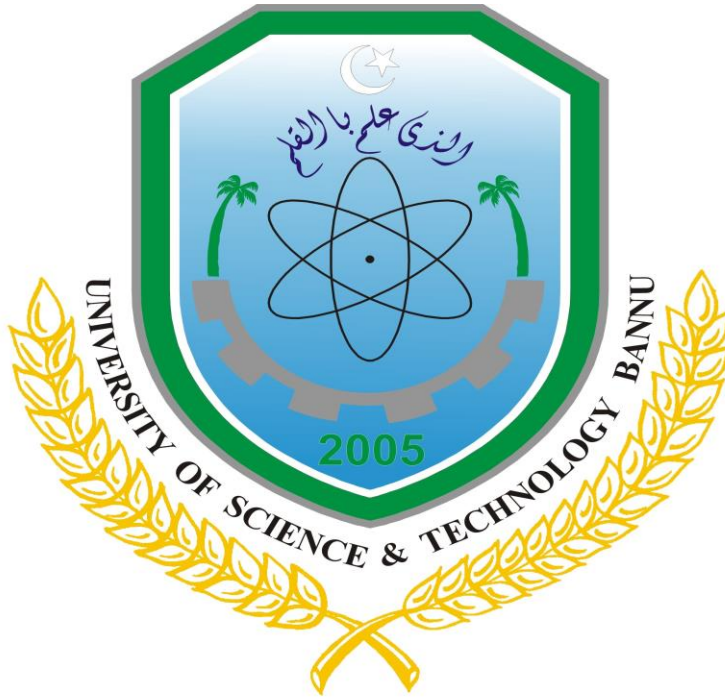


Department of Botany UST, Bannu



Curriculum of MSc Botany **2008 and onward**

DEATAIL COURSE STRUCTURE MASTER OF SCIENCE IN BOTANY

PROGRAM LENGTH

Master of Science in Botany

2 years, having 4 terms

COURSE CONTENTS

Code	Term I	Credit Hours	Code	Term II	Credit Hours
Bot-501	Biostatistics	03	Bot-508	Anatomy of vascular Plants	02+1
Bot-502	Bacteriology & Virology	02+1	Bot-509	Genetics-I	02+1
Bot-503	Phycology & Bryology	02+1	Bot-510	Plant Biochemistry-I	02+1
Bot-504	Mycology & Plant Pathology	02+1	Bot-511	Plant Ecology-I	02+1
Bot-505	Diversity of Vascular Plants	02+1	Bot-512	Plant Physiology-I	02+1
Bot-506	Plant Systematic	02+1	Bot-513	Functional English II	02
Bot-507	Functional English	02			
Code	Term III	Credit Hours	Code	Term IV	Credit hrs
Bot-514	Molecular Biology	02+1	Bot-520	Environmental Biology	02+1
Bot-515	Plant Biochemistry –II	02+1	Bot-521	Special Paper-I	03+1
Bot-516	Plant Ecology-II	02+1	Bot-522	Special Paper-II	03+1
Bot-517	Plant Physiology-II	02+1	Bot-523	Research Methodology	1(1+0)
Bot-518	Biodiversity & conservation	02+1		Research/Special Paper III	4
Bot-519	Genetics-II	02+1			

Note:

Special Papers/ Elective subjects can be introduced subject to the availability of competent and qualified teachers and market demand.

Term 1st

Title of the Course: Bot-501-Biostatistics

Credit Hours: 03 (21)

Title of the Course: Bot-502 Bacteriology and Virology Credit Hours: 3(2+1)

Specific objectives of course: To understand the morphology, structure and economic importance of Viruses and Bacteria

Course outline:

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. 8. 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) 5. Importance of bacteria with special reference to application in various modern sciences specially agriculture, biotechnology and genetic engineering.

Lab outline:

a) Viruses Observation of symptoms of some viral infected plant specimens.

b) Bacteria, Actinomycetes and Cyanobacteria

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

Recommended Books:

- Black, J.G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
- Prescott, L.M., Harley, J.P. and Klein, D.A. 2005. Microbiology McGraw Hill Companies, Inc.

- Arora, D.R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
- Ross F.C. 1995. Fundamentals of Microbiology. John Wiley Co. New York.
- Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens, The Haworth Press, Inc.
- Hull R. Matthews, 2004, Plant Virology, Academic Press.
- Tortora, G.J. ; Funke, B.R. and Case C.L. , 2004, Microbiology. Pearson Education.

Journals/Periodicals:

World Journal of Microbiology & Biotechnology, Current Microbiology, Journal of Industrial Microbiology and Biotechnology, Journal of General Virology, Journal of Virology

Title of the Course: Bot-503 Phycology and Bryology Credit Hours: 3(2+1)

Specific objectives of course: To understand the classification, morphology and economic importance of Algae and Bryophytes

Course Outline:

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

b) Bryology: Introduction and general account of bryophytes, classification, theories of origin and evolution. Brief study of the classes: Hepaticopsida, Anthocerosida and Bryopsida.

Lab Outline:

a) 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.

b) Bryology Study of the following genera: *Pellia*, *Porella*, *Anthoceros* and *Polytrichum*.

Recommended Books:

- Bold, H. C. and M.J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs
- Lee. R.E. 1999. Phycology. Cambridge University Press, U.K.
- Dawson, E.Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.
- Chapman, V.J. and D.J. Chapman. 1983. Sea weed and their uses. McMillan and Co. Ltd. London.
- Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.

- Schofield, W.B. 1985. Introduction to Bryology. Macmillan Publishing Co. London.
- Hussain, F. and I. Ilahi. 2004. A text book of Botany. Department of Botany, University of Peshawar.

Journals / Periodicals:

Pakistan Journal of Botany, International Journal of Phycology and Phycochemistry, Bryology, Phycology.

