

UOS/CE/No. 2946

2-9-17

**UNIVERSITY OF SARGODHA, SARGODHA**

Session 2017-21

**NOTIFICATION**

2018 2016

No. UOS/Acad/762

Dated: 30.08.2017

On the recommendation of Academic Council made in its meeting dated 23.08.2016, the Syndicate in its 1/2017 meeting held on 15-16.05.2017 has approved the curricula of following programs to be implemented from the session mentioned against each:-

1. Revised Scheme of Studies for BS, M.Sc, M.Phil & Ph.D Botany w.e.f 2016 and onward (annex-'A', 'B', 'C' & 'D').
2. Addition of Elective Courses in MS (CS) Curriculum w.e.f 2016 (annex-'E').
3. Addition of courses in scheme of studies of Ph.D program of Computer Science (annex-'F'). (already included and notified vide No.UOS/Acad/573 dated 19.06.2017)
4. Revised curriculum of BS 4-Year Mathematics program w.e.f 2016 & onward (annex-'G').
5. Revised curricula of M.Sc and M.Phil / Ph.D Mathematics w.e.f 2016 (annex-'H', 'I')
6. Revised Scheme of Studies for BS, M.Sc, M.Phil and Ph.D Zoology w.e.f 2016 (annex-'J', 'K', 'L', 'M')
7. Addition of Elective Courses in the Scheme of Studies of MS(CS) program (annex-'N')
8. No. of credit hours for MS (CS) Thesis in Computer Science department (annex-'O')
9. Addition of Elective Courses BS (CS) program in Computer Science w.e.f 2016 s(annex-'P')
10. Revised curricula of BS & M.Sc program in Biotechnology w.e.f 2016-17 (annex-'Q' & 'R')

ACE 5/1

L. D. G. (S)

Amjad  
12/9/17

ACE 11

19/17

(Amjad Hussain Janjua)  
Deputy Registrar (Acad)  
30/8/17

**Distribution:**

- Chairman / Incharges of the concerned departments
- Controller of Examinations
- Directors Sub-Campuses
- Principals Affiliated Colleges (concerned)
- Web-Developer (for uploading on university web-site)

**C.C:**

- Dean, Faculty of Sciences
- Secretary to the Vice-Chancellor
- P.A to Registrar

## UNIVERSITY OF SARGODHA

BS BOTANY (4 YEAR PROGRAM) FROM FALL 2016 AND ONWARDS

## SCHEME OF STUDIES

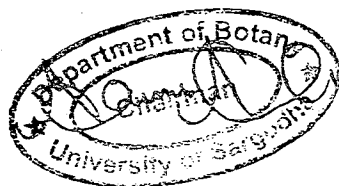
Course will be comprised of 8 semesters of 18 weeks each. Following are the courses of reading.

## I SEMESTER:

Course Code	Description	Credit hours
BOT-101	Diversity of Plants	04 (3+1)
ZOL-101	Principles of Animal life	04 (3+1)
CHEM-181	Physical Chemistry	04 (3+1)
ENG-101	English-I (Functional English)	03
PKS-101	Pakistan Studies	02
Total Credit hours		17

## II SEMESTER:

Course Code	Description	Credit hours
BOT-102	Plant systematic, Anatomy and Development/ Embryology	04 (3+1)
ZOL-102	Diversity in Animals Invertebrates	04 (3+1)
CHEM-161	Inorganic Chemistry	04 (3+1)
ENG-102	English-II(Communication Skills)	03
ISL-102	Islamic studies	02
Total Credit hours		17



**III SEMESTER:**

Course Code	Description	Credit hours
BOT-203	Cell Biology, Genetics & Evolution	04 (3+1)
ZOL-203	Diversity of Animal Chordates	04 (3+1)
CHEM-271	Organic Chemistry	04 (3+1)
ENG-203	English-III (Technical Report Writing and Presentation Skills)	03
COMP-203	Introduction to Information and Communication Technologies	03
Total Credit hours		18

**IV SEMESTER:**

Course Code	Description	Credit hours
BOT-204	Plant Physiology & Ecology	04 (3+1)
ZOL-204	Principles of Animal Physiology	04 (3+1)
CHEM-292	Basic Biochemistry	04 (3+1)
BOT-205	Biodiversity and Conservation	03(2+1)
Code of relevant Department.	Mathematics/ Psychology	03
Total Credit hours		18

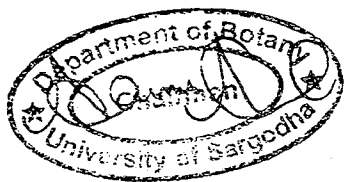


**V SEMESTER:**

Course Code	Description	Credit hours
STAT-412	Biostatistics	03(2+1)
BOT-306	Bacteriology and Virology	03(2+1)
BOT -307	Phycology & Bryology	03(2+1)
BOT -308	Mycology & Plant Pathology	03(2+1)
BOT -309	Diversity of Vascular Plants	03(2+1)
BOT -310	Plant systematics	03(2+1)
Total Credit hours		<b>18</b>

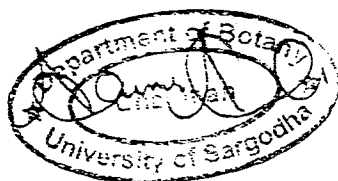
**VI SEMESTER:**

Course Code	Description	Credit hours
BOT-311	Plant Anatomy	03(2+1)
BOT-312	Genetics-I	03(2+1)
BOT-313	Plant Biochemistry-I	03(2+1)
BOT-314	Plant Ecology-I	03(2+1)
BOT-315	Plant Physiology-I	03(2+1)
BOT-316	Cell Biology	03(2+1)
Total Credit hours		<b>18</b>



