Learning.

4. Slater A, 208. Plant Biotechnology: The Genetic Manipulation of Plants. 2nd Editon; Oxford University Pres, USA

5. Altman A, 201. Plant Biotechnology and Agriculture: Prospects for the 21st Century. 1 st Editon; Academic Pres.

BOT-6315 Research Methodology

Aims and Objectives

To enable the students to know the theoretical aspects of planning research, handling, presentation of data, writing and submission of research papers and thesis.

Course Contents

Research Methods (planning research, various methods, analyzing results, giving reports, etc.). Research process including: formulating research questions; sampling (probability and no-probability). **Measurement (surveys, scaling, qualitative, unobtrusive).** Research design (experimental and quasi-experimental). **Data analysis; and writing the research paper.** The Major theoretical and philosophical underpinnings of research including: the idea of validity in research; reliability of measures; and ethics

Recommended Books

1. Brizuela, B.M., Stewart, J.P., Carrilo, R.G., and Berger, J.G. 2000. Acts of Inquiry in Qualitative Research. Harvard Education Press, Cambridge.

2. Leedy, P.D., and Ormond, J. E. 2004. Practical Research: Planning and Design. 8th Edition. Prentice Hall, Inc., London.

3. Shank, G.D. 2001. Qualitative Research: A Personal Skills Approach. 2nd Edition. Pearson Education Inc., New York.

4. Brandret, M., Mchille, L., and Peterson, L. 1996. Practical Methods in Mycorrhizal Research. Mycologue Publications, University of Guelph, Guelph, Ontario.

5. Harley, J.L., and Smith, S.E. 1983. Mycorrhizal Symbiosis. Academic Press, London.

6. Kendrick, B. 2001.The Fifth Kingdom. 3rd Edition. Focus Publishing/R. Pullins Company, Massachusetts.

7. Schenk, N.C. 1982. Methods and Principles of Mycorrhizal Research. The American Phytopathological Society. St. Paul, Minnesota.

BOT-6316 Applied Computer

Aims and Objective

To acquaint the students with the structure, operation and application of computers.

Course Contents

History, classification, basic components, CPU, memory, peripheral devices, storage media and devices, physical and logical storages, data organization, file storage, program and software, application software, operating system, social impact of computer on society, computer in office, industry and education, internet and its services like email search engine, retrieval of information using different websites, social impact of internet on society.

Practical

Basic computer organization including motherboard, memory, I/O cards, networking devices, introduction to office tools including spreadsheet, word processing and presentation, overview of different browsers, introduction to various operating system.

Recommended Books:

1. Brain Williams and Stacey Sawyer, "Using Information Technology" McGraw-Hill, ISBN: 0072260718,(Latest edition).

3. Peter Norton's "Introduction to computer'' latest edition.

4. J. Glenn Brookshear, " Computer science" an overview, 10th edition.

2. Lab handouts-miscellanneous.

BOT-6317 ETHNOBOTANY

Aims and Objectives

To understand the local uses of various plants for human services.

Course Contents

1. Introduction

Definition, history, objectives and significance, nature of ethnobotany

2. Relationship of ethnobotany with related subjects

Botany, ecology, cultural anthropology, agronomy, economics, forestry and horticulture

3. Traditional Uses of Plant Resources

Use for livelihood, economic uses, medical uses, cultural uses, ecological uses

4. Ethnobotany and Community development

Community institution, role of ethnobotany, participatory community development

5. Ethnobotany and development of Plant Resources

Sustainable exploitation, valuation

6. Development of ethnobotany

Cultivation, training program and specific techniques

7. Applied ethnobotany

Local inventories values, questions of harvested resources, ethnobotanical knowledge and biodiversity, applications of applied ethnobotany in Pakistan

Practical

1. Field documentation methods

2. Folk nomenclature and classification

3. Specimen collectin

5. Development of questionnaires

6. Valuating plants of ethnobotanical significance

Recommended Books

1. Cotton, C.M. 1997. Ethnobotany: Principles and Applications. John Wiley and Sons, New York.

2. Cunningham, A.B. 2001. Applied Ethnobotany: People, Wild Plant Use and Conservation. Earthspan Publication, London.

3. Hamilton, S.L. 1993. Ethics, Religion and Biodiversity: Relationship between Conservation and Cultural values. The White Horse Press, Cambridge.

4. Jain, S.K., and Mudgal, V. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehra Dun.

5. Martin, G.J. 1995. Ethnobotany: A Methods Manual. Chapman & Hall, London.

6. Rostogi, 1999. Methods in Applied Ethnobotany. International Centre for Integrated Mountain Development, Kahtmandu.

BOT-6318 SALINITY AND WATER-LOGGING

Aims and Objectives

To provide comprehensive knowledge of nature, origin, causes and extent of salinity and water-logging in Pakistan.