Title of the Course: Bot-504 Mycology and Plant Pathology Credit Hours: 3(2+1)

Specific Objectives of course: To introduce the students to Mycology and Diseases caused by Fungi.

Course Outline:

a) 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.**

b) 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.**

Lab Outline:

a) 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.

b) 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 pathogenicity. Demonstration of control measures through chemotherapeutants.

Recommended Books:

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

Periodicals:

Pakistan Journal of Botany, Mycotoxin, Mycopath, Phytopathology, Australasian Journal of Plant pathology, Asian Journal of Plant Pathology, Annual Review of Plant Pathology

Title of the Course: B0t-505 Diversity of Vascular Plants Credit Hours: 3(2+1)

Specific Objectives of course: To enable the students to understand and appreciate the biology and evolution of plant architecture

Course Outline:

a) 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*), Lycopsidea (*Lycopodium*, *Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Ophioglossum*, *Dryopteris* and *Azolla/Marsilea*).

b) Origin and Evolution of seed habit.

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

d) Angiosperms: Origin, general characteristics, Importance, and life cycle of angiosperms

e) 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.

Lab Outline:

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

Recommended Books:

- Beck, C.B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York,
- Foster, A.S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.
- Jones, D. 1983. Cycadales of the World, Washington, DC.
- Mauseth, J.D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.
- Moore, R.c., W.d. Clarke and Vodopich, D.S. 1998. Botany McGraw Hill Company, USA
- Raven, P.H. Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants, W.H. Freeman and Company Worth Publishers.
- Ray, P.M. Steeves, T.A. and Fultz, T.A. 1998. Botany Saunders College Publishing, USA.
- Taylor, T.N. and Taylor, E.D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.
- Stewart, W. N. and Rothwell, G.W. 1993. Paleobotany and the Evolution of Plants, University Press, Cambridge.
- Faegri, K., P.E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, Jhon Wiley & Sons. N.Y.

Journals / Periodicals:

Pakistan Journal of Botany, New Phytologist, Review of Palaeobotany & Palynology, Palaeontographica, Palaeobotanist

Title of the Course: Bot-506 Plant Systematic Credit Hours: 3(2+1)

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

Course Outline:

- 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:
 1. Apiaceae (Umbelliferae)
 2. Arecaceae (Palmae)
 3. Asclepiadaceae
 4. Asteraceae (Compositae)
 5. Boraginaceae
 6. Brassicaceae (Cruciferae)
 7. Cannaceae
 8. Capparidaceae
 9. Caryophyllaceae
 10. Casuarinaceae
 11. Chenopodiaceae
 12. Convolvulaceae
 13. Cucurbitaceae
 14. Cyperaceae
 15. Euphorbiaceae
 16. Fabaceae (Leguminosae)
 17. Juncaceae
 18. Lamiaceae (Labiatae)
 19. Liliaceae
 20. Magnoliaceae
 21. Malvaceae
 22. Myrtaceae
 23. Orchidaceae
 24. Papaveraceae
 25. Poaceae (Gramineae)
 26. Ranunculaceae
 27. Rosaceae
 28. Salicaceae
 29. Scrophulariaceae
 30. Solanaceae
 31. Trochodendraceae
 32. Winteraceae

Lab Outline:

- Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan
- Preparation of indented and bracketed types of keys

- Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.
- Study of variation pattern in different taxa.
- Submission of properly mounted and fully identified hundred herbarium specimens at the time of examination
- Field trips shall be undertaken to study and collect plants from different ecological zones of Pakistan.

Recommended Books:

- Ali, S.I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi
- Ali, S.I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
- Greuter, W., McNeill, J., Barrie, F.R., Burdet, H. M., Demoulin, V., Filguerras, T.S., Nicolson, D.H. Silva, P.C., Skog, J.E., Trehane, P., Turland, N.J. & Hawksworth, D.L., (eds.) 2000. International code of botanical nomenclature (Saint Louis Code) adopted by the Sixteenth International botanical congress St. Louis Missouri, July –August 1999. Koeltz, Konigstein. (Regnum Veg.138.)
- Davis, P.H. & Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
- Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London
- Nasir, E. & Ali, S.I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
- Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold..
- Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh
- Jones, S. B. and Luchsinger, A.E. 1987. Plant Systematics. McGraw Hill, Inc. New York.
- Naik, V.N. 2005. Taxonomy of Angiosperms. Tata McGraw Hill Publishing Company, New Delhi.
- Stussy, T.F. 1990. Plant Taxonomy, Columbia University Press, USA.
- Jeffrey C. 1980. An Introduction to Plant Taxonomy. Cambridge University Press. UK 13.
- Levin, D.A. 2000. The Origin, Expansion and Demise of Plant Species. Oxford University Press.
- Sivarajan V.V and N.K.P Robson 1991 Introduction to the Principles of Plant Taxonomy.
- Radford, A.E., W.C. Dickison, J.R. Massey, and C. R. Bell. 1998 Vascular Plant Systematic. Harper and Row, New York.
- Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.
- Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.
- Heywood V.H. 1978. Flowering Plants of the World. Oxford University Press.
- Simpson, M.G. 2006. Plant Systematics. Elsevier Academic Press.
- Soltis, D.E. P.S. Soltis, P.K Endress, and M.W. Chase, 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.

- Pullaiah, T. 2007 Taxonomy of Angiosperms 3rd Ed. Regency Publication, New Delhi.

Journals / Periodicals:

- Pakistan Journal Botany, Flora of Pakistan, Taxon, Botanical Journal of the Linnean Society

Title of Course: Bot-507 English-I credit hours (02)

Objectives: Enhance language skills and develop critical thinking.