## List of Optional Papers/Elective in lieu of Thesis

Course	Title	Credit Hours	Course	Title	Credit Hours
BOT-424	Plant Water Relations	03(2+1)	BOT-425	Plant Micro Techniques	03(2+1)
BOT-426	Plant Seed Physiology	03(2+1)	BOT-427	Palynology	03(2+1)
BOT-428	Plant Tissue Culture	03(2+1)	BOT-429	Plant Biotechnology	03(2+1)
BOT-430	Advanced Environmental Biology	03(2+1)	BOT-431	Plant-Conservation Management	03(2+1)
BOT-432	Conservation Genetics	03(2+1)	BOT-433	Basic-Ecological Genetics	03(2+1)
BOT-434	Medicinal Plants	03(2+1)	BOT-435	Ethno botany	03(2+1)
BOT-436	Biodegradation and Bioremediation	03(2+1)	BOT-437	Water-pollution Management	03(2+1)
BOT-438	Air-pollution Management Strategies	03(2+1)	BOT-439	Conservation Ecology	03(2+1)
BOT-440	Plant Stress Physiology	03(2+1)	BOT-441	Advanced Plant Anatomy	03(2+1)
BOT-442	Seed Production Technology	03(2+1)	BOT-443	Seed Pathology	03(2+1)



**BOTANY****1<sup>st</sup> Semester****Diversity of Plants****BOT-101****Cr. 4 (3+1)****Course Outline:****Cr. 03**

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

- a) a). Viruses (RNA and DNA types) with special reference to TMV;
- b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to bio fertilizers, pathogenicity and industrial importance;
- c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
- d) Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
- e) Lichens (Physcia)
- f) Bryophytes
  - i. Riccia
  - ii. Anthoceros
  - iii. Funaria
- g) Pteridophytes.
  - i. Psilopsida (Psilotum)
  - ii. Lycopsidea (Selaginella)
  - iii. Sphenopsida (Equisetum)
  - iv. Pteropsida (Marsilea)
- h) Gymnosperms
  - i. Cycas
  - ii. Pinus
  - iii. Ephedra
- i) Angiosperms
  - 1. Monocot (Poaceae)
  - 2. Dicot (Solanaceae)

**Lab Outline:****Cr .01**

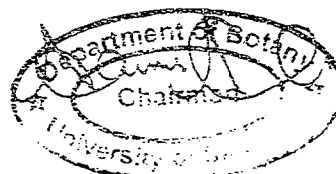
- i. Culturing, maintenance, preservation and staining of microorganisms.
- ii. Study of morphology and reproductive structures of the types mentioned in theory.
- iii. Identification of various types mentioned from prepared slides and fresh collections.

**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, 3<sup>rd</sup> Ed. W.M.C. Brown Publishers.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. 4<sup>th</sup> Ed. John Wiley and Sons Publishers.
4. Agrios, G. N. 2004. Plant pathology. 8<sup>th</sup> 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 Willey 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 3<sup>rd</sup> Ed., Jones and Bartlett Pub. UK
9. Marti, J. & Ingrouille. 2006. Plant diversity and Evolution. 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.



ZOL-101:

**PRINCIPLES OF ANIMAL LIFE**

Cr. 4 (3+1)

Cr. 03

**Course Outline:****1. Place of Zoology in Science**

A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is zoology? The classification of animals; the scientific method.

**2. The Chemical Basis of Animal Life**

Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids.

**3. Cells, Tissues, Organs, and Organ System of Animals**

Structure and functions of cell membranes; various movements across membranes; cytoplasm, organelles, and cellular components: functional account of ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles based on their structural aspects. The nucleus: nuclear envelope, chromosomes and nucleolus. Tissues: diversity in epithelial tissue, connective tissue, muscle tissue and nervous tissue to perform various functions. Structural integrations for functions in organs and organ systems.

**4. Energy and Enzymes: Life's Driving and Controlling Forces**

Energy and the laws of energy transformation; activation energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.

**5. How Animals Harvest Energy Stored in Nutrients**

Glycolysis: the first phase of nutrient metabolism; fermentation: "life without oxygen"; aerobic respiration: the major source of ATP; metabolism of fats and proteins; control of metabolism; the metabolic pool.

**6. Ecology I: Individuals and Populations**

Animals and their abiotic environment; populations; interspecific interactions.

**7. Ecology II: Communities and Ecosystems**

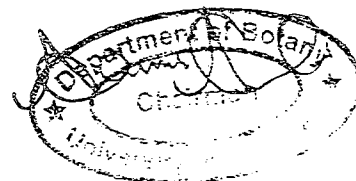
Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

**Lab Outline:**

Tests for different carbohydrates, proteins and lipids.

Cr. 01

**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, and columnar), connective tissue (adipose, cartilage, bone, and 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.

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. Hickman, C.P., Roberts, L.S. And Larson, A. Integrated Principles of Zoology, 12th Edition (International), 2004. Singapore: McGraw-Hill.
2. Miller, S.A. And Harley, J.B. Zoology, 6th Edition (International), 2005. Singapore: McGraw-Hill.
3. Pechenik, J.A. Biology of Invertebrates, 5th Edition (International), 2000. Singapore: McGraw-Hill.
4. Kent, G.C. And Miller. S. Comparative Anatomy of Vertebrates, 2001. New York: McGraw-Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
6. Miller, S.A. General Zoology Laboratory Manual. 5<sup>th</sup>edition (International), 2002. Singapore: McGraw-Hill.
7. Hickman, C.P. And Kats, H.L., Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
8. Molles, M.C. Ecology: Concepts and Applications. 6<sup>th</sup>edition. 2005. McGraw-Hill, New York, USA.
9. Odum, E. P. Fundamentals of Ecology. 3rd Edition. 1994. W.B. Saunders. Philadelphia.
10. Slingby, D. And Cook, C. Practical Ecology. 1986. McMillan Education Ltd. UK.