To enable the students to assess the quality of irrigation water and physiology of salt tolerance of plants

Course Contents

1. Sources of salinity

Marine sources, lithogenic sources, anthropogenic sources

2. Saline habitats

Marine salines, coastal salines, inland salines, aerogenic salines, anthropogenic salines, extent of salinity in Pakistan, interrelation of salinity and water-logging

3. Classification, sampling and analysis of salt effected soil

Classification system, Saline soil, sodic soil, saline sodic soil, composite sampling, soil pit, salinity of soil, physical characteristics of soil, SAR and its effects on soil characteristics.

4. Effect of soil salinity

Effect of soil salinity and alkalinity on plant growth, classification of halophytes

5. Quality and classification of irrigation water

Characteristics that determine water quality for irrigated agriculture, Wilcox water classification, US Salinity Laboratory-classification, and Doneens classification system.

6. Management and reclamation of saline and sodic soil

Management and reclamation of saline and sodic soils, biological, chemical and hydro-technical methods, mechanism of salt tolerance in plants, adaptations of halophytes

7. Water-logging

Causes of water-logging, extent of water-logging in Pakistan, physico-chemical changes in soil as a result of water logging, gas exchange, conductivity, sulphate, soil nitrogen, silica, oxidation-reduction potential, Iron & Mn relations in water-logged soil, Adaptations of plants to waterlogging

Practical

1. Measurement of electrical conductivity of soil saturation extract and measurement of pH and EC of water logged soil

2. Measurement of cation exchange capacity of soil.

3. Determination of the amount of soluble calcium.

4. Calculation of exchangeable sodium percentage of soil from its sodium adsorption ratio.

5. Determination of the amount of chlorides and sulphates in a soil saturation extract.

6. Analysis of the irrigation water for the following:

Electrical conductivity, sodium adsorption ratio, chlorides, sulphates, carbonates, bicarbonates, total dissolved salts, Ca+2, Mg+2, Na+2

7. Classification of irrigation water with reference to its salinity and sodium hazard.

8. Effects of salinized media on germination of seeds of different crop plants.

9. Quantitative study of halophytes in the field.

10. Visit to laboratory of Soil Survey of Pakistan, Lahore.

11. Field observations of saline and water-logged areas of the Punjab and its effects on plant distribution through quantitative studies of vegetation.

Recommended Books

1. Armstrong, W. 1975. Water-logged Soils in Environment and Plant Ecology. John Wiley and Sons, London.

2. Chapman, V.J. 1971. Salt Marshes and Deserts of the World. Leonard Hill Books, London.

3. F.A.O. 1975. Quality of Water in Agriculture. Bulletin 29, Irrigation and Drainage Series, FAO, Rome.

4. Richards, L.A. 1954. Diagnosis and Improvement of Saline and Alkali Soils Handbook 60, U.S. Department of Agriculture, Washington.

5. UNESCO 1973. Irrigation, Drainage and Salinity. Hutchinson, FAO, Rome.

6. Waisel, Y. 1972. Biology of Halophytes. Academic Press, New York.

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 4th SEMESTER

Fourth Semester

Course Code	**Course Title**	**Lecture Credit's**
BOT-6401	Genetics-II	3(2-1)
BOT-6402	Biodiversity and Conservation	3(2-1)
Bot-6403	Plant Physiology-II	3(2-1)
BOT-6404	Principles of Biotechnology	3(3-0)
*BOT-6405 Optional	Thesis *Non Thesis students*	(06) 3(3-0)
Total Credit Hour's		**15**

BOT-6401 Genetics II

Aims and Objectives To introduce students to recombination of genetic material at molecular levels with emphasis on introduction to biotechnology and genomics

Course Contents

1. Recombinant DNA :Recombinant DNA Technology – Introduction, Basic Techniques, PCR and Rt PCR, Restriction enzymes, Plasmids, Bacteriophages as tools, the formation of recombinant DNA, recombinant DNA methodology, recombinant DNA and social responsibility, Site directed Mutagenesis, DNA sequencing.
2. Application of Recombinant DNA: Applications of recombinant DNA technology using prokaryotes, recombinant DNA technology in eukaryotes: An overview, transgenic yeast, transgenic plants, transgenic animals, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.
3. Control of Gene Expression: Discovery of the *lac* system: negative control, catabolite repression of the *lac* operon: positive control, transcription: gene regulation in eukaryotes - an overview.
4. Mechanisms of Genetic Change I: Gene Mutation : The molecular basis of gene mutations, spontaneous mutations, induced mutations, reversion analysis mutagens and carcinogens, biological repair mechanisms.

5. Mechanisms of Genetic Change II: Recombination: General homologous recombination, the holiday model, enzymatic mechanism of recombination, site-specific recombination, recombination and chromosomal rearrangements.