- Basics of Grammar
- Parts of speech and use of articles
- Sentence structure, active and passive voice
- Practice in unified sentence
- Analysis of phrase, clause and sentence structure
- Transitive and intransitive verbs
- Punctuation and spelling
- **Comprehension**
- Answers to questions on a given text
- **Discussion**
- General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)
- **Listening**
- To be improved by showing documentaries/films carefully selected by subject teachers
- **Translation skills**
- **Urdu to English**
- **Paragraph writing**
- Topics to be chosen at the discretion of the teacher
- **Presentation skills**
- Introduction

Recommended books:

1. **Functional English**
 - a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Term 2nd

Title of the course: **Anatomy of Vascular Plants Credit hours: 3(2+1)**

Specific objectives of course: To provide the students understanding about anatomical features of vascular plants

Course Outline:

- 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.
- Apical meristem: Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.
- Leaf: types, origin, internal organization, development of different tissues with special reference to mesophyll, venation, bundle-sheaths and bundle-sheath extensions. 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.
- 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.
- Secretory tissues: Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.
- Anatomy of reproductive parts: - Flower - Seed - Fruit
- Economic aspects of applied plant anatomy
- Anatomical adaptations 11. Molecular markers in tree species used for wood identification.

Lab outline:

- 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.
- Study of abnormal/unusual secondary growth.
- Peel and ground sectioning and maceration of fossil material.
- Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides.

Recommended Books:

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

Journals / Periodicals:

Pakistan Journal of Botany

Title of the Course: Genetics -I Credit Hours: 3(2+1)

Specific Objectives of course: To understand the nature and function of genetic material

Course Outline:

- **Extensions of Mendelian Analysis** : Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity Linkage
- **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
- **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, universality of genetic information transfer, eukaryotic RNA.
- **The Extra nuclear Genome** : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochondrial 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.

Lab Outline:

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 *Saccharomyces* 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. ii. 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.
8. Gardner, E.J., 2004. Principles of Genetics, John Willey and Sons, New York.
6. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.

7. 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.
8. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
9. Hartl, D.L. and Jones, E.W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbury, USA. 11 Hedrick, P.W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

Journals / Periodicals:

J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

Title of the Course: Plant Biochemistry-I Credit Hours: 3(2+1)

Specific Objectives of course: To elucidate the structure and role of primary metabolites in plants

Course Outline:

- **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.

Lab Outline:

- Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
- To determine the R_f value of monosaccharides on a paper Chromatogram.
- To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophotometrically.
- To determine the saponification number of fats.
- To extract and estimate oil from plant material using soxhlet apparatus.

- Analysis of various lipids by TLC methods.
- To estimate soluble proteins by Biuret or Lowry or Dye-binding method.
- To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.
- To determine the R_f value of amino acids on a paper chromatogram.
- Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.
- To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source.
- To determine the PK_a and isoelectric point of an amino acid.

Recommended Books:

- Conn E E. and Stumpf P.K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
- Lehninger, A L. 1998. Principles of Biochemistry. Worth Publishers Inc.
- Voet, D., Voet J.G. and Pratt, C.W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York. 48
- Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
- Smith, E. L., Hill, R L, Lehman, R I., Lefkowitz, R J. Handler and Abraham. 2003, Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.
- Zubay G., 2003, Biochemistry, MacMillan Publishing Co., New York.
- Chesworth, J.M., Strichbury T. and Scaife, J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.
- McKee, T. and McKee, J.R. 1999. Biochemistry – An Introduction. WCB/McGraw-Hill, New York, Boston, USA.
- Lea, P.J. and Leegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.
- Abdes, R.H. Frey, P.A. and Jencks W.P. 2004, Biochemistry, Jones and Bartlet, London.
- Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
- Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
- Bowsher, C. 2008. Plant Biochemistry. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals:

Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Title of the Course: Plant Ecology I Credit Hours: 3(2+1)

Specific Objectives of course: To understand the role and interaction of plants with their environment

Course Outline:

- Introduction: history and recent developments in ecology
- 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
- 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,
- Carbon dioxide: Stomatal responses, water loss and CO₂-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO₂ concentration. Functional significance of different pathways of CO₂ fixation. Productivity: response of photosynthesis to environmental factors, C and N balance 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.
- Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress
- Wind as an ecological factor. 8. Fire as an ecological factor.

Lab Outline:

- Determination of physico-chemical properties of soil and water.
- Measurements of light and temperature under different ecological conditions.
- Measurements of wind velocity.
- Measurement of CO₂ and O₂ concentration of air and water.
- Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.
- Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem pressure potential, leaf area and rate of CO₂ exchange in plants in relation to various environmental conditions.

Recommended Books:

- Schultz, J. C. 2005. Plant Ecology, Springer-Verlag
- Bazzaz, F.A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press
- Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
- Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag

- Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
- Nobel, P.S 1999, Physico-chemical and Environmental Plant Physiology,.Academic Press.
- Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
- Smith, R. L. 2004. Ecology and field Biology. Addison Wesley Longman, Inc., New York.
- Barbour, M.G., Burke, J.H and Pitts, W.D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.
- Smith R.L. 1998 Elements of Ecology. Harper & Row Publishing.
- Townsend. C.R. Begon. M and J.L Harper. 2002 Essentials of ecology. Blackwell Publishing.
- Gurevitch. J. Scheiner, S.M. and G.A Fox. 2006 The Ecology of Plants\, Sinaur Asssoicate Inc.
- Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.
- Hussain. S.S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.
- More. P.D. and Chapman S.B. 1986 Methods in Plant Ecology, Blackwell Scientific Publication Oxford.
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Journals / Periodicals:

- Pakistan Journal of Botany, Journal of Ecology, Journal of Applied Ecology, Ecology, Journal of Arid Environment

Title of the Course: Plant Physiology-I Credit Hours: 3(2+1)

Specific Objectives of course: To provide comprehensive knowledge on some vital functions and mechanisms of plants

Course Outline:

- **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. CO₂ reduction (dark reactions) - C₃ pathway and Photorespiration, Regulation of C₃ pathway, C₄ pathway and its different forms, C₃-C₄ 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.
- **4. 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.