CHEM-181

PHYSICAL CHEMISTRY

Cr. 4 (3+1)

Cr. 03

**Course Outline:**

**Elementary Mathematics:** Logarithmic, exponential and trigonometric functions, differentiation of elementary functions, methods of differentiation & integration, significance of differentiation & integration.

**Physical States of Matter: Gases** (van der Waal's equation, critical Phenomena, Critical values of T, P & V., liquification of gases, molecular collisions, collision diameter, mean free path).

**Liquids** (viscosity, Parachor value, Refractive index, molar refraction and its applications. Dipole moment, **Solids** (Unit cells. Bragg crystal analysis, crystal structure of NaCl, powder method of crystal structure analysis).

**Atomic Structure:** De Broglie equation. Schrodinger wave equation, solution for particle in 1D box, quantization concept, Heisenberg Uncertainty Principle, Pauli Exclusion Principle, Hund's Rule.

**Chemical Thermodynamics:** First law of thermodynamics, state functions, isothermal and adiabatic processes in ideal gases, heat capacity. reversible and irreversible processes. Spontaneous and non-spontaneous processes, second law of thermodynamics, change of entropy with change in T, P & V.

**Chemical Equilibrium:** Law of Mass Action, equilibrium constant, relationship between  $K_c$ ,  $K_p$ ,  $K_x$  and  $K_a$  and LeChaterlier's Principle.

**Solutions:** composition, ideal and non-ideal solutions. Raoult's law. Colligative properties. ebullioscopy, cryoscopy, osmotic pressure, distillation and concept of azeotrops.

**Chemical Kinetics:** Zero, first and second order reaction, Arrhenius equation, activation energy, Lindermmann's mechanism, collision theory and transition state theory.

**Electrochemistry:** Conductance, dependence of conductance on the nature of solvent and temperature, Kohlrausch's law and its applications, measurement of conductance strong and weak electrolytes, degree of dissociation.

(Cr. 01)

**Physical Chemistry Lab**

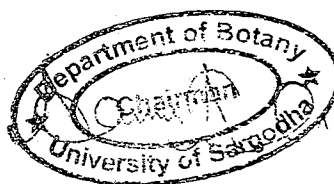
1. Determination of surface tension and Parachor value by stalagmometer.
2. Determination of percent composition of liquid solutions from surface tension measurement.
3. Determination of viscosity and Rhechor value of liquids from viscosity measurement.
4. Determination of percent composition of liquid solutions viscometrically.
5. Determination of refractive index and molar refractivity by refractometer.



6. Determination of percent composition of liquid solutions by refractive index measurements.
7. Determination of heat of solution by solubility method.
8. Determination of heat of neutralization of an acid with a base.
9. A kinetic study of acid hydrolysis of ethyl acetate.
10. Kinetic study of saponification of ethyl acetate.
11. Determination of molecular weight of a compound by elevation in boiling point. (Ebullioscopic method).
12. Determination of molecular weight of a compound by lowering of freezing point (The Cryoscopic methods).
13. Determination of equilibrium constant of KI – I<sub>2</sub> K<sub>13</sub>.
14. Conductometric titration of strong acid and strong base.

#### Recommended Books (Physical Chemistry)

1. Chaudhry, G.R., Text Book of Physical Chemistry, 2<sup>nd</sup> Edition, New Kitab Markaz, Amin pur Bazar, Faisalabad, Pakistan, (2001).
2. Shaheen, M.A. Jilani Manual of Practical Chemistry, Vol.I, Jilani Notes, Lahore Pakistan
3. Maron S. H. and Jerome, B. "Fundamentals of Physical Chemistry" Macruthan Publishing co. Inc. New York, (1995).
4. Atkins P.W. and Clugston, M.J. "Principles of Physical Chemistry" Pitam Publishing Company. NY (1998).
5. Moore, W.J., "Physical Chemistry", 5<sup>th</sup> Ed. Longmans Publishers, NY (1972).
6. Jones, M., "Elements of Physical Chemistry" 3<sup>rd</sup> Ed. Benjamin Cummings Publishing Company Inc., NY (1993).
7. Adamson, A. W., "Understanding Physical Chemistry" 3<sup>rd</sup> Ed. Benjamin Cummings Publishing Company Inc. NY (1973).
8. Heald, C. and Smith, A.C.K. Applied Physical Chemistry. MacMillan UK (1973).
9. Akhtar, M.N. & Ghulam Nabi, "Text Book of Physical Chemistry" Ilmi Kitab Khawna, Lahore (2006).
10. Bhatti, H.N. and K. Hussain, "Principles of Physical Chemistry"; Carwan Book House, Lahore (2005).
11. Levitt, B.P., "Findlay's Practical Physical Chemistry". 9<sup>th</sup> Ed. Longman, London (1973).
12. Das, R.C. and B. Behera, "Experimental Physical Chemistry", Tata McGraw Hill. Delhi (2003).
13. Crocleford, H.D., H.W. Biard, F.W. Getzen & J.W. Nowell, "Laboratory Manual of Physical Chemistry", 2<sup>nd</sup> Ed., John Wiley & Sons, London (1975).