6. Mechanisms of Genetic Change III: Transposable Genetic Elements: Insertion sequences, transposons, rearrangements mediated by transposable elements, review of transposable elements in prokaryotes, controlling elements in maize.

7. Human Genome Project :Strategies and application, achievement and future prospects.

8. Plant Genome Projects: Arabidopsis, achievement and future prospects. Other plant genome projects

9. Bioinformatics : Application of computational tests to the analysis of genome and their gene products

10. Bioethics : Moral, Religious and ethical concerns

Practical

1. Problems relating to the theory
1. Isolation and separation of DNA and protein on Gel electrophoresis.
    i. Bacterial chromosome
    ii. Plasmid DNA (minipreps)
    iii. Plant DNA
    iv. Protein
3. DNA Amplification by PCR

Recommended Books

1. Trun, N and Trempy J.,2004, Fundamental Bacterial Genetics, Blackwell Publishing House.

2. Winnacker, E.L.2003, From Gene to Clones – Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.

3. Beaycgamp T.L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.

4. Brown, T.A.,2002 Genomes, Bios Scientific Publishers Ltd.

5. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.

6. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India,.

7. Lwein, B. 2004, Gene VIII, Pearson Education Int..

8. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India,.

10. Hartt, D. L, and Jones, E.W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA

BOT-6402 Biodiversity and Conservation

Aims and Objectives

To familiarize the students with the diversity of nature. Importance of biodiversity for survival and proper functioning of ecosystems

Course Contents

1. Definition of biodiversity as defined in the convention of biological diversity (CBD).

2. Introduction of species on each other for their survival.

3. Extent of known and estimated biodiversity of earth.

4. Measuring biodiversity: Alpha, Beta, and Gamma diversity, Systematic diversity, functional diversity, taxic diversity.

5. Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of living resources).

6. Sustainable and unsustainable use of ecosystem resources, consequences of unsustainable use, ecosystem degradation, extinct species, desertification and deforestation.

7. Biodiversity Hot spots of the world.

8. International treaties/agreements regarding Biodiversity and conservation; CBD, CITES, Ramsar.

9. IUCN categorised protected areas in Pakistan.

10. Environmental Impact Assessment.

11. Use of herbarium and Botanical Garden in biodiversity and conservation.

Practical

1. Inventory of plant biodiversity in various habitats.

2. Field survey for baseline studies and Impact Assessment.

3. Identification of wild plant species used by local communities in different ecosystems.

Books Recommended

1. Heywood, V. (ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.

2. Falk, D.A. & Holsinger, K.E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.

3. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press, Cambridge, UK.

4. IUCN. 1994. IUCN Red List Categories. As Approved by the IUCN Council. IUCN.

5. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.

6. Bush, M.B. 1997 Ecology of a changing Planet. Prentice hall. New Jersy.

7. French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W.W. Norton & Co.

8. Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd.

BOT-6403 Plant Physiology-II

Aims and Objective To give it comprehensive and advance knowledge of growth regulators, mechanism of water uptake and role of essential nutrients in plant metabolism

Course Contents

1. Plant Growth Regulators : Major natural hormones and their synthethic analogues. Bioassay, structure, biosynthesis, receptors, signal trasduction and mode of action, transport, physiological effects of Auxins , Gibberellins, Cytokinins, Abscisic acid, Ethylene, Polyamines, Brassinosteriods, Jasmonates, and Salicylic acid.

2. Water Relations: The soil -plant -atmosphere continuum - an overview. Structure of water. Physico-chemical properties of water. Water in the soil and its potentials. Water in cell components. Absorption of water in plants (pathways and driving forces, Aquaporins,-their structure and types). Cell water relations terminology. Hofler diagram - analysis of change in turgor, water and osmotic potential with changes in cell volume. Modulus of elasticity coefficient; Hydraulic conductivity. Osmoregulation, Methods for measurement of water , osmotic and turgor potentials- Pressure chamber, psychrometry, pressure probe, pressure volume curve.

3. Plant Mineral Nutrition: Inorganic composition of plant and soil. Absorption of mineral nutrients - roots, mycorrhizae. Effect of soil pH on nutrient availability. Ion traffic into root. The nature of membrane carriers, channels and electrogenic pumps .Passive and active (primary and secondary) transports and their energetics. Essential and beneficial elements-their functions and deficiency symptoms in plants. Fertilizers and their significance in Agriculture.

4. Phytochromes: Discovery of phytochromes and cryptochromes. Physical and chemical properties of phytochromes. Distribution of phytochromes among species, cells and tissues and their role in biological processes. Phytochromes and gene expression.

5. Control of Flowering: Autonomous versus environmental regulation. Circadien rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering. Biochemical signaling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.

6. Gene Regulation and Signal Transduction : Genome size and organization. Gene regulation in prokaryotes and eukaryotes. Signal transduction in prokaryotes and eukaryotes.

