



University of Chitral یونیورسٹی آف چترار
BECOME WHAT YOU WANT TO BE



SCHEME OF STUDIES BS BOTANY 4 YEAR PROGRAMME

**DEPARTMENT OF BOTANY
UNIVERSITY OF CHITRAL**



Name of Degree: BS Botany

Eligibility Criteria: The minimum requirements for admission is at least 45% marks in FSc(Pre-Medical)

Examination Duration: The minimum duration for completion of BS Botany degree is four and maximum is seven years' subject to approval of extension from the competent authority.

Degree Completion Requirements: To become eligible for award of BS Botany degree, a student must satisfy the following requirements:

- Must have studied and passed the prescribed courses, totaling at least 136 credit hours.
- Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 on a scale of 4.0

Scheme of Study for BS Botany Program			
1st Semester BS Botany			
Course Code	Subject	Course Type	Credit Hour
Bot-111	Functional English	Compulsory- I	3 (3+0)
Bot-112	Pakistan studies	Compulsory-II	2 (2+0)
Bot-113	Mathematics	Compulsory-III	3(3+0)
Bot-114	Principles in Animal Life-I	General-I	3 (2+1)
Bot-115	Organic Chemistry	General-II	3 (2+1)
Bot-116	Diversity of Plants	Foundation-I	4 (3+1)
Total Credit Hour			18(15+3)
2nd Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-121	Communication Skills	Compulsory-IV	3 (3+0)
Bot-122	Islamic Studies	Compulsory-V	2 (2+0)
Bot-124	Principles in Animal Life-II	General -III	3 (2+1)
Bot-125	Inorganic Chemistry	General -IV	3 (2+1)
Bot-126	Plant Systematics, Anatomy and Development/ Embryology	Foundation -V	4 (3+1)
	Any one from the following	Compulsory -VI	
Bot-123	Introduction to Sociology		3(3+0)
Bot-127	Edaphology		3(2+1)
Bot-128	Microbiology		3(2+1)
Total Credit Hour			18(15+3) or 18(14+4)



3 rd Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-231	Technical Report Writing & Presentation Skill	Compulsory -VII	3(3+0)
Bot-232	Introduction to computer	Compulsory -VIII	3 (2+1)
Bot-233	Animal Diversity: Invertebrates	General-V	4 (3+1)
Bot-234	Environmental Chemistry	General-VI	3 (2+1)
Bot-235	Cell Biology, Genetics and Evolution	Foundation -III	4 (3+1)
Total Credit Hour			17(12+4)
4 th Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-241	Animal Diversity: Chordates	General-VII	3 (2+1)
Bot-243	Plant Physiology and Ecology	Foundation-IV	4 (3+1)
Bot-244	Biodiversity and Conservation	Fondation-V	4 (3+1)
Bot-245	Biostatistics	Compulsory -IX	3 (2+1)
	Any one of the following	General -VIII	
Bot-242	General Biochemistry		3 (2+1)
Bot-246	Introduction to Geography		3(3+0)
Bot-247	Ecosystem and Environment		3(2+1)
Total Credit Hour			17(12+5) Or 17(13+4)
5 th Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-351	Bacteriology and Virology	Foundation-VI	3 (2+1)
Bot-352	Phycology and Bryology	Major-I	3 (2+1)
Bot-353	Mycology and Plant Pathology	Major-II	3 (2+1)
Bot-354	Diversity of Vascular Plants	Foundation -VII	3 (2+1)
Bot-355	Plant Systematics	Major-III	3 (2+1)
Total Credit Hour			15(10+5)



6 th Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-361	Plant Anatomy	Foundation-VIII	3 (2+1)
Bot-362	Genetics-I	Major-IV	3 (2+1)
Bot-363	Plant Biochemistry-I	Major-V	3 (2+1)
Bot-364	Plant Ecology-I	Foundation-IX	3 (2+1)
Bot-365	Plant Physiology-I	Major-VI	3 (2+1)
Bot-366	Research Methodology		3 (3+0)
Total Credit Hour			18(12+6) or 18(13+5)
7 th Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-471	Molecular Biology	Major-VII	3 (2+1)
Bot-472	Plant Biochemistry-II	Major-VIII	3 (2+1)
Bot-473	Plant Ecology-II	Major-IX	3 (2+1)
	(Elective-I) to be selected from the list of elective courses	Elective Subjects	3(2+1)
Bot-474	(Elective-II) to be selected from the list of elective courses/Research		3 (2+1)
Total Credit Hour			15(10+5)



8 th Semester			
Course Code	Subject	Course Type	Credit Hour
Bot-481	Plant Physiology-II	Major-X	3 (2+1)
Bot-482	Genetics-II	Major-XI	3 (2+1)
Bot-483	Environmental Biology	Major-XII	3 (2+1)
	(Elective-III) to be selected from the list of elective courses	Elective Subjects	3(2+1)
	(Elective-IV) to be selected from the list of elective courses/Research		3 (2+1)
Thesis-486	BS thesis		06
Total Credit Hour			15(10+5)
Net Credit Hour	18+18+17+17+15+18+15+15		133

Note:

1. Research will be offered to those students who have secured 60% marks in their previous exams in aggregate.
2. Those who have not failed any subject during their previous semesters.
3. One course from elective subjects in 7th semester and one elective course from 8th semester are mandatory for research students.
4. For special paper students two subjects in both 7th and 8th semesters are mandatory.
5. Research credit hour is 6.

Course code	Subject	Credit Hour	Remarks
Bot-474	Pharmacognosy	3(2+1)	
Bot-475	Economic Botany	3(2+1)	
Bot-476	Water logging and salinity	3(2+1)	
Bot-484	Plant tissue culture	3(2+1)	
Bot-485	Introduction to horticulture	3(2+1)	
Bot-486	Plant Pathology	3(2+1)	



First Semester

Bot –111 Functional English

Cr. Hr. 03(3+0)

Objectives: To 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 57
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

Bot-112 Pakistan Study

Cr. Hr. 02 (2+0)

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.
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.

Bot – 113 Mathematics

Cr. Hr. 03(3+0)

Objectives:

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 M. P, Wooton W, Beckenback E F, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann J. E, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski E. W., *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

Bot -114 Principles in Animal Life – I

Cr. Hr. 03(2+1)

Objectives

The course aims to impart knowledge and understanding of:

- The concept and status of Zoology in life sciences and the common processes of life through its biochemical and molecular processes.
- The structure and function of cell organelles and how common animal cell diversified in various tissues, organs and organ systems.
- Biochemical mechanisms eventually generating energy for animal work.
- Animals and their relationship with their environment.

Course Contents

Scope of Zoology: Introduction; significance and applications of zoology; animal diversity; the scientific method; environment and world resources.

The Chemical Basis of Animal Life: Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids. Cellular Organization: Structure of animal cells, cell membrane, cytoplasm and its organelles: ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, vacuoles; the nucleus: nuclear envelope, chromosomes and nucleolus.

Animal tissues: Types: epithelial, connective, muscle and nervous tissue; organs and organ systems.

Enzymes: Structure, types; function and factors affecting their activity; cofactors and coenzymes.

Energy Harvesting: Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP.

Reproduction and Development: Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development.

Ecological Concepts: Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles, and limiting factors, populations and communities, human population growth, pollution, resource depletion and biodiversity.

Practicals

1. Tests for different carbohydrates, proteins and lipids.

Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and



cardiac). Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood. Preparation of blood smears.
4. Protein digestion by pepsin.
5. Ecological notes on animals of a few model habitats.
6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended

1. Miller, S.A. and Harley, J.B. 2005. Zoology, 6th Ed. (International), Singapore: McGraw-Hill.
2. Molles, M.C. 2005. Ecology: Concepts and Applications. 6 th Ed. McGraw Hill, New York, USA.
3. Hickman, C.P., Roberts, L.S. and Larson, A. 2004. Integrated Principles of Zoology, 12th Ed. (International), Singapore: McGraw Hill.
4. Campbell, N.A. 2002. Biology. 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
5. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
6. Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.
7. Odum, E. P. 1994. Fundamentals of Ecology. 3rd Ed. W.B. Saunders. Philadelphia

Bot –115 Organic Chemistry

Cr. Hr. 03 (2+1)

Introduction to Organic Chemistry

Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.

Chemical Bonding and Properties of Organic Molecules: Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of organic molecules; inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation.

Classes and Nomenclature of Organic Compounds: Classification of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

Functional Group Chemistry: A brief introduction to the chemistry of hydrocarbons (Alkane, alkene and alkyne), alkyl halides, aldehydes, ketones and their derivatives.

Recommended Books

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., Organic Chemistry, Oxford University Press, New York.
2. Loudon, G. M., Organic Chemistry, Oxford University Press, New York
3. Sorrell, T. N., Organic Chemistry, Viva Books Private Ltd., New Delhi.
4. Finar, I. L., Organic Chemistry, Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., Organic Chemistry, McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., A Text Book of Organic Chemistry, Narosa Publishing House, New Delhi



7. March, J., Advanced Organic Chemistry, John Wiley & Sons, New York.
8. Bansal, R. K., Organic Reaction Mechanisms, Tata McGrawHill Publishing Company Ltd., New Delhi.
9. Pine, S. H., Organic Chemistry, National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., Organic Chemistry-A Brief Survey of Concepts and Applications, Prentice-Hall, New Jersey.

Bot –116 Diversity of Plants

Cr. Hr. 04(3+1)

Specific Objectives of course:

To introduce the students to the diversity of plants and their structures and significance.

Course Outline:

Comparative study of life form, structure, reproduction and economic significance of:

a) **Viruses** (RNA and DNA types) with special reference to TMV;

b) **Bacteria and Cyanobacteria**

c) **Algae** (*Chlamydomonas*, *Chara*)

d) **Fungi** (*Penicillium*, *Puccinia*, *Agaricus*)

e) **Lichens**

f) **Bryophytes**

i. *Funaria*

g) **Pteridophytes.**

h) **Gymnosperms**

i) **Angiosperms**

i. Monocot

ii. Dicot

Lab Outline:

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory. Identification of various types mentioned from prepared slides and fresh collections.

Recommended Books:

1. Lee, R. E. 1999. Phycology. Cambridge University Press, UK
2. Prescott, L. M., Harley, J. P. and Klein, A. D. 2004. Microbiology, 3rd Ed. W.M. C. Brown Publishers.
3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 1996. Introductory Mycology. 4th Ed. John Wiley and Sons Publishers.
4. Agrios, G. N. 2004. Plant pathology. 8th Ed. Academic Press London.
5. Vashishta, B. R. 1991. Botany for degree students (all volumes). S. Chand and Company. Ltd. New Delhi.
6. Andrew, H. N. 1961. Studies in Paleobotany. John Wiley and Sons.
7. Ingrouille, M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall.
8. Mauseth, J. D. 2003. Botany: An Introduction to Plant Biology 3rd Ed., Jones and Bartlett Pub. UK
9. Marti, J. Ingrouille & Plant: Diversity and Evolution. 2006 CUP
10. Taylor, T. N. & Taylor, E. D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N. Y.



11. Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire.

Journals / Periodicals:

Pakistan Journal of Botany, American Journal of Botany, Canadian Journal of Botany, Annals of Botany.

Second Semester

Bot –121 Communication Skills

Cr. Hr. 03(3+0)

Objectives:

To 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 and minutes of the meeting, use of library and internet resources

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. 58 b)

Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise 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 Yorke.

Bot –122 Islamic Studies

Cr. Hr. 02(2+0)

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.

Detail of courses

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," 67
- 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).

Bot –124 Principles in Animal Life–II

Cr. Hr. 03(2+1)

Objectives:

The course will impart knowledge and understanding of:

- Cell division and its significance in cell cycle.
- Concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.
- Animal behaviour and communication.
- Theories of evolution, gene flow and mechanism of evolution with reference to animal diversity.

Course Contents



Cell Division: Cell cycles: Mitosis and meiosis; control of the cell cycle. Inheritance Patterns: Mendelian genetics; inheritance patterns; gene, structure, chemical composition and types. Chromosomes and Gene Linkage: Eukaryotic chromosomes; linkage and crossing over; chromosomal aberrations.

Cellular Control: DNA: the genetic material; DNA replication in prokaryotes and eukaryotes; control of gene expression in eukaryotes; gene mutation; recombinant DNA technologies and their applications.

Animal Behavior: Behaviour and its types, proximate and ultimate causes; anthropomorphism; development of behavior; learning; factors controlling animal behavior; communication; behavioral ecology; social behavior.

Evolution: A Historical Perspective: Theories of evolution: Natural selection Lamarckism and neo larmarckism, Darwinism and neo Darwinian.

Evolution and Gene Frequencies: Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.

Practicals

1. Study of mitosis in onion root tip.
2. Study of meiosis in grasshopper testis (students should prepare the slide).
3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood groups.
5. Survey study of a genetic factor in population and its frequency.
6. Study of karyotypes of Drosophila, mosquito.
7. Study of cytochemical detection of DNA in protozoa and avian blood cell.
8. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).

Note for 1-2: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used).

Books Recommended

1. Pechenik, J.A. 2012. Biology of Invertebrates, 4th Edition (International), Singapore: McGraw Hill.
2. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principles of Zoology, 11th Edition (International). Singapore: McGraw Hill.
3. Miller, S.A., Harley, J.B. 2002. Zoology, 5th Edition (International), Singapore: McGraw Hill.
4. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International). Singapore: McGraw Hill.
5. Campbell, N.A. 2002. Biology. 6th Edition. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
6. Kent, G.C., Miller, S. 2000. Comparative Anatomy of Vertebrates. New York: McGraw Hill.
7. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

Bot –125 Inorganic Chemistry

Cr. Hr. 03(2+1)



- The program is aimed that the student should learn:
- The Development of periodic law and properties of elements in a systematic way.
- The principal of chemical bonding
- Chemistry of acid and bases
- Chemistry of p-block Elements

Course Content

1. The Periodic Law and Periodicity

Development of Periodic Table; Classification of elements based on s, p, d and f orbitals, group trends and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronegativities.

2. Principles of Chemical Bonding Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic homonuclear molecules, bonding theory of metals; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

3. Acids and Bases Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. Theory of Indicators, solubility, solubility product, common ion effect.

4. Chemistry of p-block Elements Chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens and pseudohalogens.

Practical

1. Laboratory Ethics and safety measures Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative analysis Analysis of four ions (two anions and two cations) from mixture of salts

3. Quantitative analysis Laboratory work illustrating topics covered in the lecture of CHEM-151

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., Wiley, New York, 1995.
3. Clyde Day, M. & Selbin, J., Theoretical Inorganic Chemistry, 2nd Ed., Van Nostrand Reinhold, 1969.
4. Lee, J.D., Concise Inorganic Chemistry, Chapman and Hall, 5th Edition, 1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., Inorganic Chemistry, Oxford University Press, 2nd Edition, 1994.



6. Bassette, J., Denney, G. H. and Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis. Longman Green & Co. 1995.

Bot –126 Plant Systematics, Anatomy and Development/Embryology Cr. Hr.
04(3+1)

Specific Objectives of course:

To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

Course Outline:

a) Plant systematics

1. Introduction to Plant Systematics: aims, objectives and importance.
2. Classification: brief history of various systems of classification.
3. Brief introduction to nomenclature.
4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
5. Diagnostic characters, economic importance and distribution pattern of the following families:
 - i. Ranunculaceae
 - ii. Rosaceae
 - iii. Euphorbiaceae
 - iv. Lamiaceae (Labiatae)
 - v. Apiaceae (Umbelliferae)

b) Anatomy

1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
 - i. Parenchyma
 - ii. Collenchyma
 - iii. Sclerenchyma
 - iv. Phloem
 - v. Xylem
3. Meristem
4. Vascular cambium
5. Structure of root, stem and leaf.
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

c) Development/Embryology

1. Early development of plant body:
2. Structure and development of Anther Microsporogenesis, Microgametophyte
3. Structure of Ovule Megasporogenesis Megagametophyte
4. Endosperm formation
5. Parthenocarpy



6. Polyembryony

Lab Outline:

Plant Systematics

1. Identification of families given in syllabus with the help of keys.
2. Technical description of common flowering plants belonging to families mentioned in theory.
3. Field trips shall be undertaken to study and collect local plants.
4. Students shall submit 40 fully identified herbarium specimens.

Anatomy and Embryology

1. Study of stomata and epidermis.
2. Tissues of primary body of plant.
3. Study of xylem 3-dimensional plane of wood.
4. T. S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens

Recommended Books:

1. Mauseth, J. D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
2. Moore, R. C., W. D. Clarke and Vodopich, D. S. 1998. Botany. McGraw Hill Company, U.S.A.
3. Raven, P. H., Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants. W. H. Freeman and Company Worth Publishers.
4. Stuessy, T. F. 1990. Plant Taxonomy. Columbia University Press, USA.
5. Lawrence, G. H. M. 1951 Taxonomy of Vascular Plants. MacMillan & Co. New York.
6. Panday, B. P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
7. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd Ed. John Wiley & Sons. Inc.
8. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
9. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
10. Maheshwari, P. 1971. Embryology of Angiosperms, McGraw-Hill. New York.
11. Eames A. J. and L. H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited, New Delhi.
12. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition, Regency Publications, New Delhi.
13. Naik, V. N. 2005 Taxonomy of Angiosperms. 20th Reprint. TataMacGraw-Hill Publishing Company, Limited New Delhi.
14. Rajput, M. T., S. S. Hassney and K. M. Khan. 1996. Plant Taxonomy. New Trends Computer Service, Hyderabad, Sindh, Pakistan.

Journals / Periodicals:

Pakistan Journal of Botany, Taxon, Phytion.



Optional Subjects

Bot- 123 Introduction to Sociology

Cr. Hr. 3 (3+0)

Objective:

The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes. The course will provide due foundation for further studies in the field of sociology.

Course Outline

1. Introduction
 - a. Definition, Scope, and Subject Matter
 - b. Sociology as a Science
 - c. Historical back ground of Sociology
2. Basic Concepts
 - a. Group, Community, Society
 - b. Associations
 - i. Non-Voluntary
 - ii. Voluntary
 - c. Organization
 - i. Informal
 - ii. Formal
 - d. Social Interaction
 - i. Levels of Social Interaction
 - ii. Process of Social Interaction
 - a) Cooperation
 - b) Competition
 - c) Conflict
 - d) Accommodation
 - e) Acculturation and diffusion
 - f) Assimilation
 - g) Amalgamation
3. Social Groups
 - a. Definition & Functions
 - b. Types of social groups
 - i. In and out groups
 - ii. Primary and Secondary group
 - iii. Reference groups
 - iv. Informal and Formal groups
 - v. Pressure groups
4. Culture
 - a. Definition, aspects and characteristics of Culture
 - i. Material and non material culture
 - ii. Ideal and real culture
 - b. Elements of culture



- i. Beliefs
 - ii. Values
 - iii. Norms and social sanctions
 - c. Organizations of culture
 - i. Traits
 - ii. Complexes
 - iii. Patterns
 - iv. Ethos
 - v. Theme
 - d. Other related concepts
 - i. Cultural Relativism
 - ii. Sub Cultures
 - iii. Ethnocentrism and Xenocentrism
 - iv. Cultural lag
- 5. Socialization & Personality
 - a. Personality, Factors in Personality Formation
 - b. Socialization, Agencies of Socialization
 - c. Role & Status
- 6. Deviance and Social Control
 - a. Deviance and its types
 - b. Social control and its need
 - c. Forms of Social control
 - d. Methods & Agencies of Social control
- 7. Collective Behavior
 - a. Collective behavior, its types
 - b. Crowd behavior
 - c. Public opinion
 - d. Propaganda
 - e. Social movements
 - f. Leadership

Recommended Books:

1. Anderson, Margaret and Howard F. Taylor. 2001. *Sociology the Essentials*. Australia: Wadsworth.
2. Brown, Ken 2004. *Sociology*. UK: Polity Press
3. Giddens, Anthony 2002. *Introduction to Sociology*. UK: Polity Press.
4. Macionis, John J. 2006. 10th Edition *Sociology* New Jersey: Prentice-Hall
5. Tischler, Henry L. 2002. *Introduction to Sociology* 7th ed. New York: The Harcourt Press.
6. Frank N Magill. 2003. *International Encyclopedia of Sociology*. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. 2005. *Sociology* 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. 1989. *Sociology: Social Structure and Social Conflict*. New York: Macmillan Publishing Company.



9. Koenig Samuel. 1957. *Sociology: An Introduction to the Science of Society*. New York: Barnes and Nobel..
10. Lee, Alfred Mclung and Lee, Elizabeth Briant 1961. *Marriage and The family*. New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. 1973. *Order and Change: Introductory Sociology* Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jeam. 1982. *Human Societies*. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. 2004. *Sociology: A Down to Earth Approach*. Toronto: Allen and Bacon.

Bot – 127 Edaphology

Cr. Hr. 03(2+1)

Specific Objectives of course:

To understand: 1. scope of edaphology, soil fertility and their properties, 2- Importance of water, and various fertilizers and their effects, 3-secondary and micronutrients, soil salinity and waterlogging and conservation.