Lab Outline:

- To determine the volume of CO₂ evolved during respiration by plant material.
- To determine the amount of O₂ used by respiring water plant by Winkler Method.
- Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.
- To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties.
- To categorize C₃ and C₄ plants through their anatomical and physiological characters. 6. To regulate stomatal opening by light of different colours and pH.

Recommended Books:

- Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
- Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
- Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
- Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
- Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.
- Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
- Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
- Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
- Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
- Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinauer's Publ. Co. Inc. Calif.
- W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
- Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
- Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

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

Journals / Periodicals:

- Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, Planta, Annual Review of Plant Biology, Journal of Plant Physiology

Title of the Course: Research Methodology Credit Hours: 1(1+0)

Specific objectives of course: 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 Outline:

- What is science, philosophy and theory, how to do science. Questions, hypothesis, their types, experimentation, validation, theories and laws.
- Research Methods (planning research, various methods, analyzing results, giving reports, etc.) research process including: formulating research questions; sampling (probability and nonprobability); 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:

- Shank, G. D. 2002. Qualitative research : a personal skills approach. Upper Saddle River, N.J.Columbus, Ohio: Prentice Hall;Merrill/Prentice Hall.
- Brizuela, B. M. 2000. Acts of inquiry in qualitative research. Cambridge, MA: Harvard Educational Review
- Shank, G. D. 2001, Qualitative Research: A Personal Skills Approach 54
- Paul Leedy, 2004, Practical Research : Planning and Design (8th, Edition), Jeanne Ellis Ormrod

Title of the Course: Functional English II (COMMUNICATION SKILLS)

Objectives: Enable the students to meet their real life communication needs.

Course Contents

- **Paragraph writing**
- Practice in writing a good, unified and coherent paragraph
- **Essay writing**
- Introduction
- **CV and job application**
- Translation skills
- Urdu to English
- **Study skills**
- Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
- **Academic skills**
- Letter/memo writing, minutes of meetings, use of library and internet
- **Presentation skills**
- Personality development (emphasis on content, style and pronunciation)

Recommended books:

Communication Skills

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).

2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

2. Reading and Study Skills by John Langan

3. Study Skills by Riachard Yorky.

Term 3rd

Title of the Course: Molecular biology Credit Hours: 3(2+1)

Specific Objectives of course: To disseminate the knowledge of molecular basis of life

Course Outline:

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 signals Translation: 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 Metabolomics; methods to study metabolomics; importance and application of metabolomics.
7. Bioinformatics and computational biology. Levels, scope, potential and industrial application of bioinformatics and computational biology.

Lab Outline: Following techniques will be used for the isolation and analysis of different components:

1. Extraction of RNA, DNA and proteins
2. Electrophoreses: One and two dimensional
3. Purification of proteins, RNA and DNA.
4. Amplification using PCR.
5. 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. Gilmarin, 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. Pearson Education, Singapore.
7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.
8. Weaver, R.F. 2005. Molecular Biology. McGraw Hill, St. Louis.

Title of the Course: Plant Biochemistry-II Credit Hours: 3(2+1)

Specific Objectives of course: 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.

Lab Outline:

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., Lefkowitz, 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. Mckee, T. and Mckee, J.R. 1999. Biochemistry – An Introduction. WCB / McGraw-Hill, New York, Boston, USA.
9. Lea, P.J.. and Leegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.
10. Abides, R.H., Frey P.A. and Jencks, W.P. 1992. Biochemistry, Jones and Bartlet, London.
11. Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
12. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
13. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals: Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Title of the Course: **Plant Ecology -II Credit Hours: 3(2+1)**

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

Course Outline: A. Population Ecology

1. Population structure and plant demography.: Seed dispersal, Dormancy, Seed Bank, Seed dormancy, Recruitment, Demography
 2. Life history pattern and resource allocation : Density dependent and density independent factors, Resource allocation, Reproductive effort, Seed size vs seed weight, Population genetics, Evolution
- B. Community Ecology : Historical development of community ecology, Community concepts and attributes, Methods of sampling of plant communities, Ecological succession, Community soil-relationship, Local Vegetation, Vegetation of Pakistan, Major formation types of the world
- C. Ecosystem Ecology : Ecological concepts of ecosystem ,Boundaries of ecosystem? Compartmentalization and system concepts, Energy flow in ecosystem, Biogeochemical cycles: water carbon and nitrogen Case studies: any example

Lab Outline: Determination of seed bank in various populations. Seed dispersal pattern of local populations. Demography and life history of local annual population. Study of community attributes. Sampling of vegetation including Quadrat, plotless, transect and Braun-Blanquet. Correlate soil properties with vegetation type. Field trip to study different communities located in different ecological regions of Pakistan. Slide show of the vegetation of Pakistan. Slide show of the major formations of the world. Soil physical and chemical properties

Recommended Books:

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 Physiological Ecology.
11. Larcher. W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag.

Journals / Periodicals: Ecology, Journal of Ecology, Journal of Applied Ecology

Title of the Course: **Plant Physiology-II Credit Hours: 3(2+1)**

Specific Objectives of course: To give it comprehensive and advance knowledge of growth regulators, mechanism of water uptake and role of essential nutrients in plant metabolism

Course Outline: 1. Plant Growth Regulators : Major natural hormones and their synthetic analogues. Bioassay, structure, biosynthesis, receptors, signal trasduction and mode of action, transport, physiological effects of Auxins , Gibberellins, Cytokinins, Absciscic

acid, Ethylene, Polyamines, Brassinosteroids, 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. Circadian 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.