Practical

1. To investigate the preferential absorption of ions by corn seedlings and potato slices.
2. To determine osmotic potential of massive tissue by freezing point depression method or by an osmometer.
3. To investigate water potential of a plant tissue by dye method and water potential apparatus.

4. Determination of K uptake by excised roots.
5. Measurement of stomatal index and conductance.
8. Qualitative determination of K content in Guard cells by Sodium cobalt nitrite method.

Recommended Books

1. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.

2. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.

3. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.

4. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

5. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.

6. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.

7. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

8. Barton, w. 2007. Recent Advances in Plant Physiology.

9. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

BOT-6404 Principles of Biotechnology

Aims and Objectives

To understand the basic techniques and principles of tissue culture and DNA Recombinant Technology

Course Contents

1. Introduction

2. Plant tissue culture

Micropropagatin : Explant Sources , Comparison with field multiplication,

Virus Elimination, Advantages. Callus culture, Cell culture, Protoplast culture and Somatic hybridization, Regeneration: Organogenesis, Somatic Embryogenesis, Haploid culture

3. Recombinant DNA Technology

Cloning and expression techniques, Cutting and joining DNA molecules, Polymerase Chain Reaction, Molecular Characterization , RFLP, RAPD and AFLP, Microarray, electrophoresis Gene Libraries and cDNA cloning, Analyzing DNA sequences, Restriction Analysis, Sequencing

4. Genetic engineering of plants:-Transformation with the Ti plasmid of *Agrobacterium tumefaciens*. – Biolistics mediated transfer genetically modified crops: species, concerns, future scope

Practical

1. Overview of plant tissue culture/plant biotechnology lab.
2. Preparation of MS medium
3. Micropropagatin of potato Initiation and maintenance of callus Organogenesis
4. Isolation and quantification of DNA
5. Agrose gel electrophoresis of DNA
6. SDS PAGE
7. Plasmid isolation
8. RE digestion

Books Recommended

1. Dodds, J. H. and L.W Roberts, 1997. Experiments in Plant Tissue Culture. Cambridge University Press, Cambridge.

2. Old, R.W and S.B. Primerose, 1994. Principles of Gene Manipulation. Blackwell, Oxford, London.

3. Glick, B.R. and J.J. Pasternak. 2003. Molecular Biotechnology: principles and applications of recombinant DNA.

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 4th SEMESTER

LIST OF ELECTIVE COURSES FOR M.Sc 2 YEAR PROGRAM IN BOTANY 4th SEMESTER

Course code	Course Title	Credit Hrs.
BOT-6407	Microbiology	3(3-0)
BOT-6408	Bioremediation & Environmental Biotechnology	3(2-1)
BOT-6409	Environmental Issues	3(2-1)
BOT-6410	Medical Microbiology	3(2-1)
BOT-6411	Advances In Molecular Biology	3(2-1)
BOT-6412	Cell and Tissue Culture	3(2-1)
BOT-6413	Methods In Molecular Biology	3(2-1)
BOT-6414	Genomics	3(3-0)
BOT-6415	Biodiversity of Plants and Fungi	3(2-1)
BOT-6416	Virology	3(2-1)
BOT-6417	Recombinant DNA technology	3(2-1)

BOT-6407 General Microbiology

Aims and Objectives

The course is designed to enable the students to work with microorganisms. The basic techniques of sterilization, culturing, isolation and determining different characteristics of the microorganisms are included.

Course Contents

The beginnings of Microbiology: Discovery of the microbial world; Discovery of the role of microorganisms in transformation of organic matter, in the causation of diseases, development of pure culture methods. The scope of microbiology. Microbial evolution, systematics and taxonomy; Characterization and identification of microorganisms. Nomenclature and Bergey's manual. **Viruses:** Bacteriophages and phages of other protests. Replication of bacteriophages. Viruses of animals and plants; History, structure and composition; classification and cultivation of animal viruses. Effects of virus infection on cells. Cancer and viruses. **Morphology and fine structure of bacteria:** Size, shape and arrangement of bacterial cells, Flagella and motility, Pili,