Outlines:

1. **Definition, scope and importance of edaphology:** soil, land and earth: Mineral and organic soils, topsoil, subsoil; Soil as a medium for plant growth.
2. **Soil fertility and productivity:** Plant nutrients, Liebig's Law of the minimum, soil solution, intensity and quantity factor in plant nutrition, dynamic equilibria in soils, evaluation of soil fertility: soil plant relation
3. **Soil Physical Properties:** Soil texture, soil structure, soil consistency, soil pores, soil density, soil color, soil temperature.
4. **Soil Chemical Properties:** Ion water interaction, soil constituents, soil pH, cation exchange equation, soil redox potential, biochemical properties of rhizosphere soil.
5. **Soil Water:** Soil water classification, measurement of soil water, water retention and curve, Hysteresis, soil water effective use and loss.
6. **Soil and Fertilizer Nitrogen:** Functions of nitrogen in plants, symptoms of deficiency and excess, nitrogen efficiency. Determination of available nitrogen in soil.
7. **Soil and Fertilizer Phosphorous:** role of phosphorus in plants, phosphorus content in soil, factors affecting phosphorus availability to plants.
8. **Soil and Fertilizer potassium:** Functions of potassium in plants, symptoms of deficiency and luxury consumption, potassium availability.
9. **Secondary and micronutrients:** Calcium, magnesium and sulfur effect on plants. Role of Boron, Manganese, Zinc in plant growth.
10. **Soil salinity, sodicity and waterlogging:** plant growth on salt affected soils, classification of salt affected soils, reclamation and management of salt affected soils, total dissolved



salts, sources of waterlogging, effects on plant growth and control measure of waterlogging.

11. **Soil erosion and conservation:** water erosion effects on plants, prevention of water erosion.

Practical:

1. Testing of soils minerals of different locations
2. Determination of soil pH and soil temperature.
3. Classification of different soil of various locations.
4. Collection of plants affected with nitrogen deficiency.
5. Identification of Phosphorus deficient soils.
6. Identification of water logged soils of locations.
7. Classification of salt affected soils in different locations.

Books:

1. Soil science & management. 1985. Edward J. Plaster. 6th edition. [Cengage Learning, Inc.](#)
2. Physical Edaphology: The Physics of Irrigated and Nonirrigated Soils. 1972. Gaylen L. Ashcroft and Sterling A. Taylor. San Francisco, W.H. Freeman. 10th edition.
3. Principles of Soil and Plant Water Relations. 2004. Kirkham M.B. Academic Press. 2nd edition.
4. The Soil Resource: Origin and Behavior. 1980. Hans Jenny. Springer Velog. 2nd Edition.
5. Principles of Soil Physics. 2004. Rattan Lal. Taylor and Fancis Group. 1st edition.
6. Guidelines for analysis and description of soil and regolith thin sections. 2021. Georges Stoops. Wiley. 1st edition.
7. Edaphology. 2012. Jesse Russell, Ronald Cohn. 1st edition.
8. Handbook of Soil Sciences Properties and Processes. 2011. [Pan Ming Huang](#) , [Yuncong Li](#) , [Malcolm E. Sumner](#). Roudlege Handbook Online. 3rd edition.
9. The Nature and Properties of Soils. 2017. Raymond R Weil and Nyle C Brady. Pearson Education. 15th edition
10. Soil Science for Gardeners: Working with Nature to Build Soil Health.2020.[Robert Pavlis](#). Paperback. 1st edition.

Bot-128 Microbiology

Cr. Hr. 03(2 + 1)

Course Objectives:To acquaint student with the knowledge of Microbiology and its applications.

Course contents:Introduction and scope of Microbiology, Historical foundations of Microbiology, General characteristics of Microbes, methods of Microbiology, bacterial forms and ultrastructure, microbial nutrition, cultivation, reproduction and growth, Metabolic characteristics, symbiotic relationships, taxonomy, classification, nomenclature of microorganism / bacteria. Physical and chemical control of microbes. Role of microbes in industry, agriculture, health, basic research and environment.

Practicals:



Sterilization techniques, culturing, staining (Gram, simple, negative, capsule and spore), colony and cell morphology, bacterial cell count and growth curve, biochemical tests (Oxidation Fermentation (OF), urease, oxidase and catalase) of bacteria.

Recommended Text Books:

1. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. Mcgraw Hill. Publisher.
2. Black, J. G., 2005. Microbiology: principles and explorations, *by* 6th Edition, J. Wiley & Sons, USA.
3. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA.
4. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology *by* 2nd Edition, J. Wiley and Sons, USA.
5. Tortora, G. J., Funke , B. R. and Case, C. L. 2008. Microbiology: an introduction 9th Edition, Pearson Education, USA.
6. Kathleen P. T., and Arthur, T. 2001. Foundations in Microbiology: Basic Principles McGraw-Hill Companies/
7. Tortora, G. J., Funke, B. R., Case, C. L. 2000. Microbiology: An Introduction, Study Guide. Benjamin-Cummings Publishing Company.
8. Tortora, G. J., Funke, B. R. and Case, C. L. 2004. Microbiology: an introduction 8th Edition, Pearson Education, USA.
9. Tortora, G. J., Christine, L. Case, C. L., Funke, B. R., Funke, B., Case, C., 2006. Microbiology: An Introduction, Publisher: Pearson Education.
10. Alcamo, I. E., 2001. Fundamentals of Microbiology *published by* Jones and Bartlett Publishers, USA.
11. Baker, S., Khan, N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor and Francis.
12. Madigan, M. T. and Martinko, J., 2005. Brock Biology of Microorganisms 11 International Ed edition Prentice Hall.
13. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. Mcgraw Hill. Publisher.

Thirds Semester

Bot –231 Technical Writing and Presentation Skills

Cr. Hr. 03(3+0)

Objectives:

To enable the students to write a research paper / technical report in a succinct manner according to a specified format.

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

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). 59

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)

Bot – 232 Introduction to Computer

Cr. Hr. 03(2+1)

Objectives

Computer is one of the most advanced and fast growing technology of the world. Each and every day a lot of improvement is emerging in both software and hardware of the computer. In response to this trend this course has been designed. It focuses on brief, introduction to computers history and types of computer. It also provides students with hands-on use of computer how to use the windows, word processing and spreadsheet programs.

Computer: Introduction /Block Diagram, Brief History/Generations, Components and Applications

Types of Computer:

A: Classification according to Logic used

B: Classification according to size: Large Computer Systems, Super Computers, Mainframe Computers, Mini Computer, Small computer Systems, Micro Computers, Hardware Vs Software

Parts of a Computer:

A: The System Unit: The Processors, Memory, Disk Systems, Display cards

B: The Monitors

C: Keyboard

D: Storage Devices

E: Printers

Types of software

A: Systems Software: Operating Systems (Windows, MS-DOS, LINUX), Translators (Compilers, Interpreters), Utility Programs



B: Applications software: General Purpose, Word Processors, Spreadsheets, Data Bases, (Accounting Packages), Communication software, Graphical designing packages, Special Purpose applications Software

Operating systems

A: Introduction to DOS: Common Commands

B: Introduction to Windows: Familiarization with Windows Icons, My Computer, Recycle Bin, Control panel, Start Button, Other Sub Menus, Task Bar, Shut down Processes

Windows

A: Use of start Menu

B: Customize the desktop

C: Use of Windows Help

D: Use of Windows accessories: Word pad, Calculator, Paint

E: Managing files and folders using My Computer

F: Managing files and Folders using Windows Explorer

G: Managing Recycle bin operations

H: Internet Explorer (Send/receive E-Mail, Browsing Internet)

Word Processor (MS-Word)

A: Open and save files in specified path or new folder

B: Selection of text by different methods and applying different operations Copying Moving & Deleting

C: Formatting text (Bold, Underline, Font, Color (Font, Fill)

MS-Word

A: Use of Undo and Redo

B: Use of text alignment, indenting and managing space. Also use of bullets and Numbering

C: Use of Page setup including page margin, Size, paper source & Layout and Printing a Page

D: Insert (Picture, Header & Footer etc)

Spreadsheet (MS-Excel)

A: Inserting and deleting cells, rows and columns

B: Managing worksheets

C: Formatting and Customizing data. Text Alignment, Border, Patterns and Drawing

MS-Excel

A: Use of formulas and functions (formatting numbers, decimal places, columns and row setup etc).

B: Use of page setup and printing configurations

Week-11

MS-PowerPoint

A: Create a New Presentation (Blank, Design Template), New Slide

B: Formatting and Customizing data

C: Animation Schemes, Action Buttons, Action Settings etc

Computer Programming

A: The need of Programming

B: Programming Languages, Machine Language, Low-Level Languages, High-Level Languages

Numbering Systems

A: Binary, Octal, Decimal and Hexadecimal



B: Conversion from one number system to other: Binary to Decimal, Binary to Octal

Computer Viruses

A: Types of Computer viruses (Trojan horses, Worms & Viruses)

B: Protection from viruses (Anti Viruses)

Telecommunication and Distributed Net Works

A: Data Transmission Modes

B: Transmission Media

C: Types of Networks: Local Area Network, Wide Area Network

Introduction to IT

Awareness of IT in Modern World

IT World

Introduction to Software Engineering

What is Software, Software Engineering, Software Process, Elements of Software Design Life Cycle (SDLC)

Recommended Books:

Sanders, Donald H. Computers today 3rd Edition McGraw Hill, 1998

Lonnie Mastering office 1997 BPB Publishing, 1997

Parker, Charles s. Computers, and their application, 3rd Edition,

Larry Long, Nancy Long Computers. National Book foundation Pakistan 6th Edition, 2000.

Bot –233 Animal Diversity: Invertebrates

Cr. Hr. 03(2+1)

Objectives:

The course is designed to provide students with:

- Taxonomic characteristics and classification of each phylum
- Concepts of evolutionary relationship of animal kingdom
- Knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life

Course Contents

Introduction: Architectural pattern of an animal, taxonomy and phylogeny, major subdivisions of animal kingdom with evolutionary perspective.

Animal-Like Protists: The Protozoa; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.

Multicellular and Tissue Levels of Organization: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction.

Phylum Cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum Ctenophora; further phylogenetic considerations.

Triploblastics and Acoelomate Body Plan: Phylum Platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; Phylum Nemertea; Phylum Gastrotricha; further phylogenetic considerations.

Pseudocoelomate Body Plan: Aschelminths: General characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and



development of Phylum Rotifera and Phylum Nematoda; Phylum Kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

Molluscan Success: Relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class. The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.

Annelida: The Metameric Body Form: relationship to other animals, metamerism and tagmatization; External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development in different classes; further phylogenetic considerations.

Arthropods: Blueprint for Success: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations; phylogeny and adaptive diversification.

Echinoderms: relationships to other animals; echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development; further phylogenetic considerations.