Lab Outline:

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.
6. 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. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
3. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
4. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
5. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.
6. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
7. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
8. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
9. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
10. Taiz, L. and Zeiger, E. 2002. Plant Physiology. 3rd Edition. Sinauer's Publ. Co. Inc. Calif.
11. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
12. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
13. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

14. Barton, w. 2007. Recent Advances in Plant Physiology. 15. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

Journals / Periodicals: Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, Planta, Annual Review of Plant Biology, Journal of Plant Physiology

Title of the Course: Biodiversity & Conservation Credit Hours: 3(2+1)

Specific objectives of course: To understand the importance of biodiversity, threats and conservation measures

Course Outline:

1. Introduction and importance of biodiversity :Species diversity, Ecological diversity, Genetic diversity, Social diversity
2. i. Causes and depletion of biodiversity: Habitat loss, Habitat fragmentation, Over-exploitation, Climatic changes, Invasive species, .Seawater intrusion ii. The value of species iii. How species become endangered? iv. Extinction of species, present rate. Theory of mass extinction v. Inventory and monitoring of biodiversity vi. Importance of red data book vii. In situ and ex situ conservation of plants viii. Implementation of laws (protection and conservation of various taxa. ix. Sustainable use of biodiversity (plant wealth) x. Protected areas of Pakistan xi. Criteria for determining different categories of protected areas xii. Baseline study
- xiii. Impact assessment xiv. Management plan for protected area xv. IUCN categories for threatened species xvi. Criteria for recognizing different categories of threatened species xvii. Gene bank management and operation xviii. Public awareness strategies. xix. Population explosion xx. Biodiversity action plan for Pakistan xxi. Role of herbaria and botanical gardens in conservation.

Lab Outline:

- 1 Causes of local species extinction.
- 2 Field excursion.
- 3 Data collection.
- 4 Preparation of an inventory of the flora of a given region.
- 5 To carry on base line study of any designated category.

Recommended Books:

1. Bush, M.B. 1997. Ecology of a Changing Planet. Prentice Hall.
2. Cunnighum, A.B. 2001. Applied ethnobotany: People, wild plant use and conservation. Earthspan Publications.
3. Cotton, C.M. (1996). Ethnobotany Principle Application. John Wiley & Sons Chichester, UK.
4. De Klemm, C. (1990) Wild plant conservation, IUCN, Gland.
5. Dyke, F.V. (2003). Conservation Biology. Mc Graw Hill, New York.
6. Grombridge, B. & Jenkins, M. D. (2002). World Atlas of Biodiversity: Earths Living Resources in the 21st. Century, University. California Press, Berkeley.

7. Heywood, V.H. 1995. Global Biodiversity Assessment. Cambridge University Press and UNEP.
8. Krishnamurthy, K.V. 2003. A Textbook of biodiversity Science publishers Inc. Enfield, NH, USA.
9. Levine, D.A. 2000. The origin, expansion and demise of plant species. Oxford University Press.
10. Ministry of Environment, IUCN, WWF. 1998. Biodiversity Action Plan for Pakistan.
11. Primack, R.B. 1998. Essentials of conservation Biology. Sinaur Association Pub. Mass. USA.
12. Virchow, D. (1998). Conservation of Genetic Resources. Springer-Verlag, Berlin
13. Falk, D.A. & Holsinger, K.E. 1991. *Genetics and Conservation of Rare Plants*. Center for Plant Conservation. Oxford University Press, Oxford, UK.
14. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. *The Conservation of Plant Biodiversity*. Cambridge University Press, Cambridge, UK.
15. IUCN. 1994. *IUCN Red List Categories*. As Approved by the IUCN Council. IUCN.
16. French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W.W. Norton & Co
17. Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd.
18. Taylor, P. 2005 Beyond Conservation. Earth Scan Publication Ltd.
19. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.

Journals / Periodicals: Systematics and Biodiversity Biological Conservation.

Title of the Course: Genetics II Credit Hours: 3(2+1)

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

Course Outline:

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 65
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

Lab Outline: Problems relating to the theory 1 Isolation and separation of DNA and protein on Gel electrophoresis. i. Bacterial chromosome ii. Plasmid DNA (minipreps) 66 iii. Plant DNA iv. Protein 2 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,.
9. Hartt, D. L, and Jones, E.W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA
10. Gelvin, S,B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
11. Primrose, S.B., Twyman, R. M. and Old R.W. 2004. Principles of Gene Manipulation, an Introduction to Genetic Engineering (6th edition), Blackwell Scientific Publications.
12. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press,.
13. Wilson, J. and Hunt, T. 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.

Journals / Periodicals: J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

Term 4th

Title of the Course: Environmental Biology Credit Hours: 3(2+1)

Specific Objectives of course: To provide updated knowledge of environmental problems and sustainable environmental management.

Course Outline:

1. Environment: Introduction, scope, pressure
2. Pollution: definition, classification and impact on habitats i. Air pollution: Sources and effect of various pollutants (inorganic, organic) on plants, prevention, control, remediation. Photochemical smog. Smog. Acid rain: 1. Theory of acid rain, 2. Adverse effects of acid rains. Chlorofluorocarbons and its effects. ii. Water pollution: Major sources of water pollution and its impact on vegetation. prevention, control remediation, eutrophication, thermal pollution. iii. Sediments pollution: fungicide, pesticides, herbicide, major sources of soil pollution and its impact. Prevention, control remediation. Heavy metal pollution. Tanneries. Hospital waste. Treatments of sewage, sludge, and polluted waters. iv. Noise pollution. v. Radiation pollution (including nuclear): Measurement, classification and effects, Principle of radiation protection, waste disposal
3. Forest: importance, deforestation, desertification and conservation
4. Ozone layer: i. Formation ii. Mechanism of depletion iii. Effects of ozone depletion
5. Greenhouse effect: causes, impacts.
6. Human population explosion: impact on environment.
7. Impact assessment: Industrial urban, civil developments.
8. National conservation strategy: Brief review of major problems of Pakistan and their solutions.
9. Sustainable Environmental management.
10. Wetlands and sanctuaries protection: The pressures, problems and solutions.
11. Range management: Types of rangelands, potential threats, sustainable management.