ENG-101:

ENGLISH-I

Cr. 3(3+0)

**Course Contents**

Cr. 03

**Aim:**

The aim of this is to groom the students linguistically in such a manner that they can operate independently on a reliable communicative competence in the twin productive skills of speech and writing. This course also aims to train students in acquiring all the study skills required to cope efficiently not only the challenges of the English language but also with the demand of other subjects written in English which need to be dealt with optional level of efficiency.

**Course contents:****General study skills:**

General study skills

Getting organized and knowing one's

Target

Dictionary skills

- Vocabulary Development
- English sounds

Using the library

Remembering and learning

Critical thinking

Tacking a book

Preparing for examination

paragraphs

writing an exam essay

preparing summary

Reporting

Writing a research paper

CV writing and application writing

Writing assignments and term papers

dealing with examinations

**Special Oral Skills**

Discussion in tutorial

Effective classroom interaction

Giving a presentation

Taking part in seminars

**Academic listening**

Note taking from lecture

Type of note-taking

Effective questioning

After the lecture

**Writing skills**

Planning stages

Getting Started

Brainstorming

Sentence type

**Reading list**Wallace. (1980) Study skills in English  
CUPLagan.(1981) English Skills. McGraw  
Hill Book Co.

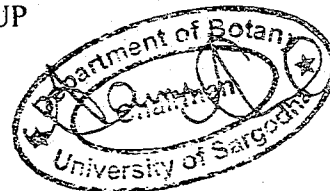
McWhorter, K.T. (1983) college reading

Basis for effective Writing

- Unity
- Support
- Organization
- Sentence

Making Rewriting Habit

and Study Skills. Little Brown &amp; Co.

O'Brien & Sordon. (1985) Developing  
Reference Skills. CollinsPrince-Machado,D. (1998) Skills for  
Success. CUP

PKS-101:

PAKISTAN STUDIES

Credit hours 2(2+0)

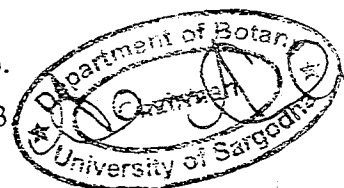
**Course Contents:**

1. **Two nation theory and ideology of Pakistan.**
  - a. Historical background of creation of Pakistan.
  - b. Two nation theory its historical context, definition and interpretation.
  - c. Quaid -i- Azam and his political ideas.
2. **Political dynamics of Pakistan.**
  - a. Constitutional Development in Pakistan (1947-73).
  - b. Salient features of Constitution of Pakistan.
  - c. Institutions of Pakistan, Political Parties: Bureaucracy, Army, Judiciary and Media.
  - d. Problems of Pakistan as a Federal State.
3. **Socio-Economic issues of Pakistan.**
  - a. Economic problems.
  - b. Social and Demographic issues.
4. **Diplomatic dynamics of Pakistan.**
  - a. Determinants and objectives of Pakistan's Foreign Policy.
  - b. Pakistan's relations with its neighboring countries.
  - c. Pakistan and the Muslim World.

(A comprehensive review of Foreign Policy of Pakistan)

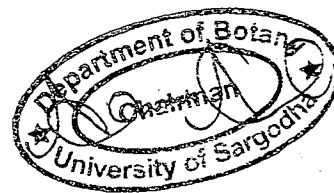
**Recommended Books**

1. Ahmad, Jamil Uddin, Early Phase of Muslim Political Movement, Publishers United Ltd., 1967.
2. Chaudhry, G.W., Constitutional Development in Pakistan, Longman, U.K., 1969.
3. Hamid, Abdul, "Muslim Separatism in India".-
4. Hussain, J., An Illustrated History of Pakistan- Book 1 & 2", Oxford University Press, Karachi, 1983.
5. Ikram, Dr. S. M., Modern Muslim India and the Birth of Pakistan, Institute of Islamic Culture, Lahore, 1990.
6. Ikram, Dr. S. M., Muslim Rule in India and Pakistan, Students Books Aid, Karachi, 1991.
7. Kadri, Justice Syed Shameem Hussain, Creation of Pakistan, Wajidalis Ltd., Lahore, 1982.
8. Kazmi, Raza, Pakistan Studies, Karachi: Oxford University Press, 2012.
9. Kureshy, K. U., Geography of Pakistan, National Book Service, Lahore, 1986.
10. Mazhar-Ul-Haq, The 1973 Constitution of Pakistan, Bookland, Lahore, 1993.



11. Mehmood, Dr. Safdar, Pakistan Political Roots and Development, Vanguard, Lahore, 1990.
12. Mehmood, Dr. Safdar, The Constitution of Pakistan 1973: Comments and Comparison, A. H. Publisher, Lahore, 1994.
13. Nasir, M. Saeed; Hyder, Syed Kamal, Economics of Pakistan, Educon Publication, Lahore, 1993-94.
14. Qureshi, I. H., A Short History of Pakistan, University of Karachi, 1992.
15. Qureshi, I. H., Struggle for Pakistan, University of Karachi, 1965.
16. Saqib, Ahsan Ullah, History of Indo-Pakistan since 1526, Dogar Brothers, Lahore, 1992.
17. Sayeed, K. B., The Political System of Pakistan, National Book Service, Lahore.
18. Sayeed, Dr. Khalid Bin, "Pakistan: The Formative Phase".
19. Shaw, Isobel, Odyssey Illustrated Guide to Pakistan, the Guide Book Company Ltd., 1996.
20. Talbot, Ian, Pakistan: A Modern History, London: Oxford University Press, 2005.
21. Ziring Lawrance, Pakistan in Twentieth Century: A Political History, London: Oxford University Press, 2006.