Lesser Invertebrates: The lophophorates, entoprocts, cycliophores, and chaetognaths. Practicals Museum study of representative Phyla, Permanent slide preparations

1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma,
2. Paramecium as representative of animal like protists. (Prepared slides).
3. Study of sponges and their various body forms.
4. Study of principal representative classes of Phylum Cnidaria.
5. Study of principal representative classes of Phylum Platyhelminthes.
6. Study of representative of Phylum Rotifera, Phylum Nematoda.
7. Study of principal representative classes of Phylum Mollusca.
8. Study of principal representative classes of Phylum Annelida.
9. Study of principal representative classes of groups of Phylum Arthropoda.
10. Brief notes on medical/economic importance of the following:
11. Plasmodium, Entamoeba histolitica, Leishmania, Liverfluke, Tapeworm, Earthworm,
12. Silkworm, Citrus butterfly.

Books Recommended

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International). Singapore: McGraw Hill.
2. Miller, S.A., Harley, J.B. 2011. Zoology, 8th Ed. (International), Singapore: McGraw Hill.
3. Pechenik, J.A. 2010. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw Hill.
4. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
5. Miller, S.A., 2002. General Zoology Laboratory Manual. 5th Ed. (International). Singapore: McGraw Hill.
6. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

Bot- 234 Environmental Chemistry

Cr. Hr. 03(2+1)



Objectives of the Course:

From this course, the students should be able to:

- Understand the fundamental principles of environmental chemistry.
- Apply these principles in pollution related subjects.
- Demonstrate the understanding of environmental chemistry principles via experimental exercises in the laboratory.

Course Outlines:

Atmospheric Chemistry The air around us, atmospheric temperature and pressure profile, Temperature inversion and photochemical smog, particulate matter in the atmosphere, Industrial pollutants, radioactivity, atmospheric aerosols, Acid rain –major sources, mechanism, control measures and effects on buildings and vegetation, Global warming – major green house gases, mechanism, control measures and global impact, The stratospheric ozone – the ozone hole, CFCs, ozone protection, biological consequences of ozone depletion.

Water Pollution and Water Treatment – sources of water pollution industrial sources and agricultural sources, heavy metals contamination of water, Eutrophication, detergents and phosphates in water, water quality criteria, Water purification – primary, secondary and advanced treatment, Removal of nitrogen and phosphorous compounds from polluted water, organic matter in water and its decomposition.

Soil Pollution – soil and mineral resources, general principles of metal extraction, Heavy metals contamination of soil, toxicity of heavy metals, bio-accumulation of heavy metals, Organic matter in soil, Macro and micro-nutrients in soil, ion-exchange in soil, soil pH and nutrients availability.

Green Revolution – pest control, pesticides, toxicity of pesticides, integrated pests management.

Energy Production and Environment – liquid and gaseous fuel, hydrogen economy.

Renewable Energy – nuclear energy, solar energy, geothermal and tidal energy.

Recommended Books

1. Collin Baird, Environmental Chemistry, W. H. Freeman and company, New York, 1995.
2. John W. Moore and Elizabeth A. Moore, Environmental Chemistry, Academic Press Inc., New York, 1976.
3. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, 1989.
4. R. W. Raiswell, P. Brimblecombe, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.

Bot –235 Cell Biology, Genetics and Evolution

Cr. Hr. 04 (3+1)

Specific objectives of course: To understand:

1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology



1. Structure and Function of Bio-molecules

- i. Carbohydrates
- ii. Lipids
- iii. Proteins
- iv. Nucleic Acids

2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.

3. Brief description of following cell organelles

- i Cell wall
- ii Cell membrane
- iii Nucleus
- iv Endoplasmic reticulum
- v Plastids
- vi Mitochondria
- vii Ribosomes
- viii Dictyosomes
- ix Vacuoles

4. Reproduction in somatic and embryonic cell, mitosis, meiosis and cell cycle

b) Genetics

1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).
3. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and Euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

c) Evolution: Introduction and theories.

Lab Outline:

Cell Biology

1. Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs
2. Measurement of cell size.
3. Study of mitosis and meiosis by smear/squash method and from prepared slides.
4. Study of chromosome morphology and variation in chromosome number.
5. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources. **Genetics**

1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carmine/orcein staining.
3. Determination of blood groups

Recommended Books:

1. Hoelzel, A. R. 2001. Conservation Genetics. Kluwer Academic Publishers.
2. Dyonsager, V. R. (1986). Cytology and Genetics. Tata and McGraw-Hill Publication Co. Ltd., New Delhi.
3. Lodish, H. 2001. Molecular Cell Biology. W. H. Freeman and Co.
4. Sinha, U. and Sinha, S. (1988). Cytogenesis Plant Breeding and Evolution, Vini Educational Books, New Delhi.
5. Strickberger, M. V. (1988), Genetics, MacMillan Press Ltd., London.



6. Carroll, S. B., Grenier, J. K. and Welnerbee, S. D. 2001. From DNA to Diversity - Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
7. Lewin, R, 1997. Principles of Human Evolution. Blackwell Science.
8. Strickberger, M. W. 2000 Evolution. Jones & Bartlet Publishers Canada
9. Ingrouille M. J. & B. Eddie. 2006. Plant Diversity and Evolution. Cambridge University Press.
10. Bruce Albert et al. 2009. Essential cell biology. Garland Sciences Publishers. Journals/Periodicals:
Theoretical & Applied Genetics, the Cell, Heredity

Fourth Semester

Bot –241 Animal Diversity: Chordates

Cr. Hr. 03(2+1)

Objectives

The course aims to:

- Provide understanding about taxonomic characteristics and classification of each phylum
- Develop concepts of evolutionary relationship of animal kingdom
- Provide knowledge and understanding about the different animal groups with special emphasis on their phylogenetic relationships

Course Contents

Protochordates:

Structure, anatomy and organ systems; reproduction; life histories and metamorphosis; phylogenetic relationships; further phylogenetic considerations.

Fishes: Vertebrate Success in Water: phylogenetic relationships; Agnatha and Gnathostomata: locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

Amphibians: The first terrestrial vertebrates: phylogenetic relationships; Caudata, Gymnophiona, and Anura; Structure and locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.

Reptiles: The First Amniotes: cladistic interpretation of the amniotic lineage; Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

Birds: Feathers, flight and endothermy: phylogenetic relationships; ancient birds and the evolution of flight; diversity of modern birds; adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development; migration and navigation.

Mammals: Specialized teeth, endothermy, hair and viviparity; diversity of mammals; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.



Practicals Museum study of:

1. Protochordates
2. Pisces
3. Amphibia
4. Reptilia
5. Aves
6. Mammalia
7. Field trips to study animal diversity in an ecosystem.

Note: Preserved specimen and/or colored projection slide and/or CD ROM projection of computer must be used.

Books Recommended

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International). Singapore: McGraw Hill.
2. Campbell, N.A. Biology, 9th Ed. 2011. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc. Miller, S.A. and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.
3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
4. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. Latest edition New York: McGraw Hill.
5. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

Bot –243 Plant Physiology and Ecology

Cr. Hr. 04(3+1)

Specific objectives of course:

1. To provide comprehensive knowledge of functioning of organs, organelles and biomolecules,
2. To enable the students to assess the effects of various environmental factors on plant growth and development.

Course Outline:

a) Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Differences between C₃ and C₄ plants. Factors affecting this process, Products of photosynthesis.
4. Respiration: Definition and respiratory substrates. Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

b) Ecology

1. Introduction, branches of ecology, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.
3. Light and Temperature.



4. Water: Characteristics of xerophytes and hydrophytes.
5. Wind: Wind as an ecological factor and its importance.
6. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan

Lab Outline:

a) Plant Physiology

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/cobalt chloride paper method.
6. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
7. Estimation of oxygen utilized by a respiring plant by Winkler's method.

b) Ecology

1. Determination of physical and chemical characteristics of soil.
2. Measurements of various population variables
3. Measurement of vegetation by Quadrat and line intercept methods.
4. Field trips to ecologically diverse habitats.
5. Measurements of wind velocity.
6. Measurement of light and temperature.
7. Effect of light and temperature on seed germination.

Recommended Books:

1. Ihsan, I. 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
2. Witham and Devlin. 1986 Exercises in Plant Physiology, AWS Publishers, Boston.
3. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc. Calif.
4. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
5. Hopkins, W. B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
6. Schultz, J. C. 2005. Plant Ecology. Springer-Verlag, Berlin.23
7. Ricklefs, R. E. 2000. Ecology. W. H. Freeman and Co., UK.
8. Ricklefs, R. E. 2001. The Economy of Nature. W. H. Freeman and Co., UK.
9. Barbour, M. G., J. H. Burke and W. D. Pitts. 1999. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
10. Chapman, J. L. and Reiss, M. J. 1995. Ecology: Principles and Applications. Cambridge University Press.
11. Hussain F. 1989. Field and Laboratory Manual of Plant Ecology. National Academy of Higher Education, Islamabad.
12. Hussain, S. S. 1989. Pakistan Manual of Plant Ecology; National Book Foundation, Islamabad.



13. Larcher, W. 2003 Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functions Groups – Springer Verlag.
14. Krebs, C. J. 1997. Ecology. Harper and Row Publishers.
15. Smith, R. L. 1996. Ecology and Field Biology. Addison Wesley Longman, Inc., New York.
16. Smith, R. L. 1998. Elements of Ecology. Harper and Row Publishers, New York.
17. Smith, R. L. 2004. Ecology and field biology. Addison Wesley Longman, Inc., New York.
18. Subrahmanyam, N. S. and Sambamurthy, A. V. S. S. 2000. Ecology. Narosa Publishing House, New Delhi.
19. Townsend, C. R., Harper, J. L. and Begon, M. E. 2002. Essentials of Ecology. Blackwell Scientific Publications, UK.
20. Odum, E. P. 1985. Basic Ecology. W. B. Saunders.

Journals / Periodicals:

Plant Physiology, Journal of Ecology

Bot –244 Biodiversity and Conservation

Cr. Hr. 04 (3+1)

Objectives:

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

Course Outline:

Biodiversity: Definition, types and threats

Threats to Biodiversity; deforestation, over grazing, erosion, desertification, ecosystem degradation, bio invasion, pollution and climate change

Biodiversity of Pakistan

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

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

Sustainable and unsustainable use of biological resources

Biodiversity Hot spots of Pakistan and the world.

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

Conservation strategies; *in situ*, *ex situ*, *in vitro* conservation

Conservation vs preservation

IUCN categorized protected areas in Pakistan; red listing

Environmental Impact Assessment.

Use of herbarium and Botanical Garden in biodiversity and conservation.