Capsules, sheaths, Prosthecae and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, protoplasts, spheroplasts, the cytoplasm, nuclear material. **The Cultivation of Bacteria:** Nutritional requirements, nutritional types of bacteria, bacteriological media, physical conditions required for growth, choice of media, conditions of incubation. **Reproduction and growth of bacteria:** Modes of cell division, New cell formation, Normal growth cycle of bacteria, synchronous growth, continuous culture, quantitative measurement of bacterial growth; Direct microscopic count, Electronic enumeration of cell numbers, the plate count method, Membrane-filter count, Turbidimetric method, Determination of nitrogen content, Determination of the dry weight of cells, The selection of a procedure to measure growth, Importance of measurement of growth. **Pure cultures and cultural characteristics:** Natural microbial populations, selective methods; Chemical methods, Physical methods, Biological methods, Selection in nature, Pure cultures; Methods of isolating pure cultures, Maintenance and preservation of pure cultures, Culture collections, Cultural characteristics; Colony characteristics, Characteristics of broth cultures. **Eukaryotic Microorganisms:** Algae: Biological and economic importance of algae; Characteristics of algae; Lichens. Fungi: Importance of fungi; Morphology; Physiology and reproduction, Cultivation of fungi. Protozoa: Ecology and importance of protozoa. Classification of protozoa. **Prokaryotic diversity Bacteria:** Purple and green bacteria; cyanobacteria, prochlorophytes, chemolithotrophs, methanotrophs and methylotrophs, sulfate and sulfur-reducing bacteria, homoacetogenic bacteria, Budding and appendaged bacteria, spirilla, spirochetes, Gliding bacteria, Sheathed bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria, Endospore forming Gram-positive rods and cocci, Mycoplasmas, High GC Gram-positive bacteria; Actinomycetes, Coryneform bacteria, propionic acid bacteria, Mycobacterium, Filamentous Actinomycetes. **Prokaryotic Diversity:** Archaea: Extremely Halophilic archaea, Methane producing archaea: Methanogens, Hyperthermophilic archaea, Thermoplasma. **Microbial Ecology:** Microorganisms in nature, Microbial activity measurements, Aquatic habitats, Deep-sea microbiology, Terrestrial environments, Hydrothermal vents, Rumen microbial ecosystem, Microbial leaching, Biogeochemical cycles; Trace metals and mercury, Biodegradation of Xenobiotics.

Practicals

The culture of microorganisms: preparation and sterilization of culture media, broth culture, agar slope, agar slab, streak plates, pour plates. Isolation of a bacterial culture, Quantitative plating methods. The turbidimetric estimation of microbial growth.

Recommended Books

1. Pelczar, Jr., Chan, E.C.S. and kreig, M.R. (1986). Microbiology, McGraw Hill, London.
2. Peltler, G.L.A Laboratory Manual of Microbiology.
3. Benson, H.J. Microbial Applications: Laboratory Manual in General Microbiology, 1994. WMC Brown Publishers, England.
4. Madigan, M.T., Martinko, J.M. and Parker, J. Brock Biology of Microorganisms, 1997. Prentice-Hall, London.

BOT-6408 Bioremediation & Environmental Biotechnology

Aims and Objectives

To remediate various pollutants using advanced biological techniques.

Course Contents

Concept of bioremediation; Bioremediation of heavy metals, xenobiotic compounds and hazardous wastes; techniques used in bioremediation, bioremediation through consortia of microbes and invertebrates; renewable and non-renewable resources; bioleaching and biomining (low grade and sulfide containing ores processing); domestic solid waste and management. Waste water, sludge and sewage management; biological methods of wastes treatment; sample collection and preservation; bioremediation of crude and petroleum oils. Role of yeast in bioremediation. Biological fuel generation; Bioremediations of industrial effluents.

Practicals

Bioremediation of heavy metals through invertebrates, consortia of microorganism, mycoremediation.

Recommended Books

1. Environmental Science (Earth as a living planet). 2000. 1st ed. Botkin, D. and Keller, E. John Wiley and Sons Inc. New York, USA.
2. Practical Environmental bioremediation the field guide, 1977. R. Barry. King, Gilbert M. Long John K. Sheldon, Lewis Publishers.
3. General Microbiology, 1995. Schlegel, H.G., Cambridge University Press.

4. Biotechnology, 1996. Smith, J.F., Cambridge University Press.

5. Environmental Biotechnology Principles and Applications, 2000.Pruce, R. Hmana, Parry McCarty, McGraw Hill.

6. Biodegradation and Remediation, 1999. Martin Alexander Academic Press Inc.

BOT-6410 Medical Microbiology

Aims and Objectives

Aims of this course are to let the students know about the science of microbiology, to work with microorganisms, their pathogenecity, and various diseases and problems caused by microorganisms. The course may also initiate their interest in agricultural, industrial and/or environmental microbiology. The course will enable the students to identify specific areas in practical life where the science of microbiology is being applied. Thus they can seek different job in various organizations such as clinical, industrial and environmental microbiology sections.