Lab Outline:

1. Examination of industrial waste water and Municipal sewage and sludge for i. Total dissolved solids. ii. pH and EC. iii. BOD/COD. iv. Chlorides, carbonate, and Nitrates.
2. Examination of water samples from different sites for the presence and diversity of organisms.
3. Effect of air pollutants on plants.
4. Visits to environmentally compromised sites and evolution of remediation methods.

Recommended Books:

1. Newman, E.I. 2001. Applied Ecology. Blackwell Science. UK
2. Mooney, H.A. and Saugier, B. 2000. Terrestrial Global Productivity. Academic Press, UK.
3. Eugene, E.D. and Smith, B.F. 2000. Environmental Science: A study of interrelationships. McGraw Hill. USA.
4. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. W.W. Norton and Company, NY.

5. Hall, C.A.S. and Perez, C.L. 2000. Quantifying Sustainable Development. Academic Press, UK.
6. Bazzaz, F.A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.
7. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.
8. Marsh, M.W. and Grossa Jr., J.M. 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.
9. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

Journals/Periodicals: Environmental Biology, Environment, Bioremediation

Title of the Course: Botany Special Paper-II Credit Hours: 4(3+1)

Specific Objectives of course:

Course Outline: To be adopted by the university as per expertise

Lab Outline:

Recommended Books:

Journals / Periodicals:

Title of the Course: Special Paper-II Credit Hours: 4(3+1)

Specific Objectives of course:

Course Outline: To be adopted by the university as per expertise

Lab Outline:

Recommended Books: Journals / Periodicals:

RESEARCH 4(0+4)

Total credit hours: 133

GENERAL RECOMMENDATIONS (BOTANY) After a comprehensive discussion by all the members of the committee constituted by HEC to adapt the curriculum (devised by HEC) following points were noted: • This document contained information which was general for all the disciplines. • It was unanimously adapted with minor modifications made. While restructuring the scheme of study semester wise for BS 4 years programme in Botany, there were general feelings that we should accommodate for the phasing out of existing 2 year degree programme and phasing in the modern 4 years degree programme. Accordingly, courses were selected compatible to meet the current and future needs.

Nevertheless emphasis was on the creation of a document that should be attractive and useful for the introduction of BS 4 years degree programme in Botany for public / private sector universities. Therefore following recommendations were made: 1. That HEC should write to Federal and Provincial Public Service Commissions for formal recognition of the BS 4 years degree programme and it must be considered equivalent to the existing M.Sc. (16 years schooling programme). 2. That HEC should provide sufficient funds to the colleges and the universities to initiate such new degree programmes. Universities and colleges offering these courses should organize training and workshops before initiating degree programme. 3. That HEC should ensure that the institutions have at least eight teachers (at least 2 teachers having M.Phil Degree). 4. That the Internship and Research projects should be encouraged but it should not be mandatory at this juncture as we do not have a culture of Internships and Research activities in the disciplines of Botany in our country. 72

COMPULSORY COURSES IN ENGLISH FOR BS (4 YEAR) IN BASIC & SOCIAL SCIENCES

English – I (Functional English)

Objectives: Enhance language skills and develop critical thinking.

Course Contents Basics of Grammar Parts of speech and use of articles Sentence structure, active and passive voice Practice in unified sentence Analysis of phrase, clause and sentence structure Transitive and intransitive verbs Punctuation and spelling

Comprehension Answers to questions on a given text

Discussion General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills Urdu to English Paragraph writing Topics to be chosen at the discretion of the teacher

Presentation skills Introduction *Note: Extensive reading is required for vocabulary building*

Recommended books:

1. Functional English a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492 2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506 b) Writing 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41. c) Reading/Comprehension 1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2. d) Speaking

ENGLISH – II (COMMUNICATION SKILLS)

Objectives: Enable the students to meet their real life communication needs.

Course Contents **Paragraph writing** Practice in writing a good, unified and coherent paragraph **Essay writing** Introduction **CV and job application** Translation skills Urdu to English **Study skills** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension **Academic skills** Letter/memo writing, minutes of meetings, use of library and internet **Presentation skills** Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:

Communication Skills a) Grammar 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6. b) Writing 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinard and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking). 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing). c) Reading 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0. 2. Reading and Study Skills by John Langan 3. Study Skills by Richard Yorky.

ENGLISH – III (TECHNICAL WRITING AND PRESENTATION SKILLS)

Objectives: Enhance language skills and develop critical thinking

Course Contents **Presentation skills** **Essay writing** Descriptive, narrative, discursive, argumentative **Academic writing** How to write a proposal for research paper/term paper How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing **Progress report writing** *Note: Extensive reading is required for vocabulary building*

RECOMMENDED BOOKS Technical Writing and Presentation Skills a) Essay Writing and Academic Writing 1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing). 2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004. 3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press. b) Presentation Skills c) Reading The Mercury Reader. A Custom Publication. Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Pakistan Studies (Compulsory)

Introduction/Objectives • Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan. • Study the process of

governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah. b. Factors leading to Muslim separatism c. People and Land i. Indus Civilization ii. Muslim advent iii. Location and geo-physical features.