Concept of pastures and wild life management

Global Biodiversity Information Facility (GBIF)

Lab outline:

Inventory of plant biodiversity in various habitats.

Field survey for baseline studies and Impact Assessment.

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

Recommended Books:

Abbasi, A. M., Khan, M. A., M. Ahmad and M. Zafar. 2012. Medicinal plant biodiversity of Lesser Himalaya Pakistan. Springer Publishers USA.

Hussain, F., 1991. Vegetation and ecology of lesser Himalaya. Department of Botany, Peshawar



Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.

Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.

Provincial conservation strategies

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

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

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

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

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

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

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

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

Taylor, P. 2005 Beyond Conservation. Earth Scan Publication Ltd.

Journals /Periodicals

Systematics and Biodiversity, Biological Conservation.

Bot – 245 Biostatistics

Cr. Hr. 03(2+1)

Biostatistics

1. Introduction

- i. Definition
- ii. Characteristics
- iii. Importance and Limitation
- iv. Population and Samples
- v. Variable types (Basic terminologies)

2. Frequency distribution

Formation of frequency table from raw data

3. Measures of Central Tendency

Arithmetic Mean

Median

Mode

Range

Variance

Standard deviation

4. Introduction to Sampling and Probability

- i. Random and Non Random sampling
- ii. Probability, Types of Probabilities
- iii. Introduction of Normal Distribution



5. Basic Experimental Design

- i. Concepts and design
- ii. Principles of experiments
- iii. Planning of experiments
- iv. Replication and randomization
- v. Field plot technique
- vi. Layout and analysis of completely randomized design (CRD)
- vii. RCBD

6. Test of significance

- i. T-test and Z-test: (Basic idea, confidence limits of means)
- ii. Chi square test: Basic idea, testing association (contingency table)
- iii. F-test: Introduction and application in analysis of variance

7. Regression and Correlation

Simple linear correlation and regression

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.

Optional Subject

Bot – 242 General Biochemistry

Cr. Hr. 03 (2+1)

Objective of the Course:

This course provides fundamental concepts in biochemistry, which focuses upon the major macromolecules and chemical properties of living systems. Primary topics include the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids.

Course Outline:

Introduction to Biochemistry

Brief introduction, to the scope and history of Biochemistry. Molecular logic of the living organism. Cell structures and their functions. Origin and nature of biomolecules

Carbohydrates

Definition and classification, Chemistry, physical and chemical properties of various classes of carbohydrates. Biological functions of starch, glycogen, cellulose and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

Lipids

Definition and classification of lipids. Chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins. Significance of lipids in biological membranes and transport mechanism.

Proteins



Chemistry and Classification of Amino acids, Physical and chemical properties of amino acids. Biological significance of amino acids, peptides. Proteins; their classification, properties and biological significance, Primary, secondary tertiary and quaternary structure of proteins. Denaturation of proteins.

Nucleic Acids

Chemical composition of nucleic acids. Structure and biological significance of nucleic acids. Chemical synthesis of oligonucleotides. Nucleic acids hydrolysis. Isolation and separation of Nucleic acids. Introduction to recombinant DNA technology.

Recommended Books

1. Lehninger, A. L., Principles of Biochemistry, Worth Publisher, New York, (2001).
2. Voet, D. and Voet J. G., Biochemistry, John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry, Appleton & Lange (2000).
4. Robert, Harper's Biochemistry, 25th Ed, (2000).
5. West, Text Book of Biochemistry, 4th Ed., (2000).
6. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
7. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978)

Bot – 246 Fundamental of Geography

Cr. Hr. 03(3+0)

Course objectives:

To expose students with the founding principles of Geography and geographical knowledge.

Course outline:

- **Introduction**
 - Definition, scope and branches of Geography
 - Roots of the discipline and basis of geographic concepts. Themes and tradition of geography.
 - Tools of geography
- **The Universe**
 - Galaxies and solar system
- **The Earth as a planet:**
 - Celestial positions, its shape and size
 - Rotation, revolution, and related phenomena
- **Sphere of the Earth**
 - Litosphere,
 - Atmosphere,
 - Hydrosphere,
 - Biosphere
- **Man Environmental Interaction**
 - Population,



- Major economic activities,
- Settlements
- Pollution

Recommended Books:

Arbogast, A. F. (2007) Discovering Physical Geography, Jhon Wiley and Sons, London.
Christopherson, R. W. (2009) Geo systems: An Introduction to Physical Geography, Person Prentice Hall, New Jersey.
De Blij, H. J and Muller, P. O. (1996) Physical Geography of the Global Environment, USA, Jhon Wiley and sons Inc., New Jersey.
Guinness, J. P. & Nagle, G. (2011) Geography, Hodder Education, London.
King, C. (1980) Physical Geography, Basil Blackwell, Oxford.
Miller, G. T. (2008) Living in the Environment, Principles, connections and Solutions, Wadsworth, USA.

Bot –247Ecosystem and Environment

Cr. Hr.03(2 + 1)

Course objectives:

To acquaint the students with the knowledge of ecosystems and the environment.

Course Contents: Concept, overall structure and components of Ecosystem, Energy flow and Biogeochemical cycling, Energy transfer (Food chain, Food webs, Food cycle, Trophic levels), Ecological pyramids, Productivity of ecosystems, Factors influencing environments and habitats, Impact of man on ecosystem, Fundamental of population ecology and community ecology, Human impacts on ecosystems, The Atmosphere (Composition, Minor and major gases, Water in atmosphere, Aerosols, Global circulation pattern), Pollution (Air, Water, Land, Thermal, Radiation and Noise), Climate Change (Green House Effect and Global Warming), Ozone Depletion (Ozone-structure, Properties/Significances, Ozone destroying catalysts, Natural, Anthropogenic, Antarctic zone hole, Changing ozone Level, Impact on biosphere), Waste Type, Disposal and Management, Environmental Ethics.

Practicals: Study of pond freshwater ecosystem, Study of vegetation profile, Study of grassland, rangeland and forest, Study of some biotic and abiotic factors of grassland, rangeland and aquatic ecosystem, methods of sampling. Measurements and description of plant communities by different methods. Study of decomposition of leaf litter by organisms.

Recommended Text Books:

1. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers.
2. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press.
3. Aston, A., Harris, S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
4. Costa, L. G., and Eaton, D. L., 2006. [Gene-Environment Interactions: Fundamentals of Ecogenetics](#). John-Wiley and Son Limited.
5. Freeland, J. R., 2005. [Molecular Ecology](#). John-Wiley and Son Limited.
6. Light. A and Rolston III.H. 2003. Environmental Ethics. Blackwell Publishers Ltd. U.S.A.
7. [Wenz](#), P. S., 2001. Environmental Ethics Today, Oxford University Press.



8. [Louis P. and Pojman](#), L. P., 2004. Environmental Ethics: Readings in Theory and Application, 4th edition. Wadsworth Publishing.
9. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blacwell Publishing Incorporated.
10. Raven, P. H., and Berg, L. R., 2005. [Environment, 5 Edition](#)th. John-Wiley and Son Limited

Fifth Semester

Bot-351 Bacteriology and Virology

Cr. Hr. 03(2+1)

Specific objectives of course:

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

Course outline:

a) Viruses

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

b) Bacteria

1. History, characteristics and classification.
2. Evolutionary tendencies in Monera (Bacteria, actinomycetes and cyanobacteria)
3. Morphology, genetic recombination, locomotion and reproduction in bacteria
4. 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.
6. Symptoms and control of major bacterial diseases in Pakistan

c) Plant microbe interaction

Lab outline:

a) Viruses

Observation of symptoms of some viral infected plant specimens.

b) Bacteria, Actinomycetes and Cyanobacteria

1. Methods of sterilization of glassware and media etc.
2. Preparation of nutrient medium and inoculation.
3. Preparation of slides for the study of various forms, capsule/slime layer, spores, flagella and Gram-staining.



4. Growth of bacteria, subculturing and identification of bacteria on morphological and biochemical basis (using available techniques).
5. Microscopic study of representative genera of Actinomycetes and Cyanobacteria from fresh collections and prepared slides.

Recommended Books:

1. Black, J. G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. Microbiology McGraw-Hill Companies, Inc.
3. Arora, D. R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
4. Ross F. C. 1995. Fundamentals of Microbiology. John Willey & Sons, New York.
5. Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens. The Haworth Press, Inc. 6.
6. Hull R. Matthews, 2004, Plant Virology, Academic Press.
7. Tortora, G. J: Funke, B. R. and Case C. L., 2004, Microbiology. Pearson Education.
8. Molecular Plant-Microbe Interactions, Kamal Bouarab, Normand Brisson, Fouad Daayf (eds), 2009 MPG Books Group, Bodmin, UK.
9. Plant-Microbe Interactions Gary Stacey, Noel T. Keen (Eds) 2011, springer London.

Journals/Periodicals:

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

Bot- 352 Phycology and Bryology

Cr. Hr. 03(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, Anthocerosopsida 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:

1. Bold, H. C. and M. J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs
2. Lee. R. E. 1999. Phycology. Cambridge University Press, U.K.
3. Dawson, E. Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.
4. Chapman, V. J. and D. J. Chapman. 1983. Sea weed and their uses. MacMillan and Co. Ltd. London.
5. Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.
6. Schofield, W. B. 1985. Introduction to Bryology. MacMillan Publishing Co. London.
7. Hussain, F. and I. Ilahi. 2012. A text book of Botany. Department of Botany, University of Peshawar.
8. Barsanti, L. and P. G. Gualtieri. 2006. Algae, anatomy, biochemistry, biotechnology. Taylor and Francis, New York.
9. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Algae. S. Chand & Co.
10. Bellinger, E. G. and D. C. Sige. 2010. Fresh water algae (Identification and use as bioindicators). John Wiley & Sons.
11. Hussain, F. 2013. Phycology. A text book of Algae. Pak Book Empire Lahore.
12. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Bryophytes. S. Chand & Co. New Delhi.
13. Fida Hussain, Habib Ahmad and Syed Zahir Shah. 2012. The unicellular algae of District Peshawar, Pakistan. Lambert Publication, Germany.

Journals / Periodicals:

Pakistan Journal of Botany, International Journal of Phycology and Phyco- chemistry, Bryology, Phycology.