Course Contents

Morphology and fine structure of bacteria: Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, the cytoplasm, nuclear material. Microbiology and Medicine, antimicrobial agents, mode of action. Bacterial pathogenicity, sources and spread of the infections in the community. Immunological principles, antigen, antibodies and antigen-antibody reactions. Bacterial pathogens and associated diseases. *Staphylococcu*s, skin and wound infections. *Streptococcus*, sore throat, scarlet fever, glomeruonephritis. *Pneumococcus*, respiratory infections. *Corynebacterium*. *Diphtheriae Mycobacterium tuberculosis*: Pulmonary and other tuberculosis infections. *.Actinomyces. Neisseria meningitis,* Gonorrhea, *Salmonella, Shigella ,Escherichia coli, Klebsiella proteus, Providenica, Bacillus anthracis. Clostridium tetnai*. Pox viruses, Herpes viruses. Herpes simplex. Cytomegalovirus infections. Adenoviruses. Influenza viruses. Hepatitis viruses. Arbovirsus, Rickettsia, Pahtogenic. Fungi and Protozoa.

Practicals

Basic techniques.(Staining of microorganisms: Simple stains, positive staining; negative staining. Demonstration of special structures by stains: Spore stain, Flagella stain. Differential stains: Gram stain, Metachromatic Granule stain, Acid fast stain. Culturing of microorganisms: Preparation and sterilization of culture media, agar slope, agar slab, streak plates, pour plates

methods. Isolation of a bacterial culture. Quantitative plating methods) Widal test. Laboratory diagnosis and control of infections: Streptococcus. Corynebacterium, Listeria, Mycobacterium. The Entero bacteriaceae: Salmonella. Escherichia, Klebsiella and Clostridium. Blood tests: TLC, DLC, RBC.

Recommended Books

1. Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, James Plorde. (2010). Sherris Medical Microbiology, Fifth Edition. McGraw Hill Publishers, Washington DC

2. Patrick R. Murry, Ken S. Rosenthal, Michael A. Pfaller: Medical Microbiology**,** 5th edition, Philadelphia: Elsevier/Mosby, 2005.

3. P.K. Murray, Ph.D., K.S. Rosenthal, Ph.D., G.S. Kobayashi, Ph.D., and M.A. Pfaller, MD,

3. Microbiology, 1986. Pelczar Jr., Chan, E.C.S. and Krieg, M.R. McGraw Hill, London.

4. Brock Biology Of Microorganisms, 1997. Madigan, M.T., Martinko, J.M. and Parker, J. Prentice-Hall, London.

5. Cruickshank, R, Duguid, J.P., Hermion, B.P. and Swain, R.H.A., (2003). Medical Microbiology. Churchill Livingstone, N.Y.

6. The Microbial World, 1986. Stainier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, R.R. Prentice Hall, London.

7. Foundations in Microbiology. (1998). Talaro & Talaro. WCB Publishers, New York.

8. Microbiology: A Human Perspective, 2001. Eugene W. Nester, Denise, G., Anderson,

9. Martha, T., Nester, C., Evans Roberts, Nancy, N. McGraw Hill Higher Education

BOT-6411 Advances in Molecular Biology

Aims and objectives

Objectives of the course are to impart knowledge about the macromolecules in animal cell and their complex organization of architecture and the unified role it plays for the ultimate sustainability of the organisms.

Course Contents

Molecular Biology of DNA, RNA, Protein, DNA replication and DNA repair. Transcription. Translation, Gene expression in prokaryotes and eukaryotes. Molecular biology of DNA and RNA viruses and yeast. Molecular immunology, Oncogenes and cancer.

Practicals

Quantitative estimation of various macromolecules. Demonstration of properties of macromolecules. Methods of bacterial culture.

Recommended Books

1. Kornberg, A. (1980). DNA Replication, W.H. Freeman, San Francisco.
2. Kornberg, A. (1982). Supplement to DNA Replication, W.H. Freeman, San Francisco.
3. Old, R.W. and Primrose, S.B. (1981). Principles of Gene Manipulation, Blackwell, Oxford.
4. Watson, J.D., Hpkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. (1990). Molecular Biology of the Gene, Benjamin, California.
5. DuPraw, Advances in Cell and Molecular Biology, Academic Press.
6. Bukhari, A.I., Shapiro, J.A., and Adhya, S.L. (1977). DNA Insertion Elements, Plasmids and Episomes, Cold Spring Harbour Laboratories.

BOT-6412 Cell and Tissue Culture

Aims and Objectives

The aim of this course is to provide students with a thorough understanding of the importance of cel, tisue and organ culture and its aplication in life sciences.

Course Contents

Plant cel and tisue culture: requirements for in vitro cultures; culture facilties; sterile techniques; media preparation and handling; calus cultures; cel suspension cultures; protoplast culture; haploid cultures, organ culture; meristem culture for virus elimination; embryo culture and embryo rescue; regeneration of plants and micro-propagation; somaclonal variation; industrial uses of plant cel culture; tisue culture in genetic enginering and biotechnology. Mammalian cel culture: origin and principles of cel culture; qualitative characteristics of cel cultures; cel counting and analysis; cryopreservation; cel banking and subculture (variety of diferent systems); primary cel culture techniques;41 development of immortalized cel line; detection of microbial contaminants; animal cels for bioasays and bioproducts; design and operation of animal cel culture bioreactors for therapeutic protein production; growth environment; Stem cel culture

Recommended Books:

1. Setlow JK, 200. Genetic Enginering: Principles and Methods. Kluwer Academic Publishers.
2. Nichol DST, 202. An Introduction to Genetic Enginering. 2nd Editon; Cambridge University Pres.