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## BOTANY

2<sup>nd</sup> Semester

BOT-102

Plant Systematic, Anatomy and Development/Embryology Cr. 4(3+1)

## a) Plant systematic

1. Introduction to Plant Systematic: aims, objectives and importance.
2. Classification: Brief history of various systems of classification with emphasis on Takhtajan.
3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN). Vienna code.
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

iv. Rosaceae

vii. Lamiaceae (Labiatae)

ix. Asteraceae (Compositae)

ii. Brassicaceae (Cruciferae)

v. Euphorbiaceae

iii. Apiaceae (Umbelliferae)

x. Liliaceae (Sen. Lato)

iii. Fabaceae (Leguminosae)

vi. Cucurbitaceae

## 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. Epidermis (including stomata and trichomes)
  - v. Xylem
  - vi. Phloem
3. Meristem: types stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

## c) Development/Embryology

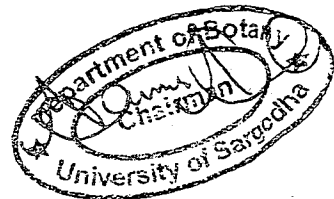
1. Early development of plant body: *Capsella bursa-pastoris*
2. Structure and development of Anther Microsporogenesis, Microgametophyte
3. Structure of Ovule Megasporogenesis, Megagametophyte
4. Endosperm formation
5. Parthenocarpy
6. Polyembryony

Cr. 01

## Lab Outline

## 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



## BOTANY

2<sup>nd</sup> Semester

BOT-102 Plant Systematic, Anatomy and Development/Embryology Cr. 4(3+1)

## a) Plant systematic

1. Introduction to Plant Systematic: aims, objectives and importance.
2. Classification: Brief history of various systems of classification with emphasis on Takhtajan.
3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN). Vienna code.
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. Brassicaceae (Cruciferae) | iii. Fabaceae (Leguminosae) |
| iv. Rosaceae                | v. Euphorbiaceae              | vi. Cucurbitaceae           |
| vii. Lamiaceae (Labiatae)   | iii. Apiaceae (Umbelliferae)  |                             |
| ix. Asteraceae (Compositae) | x. Liliaceae (Sen. Lato)      |                             |

## 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. Epidermis (including stomata and trichomes)
- v. Xylem
- vi. Phloem
3. Meristem: types stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

## c) Development/Embryology

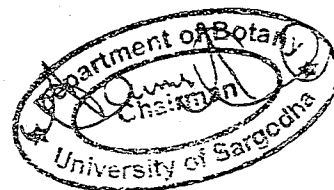
1. Early development of plant body: Capsella bursa-pastoris
2. Structure and development of Anther Microsporogenesis, Microgametophyte
3. Structure of Ovule Megasporogenesis, Megagametophyte
4. Endosperm formation
5. Parthenocarpy
6. Polyembryony

## Lab Outline

Cr. 01

## 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



**Taxonomy**

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.

**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, 3<sup>rd</sup> 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. 3<sup>rd</sup> Edition, Regency Publications, New Delhi.
13. Naik, V. N. 2005 Taxonomy of Angiosperms. 20<sup>th</sup> Reprint .Tata McGraw-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, Phytan.





ZOL-102      **DIVERSITY OF ANIMALS (INVERTEBRATES)**      Cr. 4(3+1)  
 (CLASSIFICATION, PHYLOGENY AND ORGANIZATION)

**Course Contents:**

**Cr. 03**

**1. Introduction**

Classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.

**2. Animal-Like Protists: The Protozoa**

Evolutionary perspective; 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.

**3. Multicellular and Tissue Levels of Organization**

Evolutionary perspective: 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.

**4. Triploblastics and Acoelomate Body Plan**

Evolutionary perspective; phylum platyhelminthes; classification up to class; the free-living flatworms and the tapeworms; phylum nemertea; phylum gastrotricha; further phylogenetic considerations.

**5. Pseudocoelomate Body Plan: Aschelminths**

Evolutionary perspective; 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.

**6. Molluscan Success**

Evolutionary perspective: 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.

**7. Annelida: The Metameric Body Form**

Evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration,



reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.

### 8. Arthropods: Blueprint for Success

Evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.

### 9. Hexapods and Myriapods: Terrestrial Triumphs

Evolutionary perspective; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.

### Lab Outline

Cr. 01

1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, and Paramecium as representative of animal like protists. (Prepared slides).
2. Study of sponges and their various body forms.
3. Study of principal representative classes of phylum Coelenterata.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum Nematoda.
6. Study of principal representative classes of phylum Mollusca.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
9. Brief notes on medical/economic importance of the following: Plasmodium, Entamoebahistolitica, Leishmania, Liverfluke, Tapeworm, Earthworm, Silkworm, Citrus butterfly.
10. Preparation of permanent stained slides of the following: Obelia, Daphnia, Cestode, Parapodia of Nereis.

### Books Recommended

1. Hickman, C.P. And Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A., General Zoology Laboratory Manual. 5<sup>th</sup> edition (International), 2002. Singapore: McGraw Hill.

CHEM-161

INORGANIC CHEMISTRY

Cr. 4 (3+1)

Inorganic Chemistry

Cr. 03

**Periodic Table and Periodicity of Properties:** Modern Periodic Table, Group trends and periodic properties, Atomic & ionic radii, ionization potentials, electron affinities and electronegativities; Redox potential, electrochemical series and its applications. Corrosion and electroplating.

**Acid Base Equilibria:** Acids and bases, relative strengths of acids, pH, pKa, pKb. Hard and soft acid & Bases. SHAB Principle & its application. Buffers, types buffer, Preparation, Buffer capacity and applications of buffers. Indicators: (Acid-base, Redox, Adsorption), Solubility product, Common ion effect and its applications.