Bot- 353 Mycology and Plant Pathology

Cr. Hr. 03(2+1)

Specific Objectives of course:

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

Course Outline:

a) Mycology

1. Introduction: General characters of fungi, Thallus, cell structure and ultrastructure of fungi.
2. Reproduction: Asexual and sexual reproduction and reproduction structures, life cycle, haploid, heterokaryotic and diploid states.
3. Fungal Systematics: Classification of fungi into phyla with suitable examples to illustrate somatic structures, life cycle and reproduction of Myxomycota, Chytridiomycota, Zygomycota, Oomycota, Ascomycota, Basidiomycota and Deuteromycetes.
4. Symbiotic relationships of fungi with other organisms (mycorrhiza) and their significance.
5. Importance of fungi in human affairs with special reference to Industry and Agriculture

b) Pathology

1. Introduction and classification of plant diseases.
2. Symptoms, causes and development of plant diseases



3. Disease control
4. Epidemiology and disease forecast
5. Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g., rusts, smuts, red rot of sugarcane 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:

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

Bot- 354 Diversity of Vascular Plants

Cr. Hr. 03(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:

1. An introduction to Neopalynology and Paleopalynology, its applications in botany, geology, archaeology, criminology, medicines, honey and oil and gas exploration.
2. Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.

Lab Outline:

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

Recommended Books:

1. Beck, C. B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York,
2. Foster, A. S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.
3. Jones, D. 1983. Cycadales of the World, Washington, DC.
4. Mauseth, J. D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.
5. Moore, R. C., W.d. Clarke and Vodopich, D. S. 1998. Botany McGraw-Hill Company, USA
6. Raven, P. H. Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants, W. H. Freeman and Company Worth Publishers.
7. Ray, P.M. Steeves, T. A. and Fultz, T. A. 1998. Botany Saunders College Publishing, USA.
8. Taylor, T. N. and Taylor, E. D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.
9. Stewart, W. N. and Rothwell, G. W. 1993. Paleobotany and the Evolution of Plants, University Press, Cambridge.
10. Faegri, K., P. E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, John Wiley & Sons. N. Y.
11. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Pterodophyta. S. Chand & Co. New Delhi



12. B. P. Panday. 2006. College Botany. Vol 1 & II. S. 7 th Edition. Chand & Co. New Delhi 13. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Gymnosperms. S. Chand & Co. **Journals / Periodicals:**

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

Bot- 355 Plant Systematics

Cr. Hr. 03(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:

1. Introduction: Importance and relationship with other sciences,

2. Taxonomic Evidence: Introduction and Importance

3. 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.

4. 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, and Takhtajan.

5. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm:

1. Apiaceae (Umbelliferae)
2. Asteraceae (Compositae)
3. Brassicaceae (Cruciferae)
4. Capparidaceae
5. Chenopodiaceae
6. Cucurbitaceae
7. Euphorbiaceae
8. Fabaceae (Leguminosae)
9. Liliaceae
10. Magnoliaceae
11. Malvaceae
12. Papaveraceae
13. Poaceae (Gramineae)
14. Rosaceae
15. Solanaceae

Lab Outline:

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



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

Recommended Books:

1. Ali, S. I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi
2. Ali, S. I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Greuter, W., McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Filguerras, T. S., 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.)
4. Davis, P. H. & Heywood, V. H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London
6. Nasir, E. & Ali, S. I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold.
8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh
9. Jones, S. B. and Luchsinger, A. E. 1987. Plant Systematics. McGraw-Hill, Inc. New York.
10. Naik, V. N. 2005. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company, New Delhi.
11. Stussy, T. F. 1990. Plant Taxonomy, Columbia University Press, USA.
12. 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.
14. Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.
15. Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.
16. Sivarajan V. V and N. K. P Robson 1991 Introduction to the Principles of Plant Taxonomy.
17. Radford, A. E., W. C. Dickison, J. R. Massey, and C. R. Bell. 1998 Vascular Plant Systematic. Harper and Row, New York.
18. Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.
19. Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.
20. Heywood V. H. 1978. Flowering Plants of the World. Oxford University Press.



21. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press.
22. Soltis, D. E. P. S. Soltis, P. K Endress, and M. W. Chase, 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.
23. 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 Linnaean Society

Sixth Semester

Bot-361 Plant Anatomy

Cr. Hr. 03(2+1)

Specific objectives of course:

To provide the students understanding about anatomical features of vascular plants

Course Outline:

1. The plant body and its development: fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.
2. **Meristematic tissues:** classification, cytohistological characteristics, initials and their derivatives.
3. **Apical meristem:** Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.
4. **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.
5. **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.
6. 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.
7. **Secretory tissues:** Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.
8. **Anatomy of reproductive parts:**
 - a. Flower
 - b. Seed
 - c. Fruit
9. **Economic aspects of applied plant anatomy**
10. **Anatomical adaptations**
11. **Molecular markers in tree species used for wood identification.**

Lab outline:

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



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

Recommended Books:

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

Journals / Periodicals:

Pakistan Journal of Botany

Bot- 362 Genetics-I

Cr. Hr. 03(2+1)

Specific Objectives of course:

To understand the nature and function of genetic material

Course Outline:

1. Extensions of Mendelian Analysis: Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.
2. Linkage I: Basic Eukaryotic Chromosome Mapping: The discovery of linkage, recombination, linkage symbolism, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,
3. Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.
4. 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.



5. The Extranuclear Genome : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochondrial genes in yeast, extragenomic plasmids in eukaryotes.
6. Developmental Genetics: Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.
7. 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 Sacchromyces culture techniques and study.

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

6. Bacterial Genetics.

- i. Bacterial cultural techniques, Gram staining (*E. coli*, *B. subtilis*)
- ii. Transformation. 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, 2nd Edition, Oxford University Press Inc.
6. Gardner, E. J., 2004. Principles of Genetics, John Willey and Sons, New York.
7. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.
8. Griffiths A. J. F; Wessler, S. R; Lewontin, R. C, Gelbart, W. M; Suzuki, D. T. and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company.
9. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
10. Hartl, D. L. and Jones, E. W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbry, USA.
- 11 Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.
- 12 Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.



- 13 Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.
- 14 William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of genetics. Pearson Educations.
- 15 Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.
- 16 David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill.
- 17 Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett.
- 18 Nouredine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

Journals/Periodicals:

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

Bot- 363 Plant Biochemistry-I

Cr. Hr. 03(2+1)

Specific Objectives of course:

To elucidate the structure and role of primary metabolites in plants

Course Outline:

Introduction to photosynthetic organisms, Photosynthesis: The Light Reaction Photosystems, ATP Synthesis, CO₂ Fixation, RuBisCo and enzyme kinetic, C-3 Cycle, C-4 Cycle, Regulation of photosynthesis

Introduction to carbohydrates: Occurrence and classification, Sugar structures, synthesis of polysaccharides, Carbon metabolism in the chloroplast, Starch synthesis Pentose phosphate pathway Carbon export Sucrose synthesis and transport in vascular plants, Cellulose synthesis and composition of primary cell walls

Introduction to lipids: Occurrence, classification. Structure and chemical properties of fatty acids, Fatty acid biosynthesis in plants, di and triglycerides, phospholipids, glycolipids, sulpholipids, waxes and sterols.

Introduction to 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. Plant defense proteins and peptides, Defensins and related proteins, Synthesis and functions of non-ribosomal peptides

Introduction to Nucleic Acids: General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Nucleic Acid Metabolism.

Introduction to 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. Enzymes with multiple functions - mechanisms and evolution.

Lab Outline:

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



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

Recommended Books:

1. Conn E E. and Stumpf P. K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Lehninger, A L. 2004. 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. Handler and Abraham. 2003, 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. Abdes, R. H. Frey, P. A. and Jencks W. P. 2004, 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. Bowsher, C. 2008. Plant Biochemistry.
14. Campbell, M. K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals:

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



Bot- 364 Plant Ecology-I

Cr. Hr. 3(2+1)

Credit Hours: 3 (2+1)

Specific Objectives of course:

To understand the role and interaction of plants with their environment

Course Outline:

1. Introduction: history and recent developments in ecology.
2. Soil: Nature and properties of soil (Physical and Chemical). Water in the soil-plant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion.
3. Light and temperature: Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,
4. Carbon dioxide: Stomatal responses, water loss and CO₂-assimilation rates of plants in contrasting environments. Functional significance of different pathways of CO₂ fixation.
5. Water: Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants, Water status in soil, Water and stomatal regulation, Transpiration of leaves and canopies.
6. Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress
7. Wind as an ecological factor.
8. Fire as an ecological factor.

Lab Outline:

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

Recommended Books:

1. M. Ahmad and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons New Urdu Bazar Karachi.
2. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag
3. Bazzaz, F. A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press
4. Chapin, F. S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer- Verlag
5. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag
6. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
7. Nobel, P. S 1999, Physico-chemical and Environmental Plant Physiology, Academic Press.



8. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
9. Smith, R. L. 2004. Ecology and field Biology. Addison Wesley Longman, Inc., New York.
10. Barbour, M. G., Burke, J. H and Pitts, W. D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.
11. Smith R. L. 1998 Elements of Ecology. Harper & Row Publishing.
12. Townsend. C. R. Begon. M and J. L Harper. 2002 Essentials of ecology. Blackwell Publishing.
13. Gurevitch. J. Scheiner, S. M. and G. A Fox. 2006 The Ecology of Plants\ Sinaur Associate Inc.
14. Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.
15. Hussain. S. S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.
16. More. P. D. and Chapman S. B. 1986 Methods in Plant Ecology, Blackwell Scientific Publication Oxford.
17. Rashid, A. 2005. Soil Science. National Book Foundation, Islamabad.

Journals / Periodicals:

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

Bot- 365 Plant Physiology-I

Cr. Hr. 03(2+1)

Specific Objectives of course:

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

1. 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.

2. 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.

3. 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.

5. 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:

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

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. 2006. Plant Physiology. 4th Edition. Sinauer 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.

Journals/Periodicals:

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

Bot- 366 Research Methodology

Cr. Hr. 03(3+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:

1. Shank, G. D. 2002. Qualitative research: a personal skills approach. Upper Saddle River, N.J.Columbus, Ohio: Prentice Hall;Merrill/Prentice Hall.
2. Brizuela, B. M. 2000. Acts of inquiry in qualitative research. Cambridge, MA: Harvard Educational Review
3. Shank, G. D. 2001, Qualitative Research: A Personal Skills Approach

Seventh Semester

Bot- 471 Molecular Biology

Cr. Hr. 03(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, Central Dogma
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, Docking.

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. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.
4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W. H. Freeman & Co., New York.
5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4th Edition. Jones and Bartlett Publishers, Massachusetts.
6. Watson, J. D. et al. 2004. Molecular Biology of the Gene. Peason Education, Singapore.
7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.
8. Weaver, R. F. 2005. Molecular Biology. McGraw-Hill, St. Louis.
9. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.
10. David Figurski. 2013. Genetic manipulation of DNA and protein, example from current research. In Tech Publishers.
11. Bruce Alberts et al. 2007. Molecular biology of the cell. 5th Edition. Garland and Sons.
12. M. Madan Babu. 2013. Bacterial gene regulations and transcription network. Caister Publishers. Academic Publishers.