3. Gale YL, 202. Genetic Enginering.
4. Razdan MK, 203. Introduction to Plant Tisue Culture. 2 nd Editon; Intercept, New York, USA.
5. Lanza et al., 200. Principles of Tisue Enginering. 2nd Editon; AcademicPres, California.
6. Ignacimutu S, 197. Plant Biotechnology. Oxford IBH Publisher.
7. Punia MS, 199. Plant Biotechnology and Molecular Biology: A Laboratory Manual. Scientifc Publishers.

BOT-6413 Methods in Molecular Biology

Aims and Objectives

To acquaint students with the experimental aspects of molecular biology

Course Contents

Introduction to recombinant DNA technology; restriction and modifying enzymes; cloning and expresion vectors and their types; expresion of recombinant proteins and their purifcation by afinity chromatography; polymerase chain reaction (PCR) - types; (inverse, touch-down, nested, hemi-nested, pit stop, multiplex, reverse transcriptase, RACE, real-time) and its aplications; detection of mutations and/or SNPs; DNA fingerprinting; analysis of nucleic acids by gel electrophoresis – horizontal, vertical, pulse field, denaturing gradient gel electrophoresis; analysis of proteins by native and SDS-PAGE; 2-D gels; generation of antibodies and their uses; enzymelinked immunosorbant asay; Southern, Western, Northern bloting.

Practical

Preparation of stock and working solutions; isolation of nucleic acids and their quantifcation; restriction digestion of DNA and preparation of restriction maps; gel electrophoresis; polymerase chain reaction (PCR); detection of mutations by restriction fragment length polymorphism; preparation of chemicaly competent cels; transformation of bacteria with plasmid DNA; analysis of proteins by SDS-PAGE

Recommended Books

1. Ausubel FM, 205. Short Protocols in Molecular Biology (2 volume set). 5th Editon; John Wiley and Son.
2. Gren MR and Sambrok J, 201. Molecular Cloning: A Laboratory Manual. 3rd Editon; Cold Spring Harbor Laboratory Pres.

3. Primrose SB and Twyman R, 206. Principles of Gene Manipulation and Genomics. 7th Editon; Wiley- Blackwel.
4. Wilson K and Walker J, 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Editon; Cambridge University Pres.
5. Walker JM and Rapley, 208. Molecular Biomethods Handbok (Methods in Molecular Biology). 2nd Editon; Humana Pres.

BOT-6414 Genomics

Aims and Objectives

The overarching goal of this course is to provide students with a thorough overview of both the theoretical and experimental aspects of structural and functional genomics.

Course Contents

Organization and structure of genomes; genetic maping (RFLP, microsatelite, SNP); high-resolution physical maping (STS, EST); flow cytometry; somatic cel and radiation hybrids; artifcial chromosomes in bacteria and yeast; hierarchical and whole genome shotgun sequencing; DNA sequencing strategies - manual and automated sequencing, pyrosequencing, Solexa, Helicos, Roche 454, real-time and nanopore sequencing; sequence asembly, obstacles and solutions; estimating gene number – over-prediction and under-prediction, homology searches, exon prediction programs, integrated gene-finding software packages; structural variation in the genome and its aplications; microaray and RNA interference.

RECOMMENDED BOOKS:

1. Strachan T and Read AP, 2010. Human Molecular Genetics. 4th Editon;Garland Science.
2. Sacone C and Pesole G, 203. Handbook of Comparative Genomics: Principles and Methodology. 1st Editon; Wiley-Lis.
3. Town C, 202. Functional Genomics. 1st Editon; Springer.
4. Krebs et al., 2010. Lewin Genes X. 10th Editon; Jones and Bartlet Publishers.
5. Al-Rubeai M and Fuseneger M, 2010. Systems Biology (Cel Enginering). 1st Editon; Springer

BOT-6415 Biodiversity of Plants and Fungi

Aims and Objectives

To learn about the evolutionary history and phylogenetic relation between plants and fungi.