2. Government and Politics in Pakistan Political and constitutional phases: a. 1947-58 b. 1958-71 c. 1971-77 d. 1977-88 e. 1988-99 f. 1999 onward

3. Contemporary Pakistan a. Economic institutions and issues b. Society and social structure c. Ethnicity d. Foreign policy of Pakistan and challenges e. Futuristic outlook of Pakistan

Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

ISLAMIC STUDIES (Compulsory)

Objectives: This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Introduction to Quranic Studies

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

Seats of Holy Prophet (S.A.W) I 1) Life of Muhammad Bin Abdullah (Before Prophet Hood) 2) Life of Holy Prophet (S.A.W) in Makkah 3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II 1) Life of Holy Prophet (S.A.W) in Madina 2) Important Events of Life Holy Prophet in Madina 3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah 1) Basic Concepts of Hadith 2) History of Hadith 3) Kinds of Hadith 4) Uloom –ul-Hadith 5) Sunnah & Hadith 6) Legal Position of Sunnah

Selected Study from Text of Hadith Introduction To Islamic Law & Jurisprudence

1) Basic Concepts of Islamic Law & Jurisprudence 2) History & Importance of Islamic Law & Jurisprudence 3) Sources of Islamic Law & Jurisprudence 4) Nature of Differences in Islamic Law 5) Islam and Sectarianism

Islamic Culture & Civilization 1) Basic Concepts of Islamic Culture & Civilization 2) Historical Development of Islamic Culture & Civilization 3) Characteristics of Islamic Culture & Civilization 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science 1) Basic Concepts of Islam & Science 2) Contributions of Muslims in the Development of Science 3) Quranic & Science

Islamic Economic System 1) Basic Concepts of Islamic Economic System 2) Means of Distribution of wealth in Islamic Economics 3) Islamic Concept of Riba 4) Islamic Ways of Trade & Commerce

Political System of Islam 1) Basic Concepts of Islamic Political System 2) Islamic Concept of Sovereignty 3) Basic Institutions of Govt. in Islam

Islamic History 1) Period of Khlaft-E-Rashida 2) Period of Ummayyads 3) Period of Abbasids

Social System of Islam 1) Basic Concepts Of Social System Of Islam 2) Elements Of Family 3) Ethical Values Of Islam

Reference Books: 1) Hameed ullah Muhammad, “Emergence of Islam” , IRI, Islamabad 2) Hameed ullah Muhammad, “Muslim Conduct of State” 3) Hameed ullah Muhammad, ‘Introduction to Islam’ 4) Mulana Muhammad Yousaf Islahi,” 5) Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan. 6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic

University, Islamabad (1993) 7) Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982) 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989) 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Note: One course will be selected from the following six courses of Mathematics.

COMPULSORY MATHEMATICS COURSES FOR BS (4 YEAR) (FOR STUDENTS NOT MAJORING IN MATHEMATICS)

1. MATHEMATICS I (ALGEBRA) Prerequisite(s): Mathematics at secondary level **Credit Hours:** 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines. **Course Outline:** *Preliminaries:* Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule. *Quadratic Equations:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations. *Sequences and Series:* Arithmetic progression, geometric progression, harmonic progression. *Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices. *Trigonometry:* Fundamentals of trigonometry, trigonometric identities. **Recommended Books:** Dolciani MP, Wootton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston (suggested text) Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

2. MATHEMATICS II (CALCULUS) Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0 **Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines. **Course Outline:** *Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions. *Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives. *Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals. **Recommended Books:** Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text) Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA **3. MATHEMATICS III (GEOMETRY) Prerequisite(s):** Mathematics II (Calculus) **Credit Hours:** 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines. **Course Outline:** *Geometry in Two Dimensions:* Cartesian-coordinate mesh, slope of a line, equation of a line, parallel and

perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line. 83

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions. *Conic Sections*: Parabola, ellipse,

hyperbola, the general-second-degree equation **Recommended Books**: Abraham S, Analytic Geometry, Scott, Freshman and Company, 1969 Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

4. COURSE FOR NON-MATHEMATICS MAJORS IN SOCIAL SCIENCES *Title of subject*: MATHEMATICS *Discipline* : BS (Social Sciences). *Pre-requisites* : SSC

(Metric) level Mathematics *Credit Hours* : 03 + 00 *Minimum Contact Hours*: 40

Assessment : written examination; *Effective* : 2008 and onward **Aims** : To give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.

Objectives : After completion of this course the student should be able to: • Understand the use of the essential tools of basic mathematics; • Apply the concepts and the

techniques in their respective disciplines; • Model the effects non-isothermal problems through different domains; **Contents** : 1. *Algebra : Preliminaries*: Real and complex

numbers, Introduction to sets, set operations, functions, types of functions. *Matrices*: Introduction to matrices, types of matrices, inverse of matrices, determinants, system of

linear equations, Cramer's rule. *Quadratic equations*: Solution of quadratic equations, nature of roots of quadratic equations, equations reducible to 84

quadratic equations. *Sequence and Series*: Arithmetic, geometric and harmonic progressions. *Permutation and combinations*: Introduction to permutation and

combinations, *Binomial Theorem*: Introduction to binomial theorem. *Trigonometry*: Fundamentals of trigonometry, trigonometric identities. *Graphs*: Graph of straight line,

circle and trigonometric functions. 2. *Statistics : Introduction*: Meaning and definition of statistics, relationship of statistics with social science, characteristics of statistics,

limitations of statistics and main division of statistics. *Frequency distribution*: Organisation of data, array, ungrouped and grouped data, types of frequency series,

individual, discrete and continuous series, tally sheet method, graphic presentation of the frequency distribution, bar frequency diagram histogram, frequency polygon, cumulative

frequency curve. *Measures of central tendency*: Mean median and modes, quartiles, deciles and percentiles. *Measures of dispersion*: Range, inter quartile deviation mean

deviation, standard deviation, variance, moments, skewness and kurtosis. **Recommended**

Books: 1. Swokowski. E. W., 'Fundamentals of Algebra and Trigonometry', Latest Edition. 2. Kaufmann. J. E., 'College Algebra and Trigonometry', PWS-Kent Company,