Bot- 472 Plant Biochemistry-II

Cr. Hr. 03(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, 2004. 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. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinauer Publ. Co. Inc. Calif.
10. Lea, P. J. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.
11. Abides, R. H., Frey P. A. and Jencks, W. P. 1992. Biochemistry, Jones and Bartlet, London.
12. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
13. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.
14. 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

Bot- 473 Plant Ecology-II

Cr. Hr. 03(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. Ahmad, M. and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons, New Urdu Bazar, Karachi.
2. Schultz J. C. 2005. Plant Ecology, Springer-Verlag.
3. Townsend C. R. Begon. M and J. L. Harper 2002. Essentials of Ecology, Blackwell Publishing,
4. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
5. Gurevitch, et al., 2002. The Ecology of Plants, Sinauer Associates, Inc.
6. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, The Benjamin-Cumming Publishing Co.
7. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers, 8. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.
9. Hussain, S. Pakistan Manual of Plant Ecology,
10. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad
11. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
12. 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

Bot – 474 Elective Subject I

Bot – 475 Elective Subject II

Bot – 476 Elective Subject III

Eighth Semester

Bot- 481 Plant Physiology-II

Cr. Hr. 03(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, Abscisic 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. Circadien rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering. Biochemical signaling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.
6. Signal transduction in prokaryotes and eukaryotes.
7. Dormancy; definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process of seed germination.
8. Plant Movements; Tropic movement-phototropism, gravitropism and their mechanism. Nastic movements.

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. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
2. Fitter, A. and Hay, R. K. M. 2001. Environmental Physiology of Plants. Academic Press, UK.
3. Heldt, H. W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
4. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.
5. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
6. Nobel, P. S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
7. Press, M. C., Barker, M. G., and Scholes, J. D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
8. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
9. W. B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
10. Epstein, E. and Bloom, A. J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
11. Kirkham, M. B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
12. Barton, W. 2007. Recent Advances in Plant Physiology.
13. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinauer Publ. Co. Inc. Calif.

Journals / Periodicals:

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

Bot- 482 Genetics-II

Cr. Hr. 03(2+1)

Specific Objectives of Course:

To introduce students 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, Site directed Mutagenesis, DNA sequencing.

2. Application of Recombinant DNA: Applications of recombinant DNA technology using prokaryotes, recombinant DNA technology in eukaryotes: An overview, transgenic yeast, transgenic plants, transgenic animals, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.

3. 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.



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

5. 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.

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

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

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

9. 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)

iii. Plant DNA iv. Protein

2 DNA Amplification by PCR

Recommended Books:

1. Trun, N and Trempey 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.

14. Anthony J. F Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart. W. H. 2009. An Introduction to Genetic Analysis, 7th Edition. Freeman and Company.



15. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.
16. Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.
17. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.
18. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of Genetics. Pearson Educations.
19. Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.
20. David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill.
21. Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett.
22. Nouredine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

Journals / Periodicals:

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

Bot- 483 Environmental Biology

Cr. Hr. 03(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 and global warming: 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.
12. Aerobiology (Pollen allergy & dust allergy).

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 forms 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.
10. Mohamamd Ashfaq and Mushtaq A. Saleem. Environmental Pollution and Agriculture.
11. Shah Faisal Muhamamd and Sultan Mehmood. 2012. Lambert Publishers Germany.
12. Advanced Air and Noise Pollution Control, L. K. Wang, N. C. Pereira and Y. T. Hung, Humana Press, 2005.
13. Air Pollution Control Technology Handbook, K. B. Schnelle and C. A. Brown, CRC Press, 2002. Handbook of Solid Waste Management and Waste Minimization Technologies, N. P. Cheremisinoff, Butterworth-Heinemann, 2003.
14. Pollution Control In Process Industries, S. P. Mahajan, Tata McGraw-Hill, 1985.
15. Industrial Pollution control: issues and techniques, N. J. Sell, Van Nostrand Reinhold, 1992.
16. Environmental Biotechnology: Basic Concepts and Applications, I. S. Thakur, I.K. International Publishing House Pvt. Limited, 2006.



17. Vandermeer, John H. 2011. The ecology of agro-ecosystems - Jones and Bartlett Publishers; Sudbury, Mass; 2011 - xv, 387 p.
18. Greipsson, Sigurdur. 2011. Restoration ecology - Jones and Bartlett Publishers; Sudbury, MA; 2011 - xvi, 408 p 54.
19. Santra, S. C. 2010. Fundamentals of ecology and environmental biology - New Central Book Agency; London; 2010 - 353p.
20. Singh, M.P. 2007 Forest environment and biodiversity Daya; New Delhi; 2007 - 556p.

Journals/Periodicals:

Environmental Biology, Environment, Bioremediation

Bot 484 Elective Subject III

Bot – 485 Elective Subject IV

Elective Subjects

Bot –474 Pharmacognosy

Cr. Hr. 03(2+1)

Objectives of Course:

Course Outline:

Definition of pharmacognasy, drug crude drug, official and unofficial drugs, cultivation, collection, curing, drying preservation, evaluation and classification of drugs. Therapeutic classes of drugs.

Details study of the following medicinal plants giving them synonyms, botanical origin, local names distribution of plants, method of cultivation, macroscopical characteristics and microscopical characteristics of the drugs (histology and powdered drug of the part used) chemical constituents and adulterants with special references to species growing in Pakistan. Ethnopharmacognosy of the medicinal plants.

Gymnosperm

- i. Ephedra (Ephedra Sp.) Edphedraceae

Angiosperm

(a) Dicotyledons

- i. Aconite (Root) (*Aconitum nepallus* Family Ranunculaceae)
- ii. Mandrake (Rhizome) (*Podophyllum peltatum* Family Podophyllaceae)
- iii. Opium (*Papaver somniferum* Family Papaveraceae)
- iv. Liquorice (Rhizome) (*Glycyrrhiza glabra* Family Fabaceae)
- v. Gum acacia (Gum) (*Acacia Senegal* Family Mimosaceae)
- vi. Senna (leaflet) (*Cassia angustifolia* Family Caesalpinaceae)
- vii. Linseed (Seed) (*Linun usitatissimum* Family Linaceae)
- viii. Fennel (Fruit) (*Foeniculum vulgare* Family Apiaceae)
- ix. Rauwolfia (Rhizome) (*Rauwolfia serpentina* Family Apocynaceae)
- x. Mentha (Leaf) (*Mentha piperata* Family Lamiaceae)
- xi. Atropa (Root & Leaf) (*Atropa belladonna* Family Solanaceae)
- xii. Stramonium (Leaf) (*Datura stramonium* Family Solanaceae)
- xiii. Henbane (Leaf) (*Hyocyamus niger* Family Solanaceae)
- xiv. Floxglove (Leaf) (*Digitalis purpurea* Family Scrophulariaceae)
- xv. Valeriana (Rhizome) (*Valeriana officinalis* Family Valerianaceae)
- xvi. Cinchona (Bark) (*Cinchona succirubra* Family Valerianaceae)



- xvii. Santonica (Florets) (*Artemisia* Family Asteraceae)
(b) **Monocotyledons**
i. Colchicum (Corm) (*Colchicum autumnale* Family Liliaceae)
ii. Zingiber (Rhizome) (*Zingiber officinale* Family Zingiberaceae)

Fungi

- i. Ergot (*Claviceps purpurea*, Family [Clavicipitaceae](#))

PRACTICALS

1. Microscopical Characters of the drugs.
2. Microscopical Characters of the drugs (T.S of the past used, powdered drugs)
3. Properties of gums
4. Properties of different oils studied in theory.
5. Identification tests for Starch, Ca-oxalate etc
6. Volatile and fixed oils, tannin, mucilage etc

Note: The students are required to submit Collections at Least 30 medicinal plants

Books Recommended

1. Tyler V.E.L.R Brady & E. P. Clayst, pharmacognosy 6th Ed Leimpton London.
2. Trease, G. E & W.C Evans. 1985 pharmacognosy, 12 Ed. English language Soc .Baillere Tindall.
3. Wallis, T. E. 1981. A Text book of pharmacognosy, J & A Churchill Ltd. Glouster palace, W. I. London.
4. Youngkin, H. W. 1950. A Textbook of Pharmacognosy. The Blackistan CO. Toronto Philadelphia.
5. Jains, S. K. 1987. A Manual of Ethnobotany Scientific Publisher jodhpur India.
6. Jain, S. K. 1991. Contribution to Ethnobotany of India. Scientific Publisher, Johdpur, India.

Bot –475 Economic Botany

Cr. Hr. 03(2+1)

Objectives

To learn the diverse human uses of plants and plant products.

- To learn the taxonomic diversity of useful plants.
- To learn the biological reasons why certain plant resources are important.
- To acquire an increased awareness and appreciation of plants and plant products encountered in everyday life.
- To recognize geographic, historical, & cultural differences in the uses and importance of plants.
- To relate diverse aspects of human cultural endeavors to plant resources, and to gain a better understanding and perspective of the origins, histories, and roles of important plants and plant products to the development of human culture

Course content

1. Plant and their value in the Service of the mankind.
2. Fibers-Cotton Flax, jute Hemp and Coir, Elementary knowledge of Textile and Paper industries in India.
3. Timbers woods-their identification properties and uses. Details of Teak Shisham, Saal, Chir, Deodar, Neem, Mango, Babul and jamun
4. Tannins



5. Dyes
6. Gums and Resins
7. Rubber and Latex
8. Oil-Essential oil, their properties, antibiotics methods of extraction and uses.
9. Fatty oil general account and detailed study ground nut, peanut, sesame, Masturd, Coconut Cotton seed, Castor, linseed and sunflower oils.
10. Sugars-sugar cane and sugar beet.
11. Medicinal plants: Details of Aconitum, Ephedra, Gugal, Atropa, Aloe, Tulsi Neem, Bhango, Opium, Catharanthus, Nuxvomica, Isabgul, Cinchona, Sarpghanda, Artemisia and other important local plants.
12. Spices-Ginger, Turmeric, Asafoetida, Cinnamon, Clove, Black Peper and Chillies.
13. Beverages: Non Alcoholic-Coffee, Tea, Coca, Alcoholic-General account.
14. Fumitories and masticatories: Tobacco, Betel and Betel nut.
15. Concise knowledge of origin and evolution of crop Plants and including their centres of origin.
16. Ethno Botany: General account.

Practicals:

To design according to the lab facilities

Recommended Books:

1. Jains, S. K. 1987. A Manual of Ethnobotany Scientific Publisher jodhpur India.
2. Jain, S. K. 1991. Contribution to Ethnobotany of India. Scientific Publisher, Johdpur, India.