**Chemical Bonding:** Nature of a bond, hybridization, Valence Bond Theory (VBT), The Concept of Resonance, Molecular Orbital Theory (MOT), Valence Shell Electron Pair Repulsion (VSEPR) theory. Special types of bonds such as Metallic bonds, Hydrogen Bonding, Bent bond, Ion-dipole-dipole bond, ion induced-dipole bond.

**Chemistry of p-Block Elements:** Introduction to p-block elements (Group trends in p-block elements with reference to, atomic sizes & chemical reactivities). Boranes & Boride; aluminium halides, hydrides & Alums; Silicates (Structural aspects, classifications and applications); silicones (Structural aspects, classifications and applications), Germanes; phosphazenes, Phosphides, Oxoacids of Phosphorous; Oxoacids & salts of sulphur. Noble gases (compounds of Xe, Kr, Ra; bonding and applications). Production of pure silicon chips for solar energy cells.

**Chemistry of d-Block Elements:** Electronic configuration. Characteristics. Nomenclature. Nature of bonding in coordination compounds: Werner's theory, VBT, MOT and CFT for coordination compounds. Isomerism in coordination compounds. Chelates: Classification and applications. Applications of coordination compounds (Medicinal, Industrial, Agricultural).

**Separation Techniques:** General introduction and Applications (Solvent extraction and Chromatographic techniques such as paper, Ion exchange and Column).

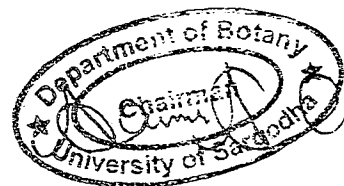
**Introduction to Analytical Techniques in Inorganic Chemistry:** Introduction to spectroscopic Techniques: Principle, brief instrumentation, sample handling and applications (Flame emission, Atomic Absorption, IR & UV/Vis).

**Chemical Industries:** Metallurgy of Al, Cr and U, fertilizers (Urea & Phosphate fertilizers) Cement and Sugar.

Inorganic Chemistry Lab

(Cr. 01)

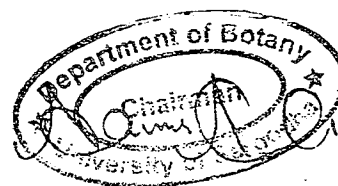
1. Qualitative Analysis; four radicals (cations and anions) for salt mixture.
2. Chromatographic separation of cations.
3. Determination of total hardness of water using EDTA.
4. Estimation of manganese (II) using EDTA.
5. Estimation of copper (iodometrically).
6. Determination of thiosulphate ion (Iodometrically).
7. Determination of ferricyanide using KI solution.
8. Determination of chloride by Volhard's and Mohr's methods.



9. Estimation of chloride ions using adsorption (Fluorescein) indicator.
10. Estimation of bromide ions using adsorption (Eosin) indicator.
11. Estimation of percentage of ferrous ions in the Mohr's salt using  $\text{KMnO}_4$ .
12. Percentage determination of ferric ions in ferric alum using  $\text{KMnO}_4$  solution.
13. Determination of purity of commercial potassium oxalate using  $\text{KMnO}_4$  solution.
14. Estimation of ferrous ions using  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.

### Recommended Books (Inorganic Chemistry)

1. Iqbal, M.Z., 'Text Book of Inorganic Chemistry', IlmiKitabKhana, Revised Edition (1998).
2. Chaudhry, G. R., 'Text Book of Inorganic Chemistry, 2<sup>nd</sup> Edition; New KitabMarkaz, Faisalabad, Pakistan (2001).
3. Shaheen, M.A. Jilani Manual of Practical Chemistry, Vol. I, Jilani Notes, Lahore Pakistan (2014).
4. Shaheen, M.A. Jilani's Concise Text Book of Inorganic Chemistry, Jilani Notes, Lahore (2015)
5. Albert, C.F., Wilkinson G. and Gaus, P.L. Basic Inorganic Chemistry, 3<sup>rd</sup> Edition, John Wiley & Sons, Inc. NY (1995).
6. Lee, J.D., 'Concise Inorganic Chemistry'. 5<sup>th</sup> Edition, Chapman & Hall, UK (1996).
7. Jolly, W.L., 'Modern Inorganic Chemistry', Chemistry', 2<sup>nd</sup> Edition McGraw Hill, NY (1991).
8. Shriver, D.F., Atkins P.W. and Langford, C.H. 'Inorganic Chemistry', 2<sup>nd</sup> Edition, Oxford Press, UK (1994).
9. Housecroft, C.E. and Sharpe, A.G., 'Inorganic Chemistry', 3<sup>rd</sup> Edition, Longman, NY (1992).
10. Rayner-Canham, G. 'Descriptive Inorganic Chemistry', W.H. Freeman & Co. UK (1995).
11. Jeffery, G.H., Bassett, J., Mendham, J. and Denney, R.C. 'Vogel's Textbooks of Quantitative Chemical Analysis', 5<sup>th</sup> Edition, Benjamin-Cummings, NY (1989).
12. Vogel, A.I. 'A Text Book of Macro and Semi micro Qualitative Inorganic Analysis', Longman Green & Co. NY (1995).
13. Skoog, D.A., West, D.M and Holler, F.J. Analytical Chemistry, 6<sup>th</sup> Edition Saunders College Publications, UK (1994).
14. Graham, H and Man, H. Chemistry in Context 5<sup>th</sup> Edition, Thomas Nelson Ltd. U.K. (2000).
15. Philp M. Advance Chemistry, Cambridge Low Price Edition, U.K. (1996).
16. David H. Modern Analytical Chemistry, McGraw Hill, NY (2000).