Boston, Latest Edition. 3. Walpole, R. E., 'Introduction of Statistics', Prentice Hall, Latest Edition. 4. Wilcox, R. R., 'Statistics for The Social Sciences', 5. Mathematics For

Chemistry **Credit Hours**: 3 **Prerequisites**: Mathematics at Secondary level **Specific**

Objectives of Course: To prepare the students not majoring in mathematics with the

essential tools of Calculus to apply the concepts and the techniques in their respective disciplines. 85

Course Outline: *Preliminaries*: Real Numbers and the Real Line, *Functions and their graphs*: Polynomial Functions, Rational Functions, Trigonometric Functions, and

Transcendental Functions. Slope of a Line, Equation of a Line, Solution of equations

involving absolute values, Inequalities. *Limits and Continuity*: Limit of a Function, Left Hand and Right Hand Limits, Continuity, Continuous Functions. *Derivatives and its Applications*: Differentiation of Polynomial, Rational and Transcendental Functions, Extreme Values of Functions. *Integration and Indefinite Integrals*: Integration by Substitution, Integration by Parts, Change of Variables in Indefinite Integrals. Least-Squares Line. **Recommended Books**: 1. Thomas, Calculus, 11th Edition. Addison Wesley publishing company, 2005. 2. H. Anton, I. Bevens, S. Davis, Calculus, 8th edition, John Wiley & Sons, Inc. 2005. 3. Hughes-Hallett, Gleason, McCallum, et al, Calculus Single and Multivariable, 3rd Edition. John Wiley & Sons, Inc. 2002. 4. Frank A.Jr, Elliott Mendelson, Calculus, Schaum's Outline Series, 4th edition, 1999. 5. E. W. Swokowski, Calculus and Analytic Geometry PWS Publishers, Boston, 1983. 6. John H. Mathews, Numerical Methods for Mathematics Science and Engineering, Prentice-Hall, Second Edition 1992. 6. **MATHEMATICS FOR PHYSICS Contents** 1. Preliminary calculus. • Differentiation Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz' theorem; special points of a function; theorems of differentiation. • Integration Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration. 86

2. Complex numbers and hyperbolic functions • The need for complex numbers • Manipulation of complex numbers Additions and subtraction; modulus and argument; multiplication; complex conjugate; division • Polar representation of complex numbers Multiplication and division in polar form • de Moivre's theorem Trigonometrical identities; finding the nth roots of unity; solving polynomial equations • Complex logarithms and complex powers • Applications to differentiation and integration • Hyperbolic functions Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions. **3. Series and limits** • Series • Summation of series Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series • Convergence of infinite series Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test • Operations with series • Power series Convergence of power series; operations with power series • Taylor series Taylor's theorem; approximation errors in Taylor series; standard Maclaurin series • Evaluation of limits **4. Partial differentiation** • Definition of the partial derivative • The total differential and total derivative • Exact and inexact differentials

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• Useful theorems of partial differentiation • The chain rule • Change of variables • Taylor's theorem for many-variable functions • Stationary values of many-variable functions • Stationary values under constraints **5. Multiple integrals** • Double integrals • Triple integrals • Applications of multiple integrals Areas and volumes; masses, centers of mass and centroids; Pappus' theorems; moments of inertia; mean values of functions • Change of variables in multiple integrals Change of variables in double integrals; **6. Vector algebra** • Scalars and vectors • Addition and subtraction of vectors •

Multiplication by a scalar • Basis vectors and components • Magnitude of a vectors • Multiplication of vectors Scalar product; vector product; scalar triple product; vector triple product • Equations of lines and planes Equation of a line; equation of a plane • Using vectors to find distances Point to line; point to plane; line to line; line to plane • Reciprocal vectors **7. Matrices and vector spaces** • Vectors spaces Basic vectors; the inner product; some useful inequalities • Matrices • The complex and Hermitian conjugates of a matrix • The determinant of a matrix Properties of determinants • The inverse of a matrix • The rank of a matrix • Simultaneous linear equations N simultaneous linear equations in N unknowns • Special square matrices

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Diagonal; symmetric and antisymmetric; orthogonal; Hermitian; unitary normal • Eigen vectors and eigen values of a normal matrix; of Hermitian and anti-Hermitian matrices; of a unitary matrix; of a general square matrix • Determination of eigen values and eigen vectors degenerate eigen values **8. Vector calculus** • Differentiation of vectors Composite vector expressions; differential of a vector • Integration of vectors • Space curves • Vector functions of several arguments • Surfaces • Scalar and vector fields • Vector operators Gradient of a scalar field; divergence of a vector field; curl of a vector field • Vector operator formulae Vector operators acting on sums and products; combinations of grad, div and curl • Cylindrical and spherical polar coordinates Cylindrical polar coordinates; spherical polar coordinates 89

Annexure “E” INTRODUCTION TO STATISTICS Credit hrs: 3(3-0) Unit 1. What is Statistics? Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises. Unit 2. Presentation of DataIntroduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves. Exercises. Unit 3. Measures of Central Tendency Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises. Unit 4. Measures of Dispersion Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises. Unit 5. Probability and Probability Distributions. Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises Unit 6. Sampling and Sampling Distributions Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

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Unit 7. Hypothesis Testing Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises. Unit 8. Testing of Hypothesis- Single Population Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises Unit 9. Testing of Hypotheses-Two or more Populations Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises Unit 10. Testing of Hypothesis-Independence of Attributes Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises. Unit 11. Regression and Correlation Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2 . Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

Recommended Books 1 Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., Inc. New York. 2 Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad. *Note: **General Courses from other Departments*** Details of courses may be developed by the concerned universities according to their Selection of Courses as recommended by their Board of Studies. 91