Course Contents

Introduction: Diversity of life. Aranging the diversity of life into Kingdoms. Prokaryotes and origin of metabolic diversity. The origin of eukaryotic diversity: Eukaryotic origin by symbiosis among prokaryotes. Eukaryotic algae as key producers in aquatic ecosystem. Major characteristics of phyla of kingdom Plant and colonization of land. Plant diversity and evolutionary history of plant kingdom, structural and reproductive adaptation for colonization of land. Plant structure and Growth. Reproduction & Development: Life cycle of plant. Evolutionary adaptation in germination of seds, methods of reproduction and their role in agriculture, overview of developmental mechanism in plants. Control systems of Plants to cope with environmental streses. Body plan and nutritonal modes in Fungi Clasifcation of Fungi.

Practical

1. Study of morphology and reproductive structures of eucaryotes and prokaryotes specimens mentioned in course outline.
2. Identifcation of various types mentioned from prepared slides and fresh colection.
3. Colection of specimens of plants and their identifcation.

Recommended Books

1. Schafer, 206. Photomorphogenesis in plant and Bacteria.
2. Barbara J. E.s., Christine J. C. B. and Thomas N. S. 2010. Microbial Rots Endophytes. Springer.
3. Shely, 2010. Stern's Introductory Plant Biology. McGraw-Hil Sciences.37
4. Ana M. P. and A. Carolina F. 201. Endophytes of forest Tres. Springer.
5. Alexopoulos, 2012. Introductory Mycology.
6. Teij S., Hideki K. et al. 2013. Species Diversity and Community Structure. Springer.

BOT-6416 Principles of Virology

Aims and Objectives

Aim of this course is to provide a generalized overview of virology as its stands today.

Course Contents

Historical perspective; general properties of viruses; clasifcation and nomenclature; virus structure and asembly; replication cycle and genetics of viruses; animal and plant viruses; propagation, detection and quantifcation of viruses; pathogenesis and immune response of viral infections; laboratory diagnosis of viral diseases; vacines and antiviral drugs; epidemiology; tumor viruses; viral vectors and gene therapy; emerging viruses; specifc aspects of selected viral diseases

Recommended Books:

1. Flint et al., 209. Principles of Virology. ASM Pres, USA.
2. Lal S, 207. The Biology of Emerging Viruses. Wiley-Blackwel, USA.
3. Carter J Saunders V. Virology: Principles and Aplications. First Editon; Wiley.
4. Wagner et al., 207. Basic Virology. Third Editon; Wiley-Blackwel
5. Flint SJ, 209. Principles of Virology, Vol. 2: Pathogenesis and Control. 3 rd Editon; AMS

BOT-6417 Recombinant DNA Technology

Aims and Objectives

To elucidate the students the techniques of recombinant DNA technology.

Basic Techniques: Extraction of nucleic acids, measurement of nucleic acids, gel electrophoresis, nucleic acid probes, hybridization of nucleic acids, nucleic acid blottings: southern blotting, northern blotting, dot or slot blots, **Cutting and Joining DNA molecules;** Restriction enzymes, host controlled restriction and modification, types of restriction enzymes, nomenclature, isoschizomers, physical methods of breaking DNA, DNA ligases, linkers, adapters, homopolymer tailing, **Vectors:** Desirable properties of vectors, plasmids vectors, bacteriophage λ vectors, cosmids, m13 vector, phasmids, supervectors: BACs, YACs, HACs.

Polymerase Chain Reaction (PCR); PCR reaction, primers, reverse transciptase PCR, real time PCR, PCR application: PCR coloning strategies, analysis of recombinant clones, diagnostic application, **Gene transfer to Plants;** *Agrobacterium tumefaciens* mediated transformation, direct nuclear transformation, viral vectors, chloroplast transformation, **Application of Transgenic Plants;** Insecticidal resistance, herbicidal resistance, virus resistance, fungal resistance, delayed ripening, salt tolerance, enhancing production and quality of food

Practical

1. Plasmid DNA isolation from bacterial cells

2. Chromosomal DNA isolation from bacterial cells

3. Agarose gel electrophoresis of isolated DNA

4. Restriction enzyme digestion of plasmid DNA

5. DNA amplification through PCR

Recommended Books

1. Brown, T.A. 2010. Gene Cloning and DNA Analysis. 6th Edition. Wiley-Blackwell, London.

2. Dale, J.W., and Schantz, M.V. 2007. From Genes to Genomes. 2nd Edition. John Wiley & Sons, Inc., London.

3. Hughes, M.A. 1996. Plant Molecular Genetics. Addison-Wesley Longman, London.

4. Nicholl, D.S.T. 2008. An Introduction to Genetic Engineering. 3rd Edition. Cambridge University Press, London.

5. Primrose, S.B., and Twyman, R.M. 2002. Principles of Genome Analysis. 3rd Edition. Blackwell Science, Oxford.

6. Primrose, S.B., Twyman, R.M., and Old, R.W. 2006. Principles of Gene Manipulation. 7th Edition. Blackwell Science, Oxford.

7. Reece, R.J. 2004. Analysis of Genes and Genomes. John Wiley & Sons, Inc., London.