ENG-102:

ENGLISH-II

Cr. 3(3+0)

**Course Contents**

Language structure

Grammatical structure

Time

Tense

Aspect

Mood

Voice

Narration

Sentence structure

Clause structure

Concord

Word order

Gender

Number

Word classes

Vocabulary work

Correct use of words

Word confused or misused

Correct use of word

Word and associations

Substitution

Homonyms

Homophones

American English

Kinds of verb

Influencing the behaviour of others

feeling and attitudes

Discussion

Various social situations

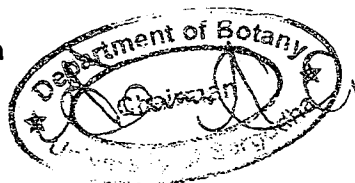
**Reading List**

Devitis.Mariani&amp; O'Malley (1991)

English Grammar for Communication

Longman

Swan, M. And Catherine (2001) How



Words for space and degree

English Works. OUP

Word formation

Burton. S. H. (1984) Mastering English

Cause and effect

Grammar. OUP

Quality

Hornby, A.S (1978) The Teaching of

Inclusion and exclusion

Structure Words and Sentence

Focus and emphasizing

Patterns. OUP

Certainty and uncertainty

Hornby, A.S (1975) A Guide to Pattern

Asking questions and responding

and Usage in English. OUP

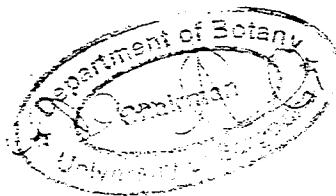
Ability

Zandvoort, R.W (1976) A Handbook of

Permission, obligation and prohibition

English Grammar. E LBS

WWW.SU.EDU.PK



اسماء برائع الامارات لاني كائن BS 4 Years

باب اول: مطالعة قرآن و حدیث

باب دوم: مطالعة بقرت

باب سوم: مطالعة تہذیب و تمدن

باب اول: مطالعة قرآن و حدیث (Topical Study of Quran & Hadith)

موضوعات

ارتحید (دلائل کا عقلی و نقلی مطالعة و تکرر و تدریس)

آیات

۱. اللہ مافی السموات و ما فی الارض و ان تد و ما فی انفسکم او تخفوه یحاسبکم بہ اللہ فبقر لمن یشاء و یعذب من یشاء و اللہ شہید قہر (الفرقة: ۲۸۳)

۲. الم تر و ان اللہ سخر لکم مافی السموات و ما فی الارض و نسیح علیک نعمہ ظاہرۃ و باطنۃ و مر اللہ من جماد فی اللہ نعیم ہدی و لا تکتب منہ (تقمان: ۲۰)

۳. و بنا لاجرا حذنا ان نسینا و احطنا بنا و لا تحمل علینا مہمرا کما حملتہ علی نفسنا و بنا لاجرا حذنا و لا تفرقنا و لا تغفرک و ارحمتنا انت مولانا فقصرتنا علی القوم الکافرین (الفرقة: ۲۸۶)

۴. سترہم ایقنا فی الاتقی و فی انفسہم حتی یسیر لہم امہ الحق اولم یکف بربک امہ غنی کبر سی سیدہ اجمہ السجدة کما فی خلق السموات و الارض و اختلاف اللیل و النہار لایت الا لای الالاب و ان عسرا ۲۰

۵. الذین یدتکرون اللہ قیاما و قعودا و علی جنوبہم و یضکرون فی خلق السموات و الارض و ما احفوت و ما اظہر اسماک عذاب النار (آل عمران: ۱۰۲)

احادیث

عس عمر بن الخطاب قال: قال رسول اللہ ﷺ: من سئل عن الابن ان تومن باللہ و ملائکة و کتبه و ساء و یوم الاخرہ بالقرعہ و یشرہ و یتق علیہ

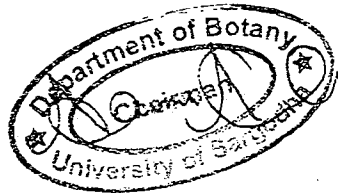
۲: رسالت (الہامی کتب و طابکہ پر ایمان، آداب نبوی، ما صاحب رسولہ و رحمہم بیت)

آیات

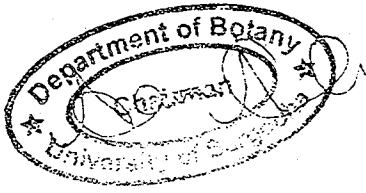
۱. امن المؤمنون حانقن الیہ من ربہ و المؤمنون کل امن باللہ و ملائکة و رسالہ لا یشرکون احد من عند و قالوا سمعنا و اطعنا و بنا و البک، المصیر (الفرقة: ۲۳۵)

۲. یا ایہا الذین امنوا لا تقدموا من یدی اللہ و رسوہ و انقر اللہ ان اللہ سمیع علیم و النحراب