Bot – 476 Waterlogging and Salinity

Cr. Hr. 03(2+1)

Course Content

(A) Water logging

Origin of water logging; Physical and chemical changes in soil as a result of water logging; Measurement of soil redox potential, iron and manganese relations in water logged soils; Adaptations of plants to water logging. Mechanism of water logging tolerance in plants. Extent of water logging in Pakistan.

(B) Salinity

Origin of saline and sodic soils; Measurement of salinity and sodicity; Classification of saline and sodic soils, inter-relations of water logging and salinity. Effects of soil salinity and alkalinity on plant growth; (1) Osmotic effect; (2) Specific ion effect, (3) Nutritional imbalance. Quality of irrigation water; Classification of irrigation water from view point of its quality; Management and reclamation of saline and sodic soils; Mechanism of salt tolerance; methods of increasing salt tolerance in plants. Biotic approach and genetic engineering for improvement of salt tolerance in crops. Extent of salinity in Pakistan.



Practicals

1. Measurement of electrical conductivity of soil saturation extract.
2. Measurement of cation-exchange capacity of soil.
3. Determination of the amounts of soluble calcium.
4. Calculation of exchangeable sodium percentage of soil from its sodium adsorption ratio.
5. Determination of the amounts of chlorides and sulphates in a soil saturation extract.
6. Analysis of irrigation water for the following: Electrical Conductivity, sodium adsorption Ratio, chlorides, sulphates, carbonates, bicarbonates, total dissolved salts, nitrates fluorides, iron and silica.
7. Classification of irrigation water from the viewpoint of its salinity and sodium hazard.
8. Effects of salinised media on seed germination of seed of different crop plants.
9. Experimental investigation to test the salt tolerance of difference crop plants.
10. Quantitative studies of halophytes in the field.
11. Measurement of pH and EC of a waterlogged soil.
12. Field trips to saline and water logged areas of Pakistan.

Books Recommended

1. Richards, L.A. (ed) 1954. Diagnosis and Improvement of Saline and Alkali Soils Handbook 60, USDA, Washington, D.C.
2. Chapman, V.J., 1971. Salt Marshes and Salt Deserts of the World.
3. Waisel Y., 1972. Biology of Halophytes.
4. UNESCO, 1973. Irrigation Drainage and Salinity.
5. Armstrong, W., 1973. Water-logged Soils. In Environment and Plant Ecology (Etherington, J.R.) John Wiley and Sons, London.
6. FAO, 1975. Quality of Water in Agriculture. Bulletin 29, Irrigation and Drainage Series.

Bot –484 Plant Tissue Culture

Cr. Hr. 03(2+1)

Objectives:

- Introduce the underlying principles of aseptic culture of plant organs.
- Provide information about equipment, procedures and terminology of aseptic culture.
- Provide an understanding of the advantages of using cell culture system.
- Provide students with an understanding of the benefits and issues of tissue culture.

Course outline:

1. **Introduction:** Introduction to plant cell and tissue culture. Plant tissue culture, plant genetic engineering and crop improvement. Tissue culture in agriculture, forestry, Botany and industry.
2. **Explant Preparation and Selection Strategies:** Explant types, size, age, quality, location and season. Sterilization of explants.
3. **Culture Facilities and Sterile Techniques:** The basic laboratory layout and equipment. Sterilization of glassware, equipments and working area.
4. **Media Components and Preparation:** Inorganic nutrients, organic nutrients, vitamins, amino acids, carbohydrates, gelling agents, antibiotic, plant hormones, complex organic



supplements. Preparation of MS media from commercial packages and from stock solution. Contamination and its disposing. Safety in the laboratory.

5. **Initiation and Maintenance of Callus:** Origin and types of callus. Role of callus in embryogenesis, organogenesis and cell culture. Initiation and propagation of callus cultures. Monitoring the growth of callus. Genetic transformation of callus. Sub-culturing of callus. Organogenesis (Rooting and Shooting). Deflasking or Acclimatization.
6. **Production of Virus Free Plants:** Disease elimination by tissue culture. Disease elimination by chemotherapy. Disease elimination by thermotherapy.
7. **Types of Culture:** Initiation, maintenance, growth characters and uses of cell suspension culture. Introduction of anther and microspore culture. Pollen culture. Haploid for plant breeding and genetics. Factors affecting the success of anther culture. Organ and embryo culture. Culturing of Hairy roots, Minitubers and Microtubers. Callus culture, Meristem culture, and fern spore culture.
8. **Isolation and culture of plant protoplast:** Types of isolation, determination of protoplast, viability, protoplast morphology, culture of isolated chloroplast, cell wall regeneration by cultured protoplast, uses of protoplast, protoplast fusion.
9. **Somaclonal Variation:** Origin, mechanism and uses of somaclonal variation. Somaclonal variations for salt, herbicide, drought, and disease tolerance. Somaclonal variations in major crops.
10. **Somatic Hybridization and Germplasm Conservation:** Protoplast fusion and hybridization. Somatic hybrids plants and their regeneration. Germplasm conservation, methods for germplasm conservation. Cryopreservation. Artificial seeds.

Practicals:

1. Starting a primary culture (tissue digestion, cell count and cell culture).
2. Maintenance of a cell line.
3. Cryopreservation of cell line.
4. Plant cell culture.
5. Vital staining.
6. Organ culture

Recommended Books:

1. John, H.D. and L.W. Roberts. Plant tissue culture. Second edition. Cambridge University Press Cambridge. 1985.
2. Smith.R.H. Plant Tissue Culture Techniques and experiments. Second edition. Academic press 2000.
3. Evans, D.E. J.O.D. Coleman and A. Kearns. Plant Cell Culture. BIOS Scientific Publishers London.
4. Chopra V.L., V.S.Malik and S.R. Bhat. Plant Biotechnology. Oxford IBHPublishers New Delhi.
5. Attege, C.R and B. Kristiansen.2001. Basic Biotechnology, CambridgeUniversity, PressUK.
6. Halford, N., 2006. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. John Wiley and Sons Limited.
7. Vunjak-Novakovic, G., Freshney, R.I., 2006.Culture of Cells for Tissue Engineering.1st Edition Wiley, John & Sons



8. Freshney, R.I., 2006. Culture of Animal Cells: A Manual of Basic Technique. 5th Edition. Wiley, John & Sons.
9. Neumann, K-H., Kumar, A., Imani, J., 2009. Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application .1st Edition. Springer-Verlag New York, LLC.
10. Abbot. 2013. Recent Advances in Plant Tissue Culture and Biotechnology. RDM

Bot -485 Introduction to Horticulture

Cr. Hr. 03(2+1)

Specific Objectives

To enable the students to understand the basics of Horticulture.

Learning Outcomes:

Students must be able to prepare media, identify and propagate important horticultural plants

Students are expected to grow different horticultural crops of the region

Course Outlines:

Introduction, history, importance and future scope, Definition and divisions of horticulture.

Classification of horticultural crops, Plant parts, their modifications and functions.

Plant environment; climate (temperature, light, humidity etc) and soil (structure, texture, fertility)

Phases of plant growth, Propagation of horticultural plants.

Establishment of orchards, vegetable farms and ornamental gardens; site selection, layout methods, wind breaks and their role.

Management practices; irrigation, manures and fertilizers, training and pruning, cultivation and weed control.

Climate, soil, propagation, rootstocks, cultivars, important pests, harvesting, post-harvest handling and marketing of important horticultural crops (fruits, vegetables and ornamentals) of the region.

Practicals

- Visit of nurseries, commercial gardens and public parks.
- Identification and nomenclature of important fruits, vegetables and ornamental plants; Garden tools and their uses.
- Media and its preparation. Techniques of propagation.
- Practice in layout methods, Selection of plants from nursery, propagation methods.
- Planting and after care.
- Production techniques and identification of important cultivars of horticultural crops of the region.

Recommended Books

1. Acquaah, G. 2009. Horticulture: Principles and Practices (4th Ed.). Prentice-Hall India Learning Pvt. Ltd. New Delhi, India.
2. Adams, C. R., K.M. Bamford and M. P. Early. 2012. Principles of Horticulture (6th Ed.). Routledge, New York, USA.
3. Ingles, J. 2009. Ornamental Horticulture. Delmar 5 Maxwell Drive, Cifton, Park, New York.
4. Malik, M.N. 1994. Horticulture, National Book Foundation, Islamabad.
5. Chadha, K.L. 2006. Handbook of Horticulture (6th Ed.). ICAR, New Delhi, India.
6. Christopher, E. P. 2012. Introductory Horticulture. Biotech books, New Delhi, India.
7. Carrol, L., J.R. Shry and H.E. Reily. 2011. Introductory Horticulture (8th Ed.) Delmar-Thomson Learning, Albany, USA



8. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 2009. Plant Propagation—Principles and Practices (7th Ed.). Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.
9. Peter, K.V. 2009. Basics of Horticulture. New India publishing Agency, New Dehli, India.
10. Reiley, H.E., C.L. Shry (Jr). 2004. Introductory Horticulture (6th Ed.).

Bot –486 Plant Pathology

Cr. Hr. 03(2+1)

Specific Objectives

To enable the students to understand the basics of pathology and pathogen.

Outcome

Students must be

Course Content

1. The importance of plant disease.
2. The nature and classification of plant diseases.
3. Causes of plant disease.
4. The nature and classification of plant pathogens.
5. Growth and reproduction of plant pathogens.
6. Pathogenesis-I, The parasite in Relationship with its host.
7. Pathogenesis-II. Resistance and susceptibility.
8. The production and liberation of inoculums.
9. The dissemination of plant pathogens.
10. The phenomena of infection.
11. The effect of environment and nutrition on disease development.
12. Detailed study of the following plants diseases. Black rot of crucifers, Bacterial will of cucurbits, damping off caused by *Pythium sp.* Late Blight of potato and tomato, white rust of crucifers, downy mildew of cereals and grasses, corn smut, loose smut of Barley, Bunt, or stinking smut of wheat, black stem rust of wheat, white heart rot of deciduous trees. Tobacco Mosaic.
13. Diseases in transit and storage.
14. The principles of the control of plant disease: Quarantines, Eradication campaigns, and International Plant Protection, Cultural practices in disease control, Chemical control and resistant varieties.

Book Recommended

1. Principles of Pathology of E.C. Stakman and J.G. Harrar.
2. Plant Pathology by J.C. Walker.
3. Plant Pathology by E.J. Butler and S.G. Jones.
4. Principles of Plant Infection of E. Gaumann.
5. Fungi and Plant disease by Mundkar.
6. Fungi of Pakistan by Sultan Ahmed. Part I and II.
7. Principles of Plant Pathology by J.G. Manners.
8. Introduction to Plant Diseases by G.B. Lucas and C.L. Campbell



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