پیشکش  
شعبہ علوم اسلامیہ  
یونیورسٹی آف سوات



- ٢. يا ايها الذين آمنوا لا تراءوا اصواتكم فوق صوت النبي ولا تجهروا له بالقول كجهر بعضكم لبعض ان تحبط اعمالكم وانه لا يسمع الا من وراء ظهره (الحجرات: ٢)
  - ٣. ان الذين يفضون اصواتهم عند رسول الله اولئك الذين امتحن الله قلوبهم للتقوى لهم مغفرة واجر عظيم (الحجرات: ٣)
  - ٤. ولو انهم صبروا حتى تخرج اليهم لكان خيرا لهم والله غفور رحيم (الحجرات: ٤)
  - ٥. ان الذين يتادونك من وراء الحجرات اكثرهم لا يقولون (الحجرات: ٥)
  - ٦. يا ايها الذين آمنوا ان جاءكم فاسق بنبأ فتبينوا ان تصيبوا قوما بجهالة فتصبحوا على ما فعلتم نادمين (الحجرات: ٦)
  - ٧. واعلموا ان فيكم رسول الله لو يظلمكم في كثير من الامور لئن لم يكن الله حب اليكم الايمان وزينه في قلوبكم وكره اليكم الكفر والفسوق والمعصيان اولئك هم الراشدون (الحجرات: ٧)
  - ٨. فضلا من الله ونعمة والله عليم حكيم (الحجرات: ٨)
  - ٩. النبي اولى بالمؤمنين من انفسهم وازواجه امهاتهم واولوالارحام بعضهم اولى ببعض في كتاب الله من اهل بيته المهاجرين الا تعلموا الى اولياءكم معروفاء كان ذلك في الكتاب مسطورا (الاحزاب: ٦)
  - ١٠. ان الله وملائكته يصلون على النبي يا ايها الذين آمنوا صلوا عليه وسلموا تسليما (الاحزاب: ٥٦)
  - ١١. ان الذين يؤذون الله ورسوله لعنهم الله في الدنيا والاخرة واعد لهم عذابا مهينا (الاحزاب: ٥٦)
  - ١٢. لقد كان لكم في رسول الله اسوة حسنة لمن كان يرجو الله واليوم الآخر وذكر الله كثيرا (الاحزاب: ٢١)
  - ١٣. ما كان محمد ابراهيم من رحلتكم ولكن رسول الله وخاتم النبيين وكان الله بكل شئ عليما (الاحزاب: ٤٠)
- احاديث
- ١. عن العاص بن عدي المصطفى قال قال رسول الله صلى الله عليه وآله وسلم قال الله عز وجل يا ايها الذين آمنوا صلوا عليه وسلموا تسليما (الاحزاب: ٥٦)
  - ٢. ولا تكونوا كالدن بسم الله فانهم انفسهم اولئك هم الفاسقون (التحريم: ١٤)
- احاديث
- ١. يا ايها الناس امروا الله ونهوا عن ما نهى الله ان الله خير ما يعبىون (التحريم: ١٤)
  - ٢. ولا تكونوا كالدن بسم الله فانهم انفسهم اولئك هم الفاسقون (التحريم: ١٤)
- احاديث
- ١. عن ابن مسعود عن النبي صلى الله عليه وآله وسلم قال قال رسول الله صلى الله عليه وآله وسلم قال الله عز وجل يا ايها الذين آمنوا صلوا عليه وسلموا تسليما (الاحزاب: ٥٦)
  - ٢. كسبه وانه اعفوه وما زاد عمل فيه ظم احتج ترمذي
٣. عبادات (نماز، زكاة، صوم، حج، جوار)
- ١. قد فتح المومنين الذين هم على صلاحهم حاشعون (المومنون: ٢)
  - ٢. والذين هم للزكوة فاعون (المومنون: ٣)
  - ٣. يا ايها الذين آمنوا اهل اولادكم على تجارة تنجيكم من عذاب اليم (الصف: ١٠)
  - ٤. تؤمنون بالله ورسوله وتجاهدون في سبيل الله ممالكم وانفسكم ذلكم خير لكم ان كنتم تعلمون (الصف: ١١)
  - ٥. يعقر لكم دنوبكم ويذهبتم جنات تجري من تحتها الانهار ومساكن طيبة في جنت عدن ذلك الفوز العظيم (الصف: ١٢)





- ١. والذين هم على صلواتهم يحافظون. (المؤمنون: ٢٠)
- ٢. أولئك هم البرارون. (المؤمنون: ٤)
- ٨. الذين يرثون الفردوس. (المؤمنون: ٨)
- ٩. هم فيها خالدون. (المؤمنون: ٩)

احاديث

- ١. عن انس قال: قال رسول الله ﷺ والذي نفسي بيده لا يؤمن عبد حتى يحب لا حبه ما يحب لنفسه. (متفق عليه)
- ٢. عن التميمي بن بشير قال: قال رسول الله ﷺ ترى المؤمنين في تراحمهم وتوادهم وتعاطفهم كمثل الجسد. إذا اشتكى عضو تداعى له سائر الجسد بالسهر والحمى. (متفق عليه)

آداب معاشرت

- ١. وإن طافتان من أه ومنين اقتلوا فاصلحوا بينهما فإن بفت احدهما على الاخرى فقاتلوا التي تفتى حتى تفي، التي امر الله فان قاتلت فاصلحوا بينهما بالعدل والمسارعة الى الله يحب المقسطين. (الحجرات: ٩)
- ٢. انما المؤمنون اخوة فاصلحوا بين اخويكم واتقوا الله لعلكم ترحمون. (الحجرات: ١٠)
- ٣. يا ايها الذين امنوا لا يخزقون من قوم عسى ان يكونوا خيرا منهم ولا نساء من نساء عسى ان يكن خيرا منهن ولا تملوا ما ملوا الله وما يملوا بالله الذين امنوا الا بخير من الله والى الله المرجع. (الحجرات: ١١)
- ٤. يا ايها الذين امنوا اجتنبوا كثيرا من الظن ان الظن اثم ولا تحسوا ولا يفت بعصم بعض احدكم ان يكره احدكم ان يفت احدكم من غير علم به. (الحجرات: ١٢)
- ٥. متافكر هذوه واتقوا الله ان الله تواب رحيم. (الحجرات: ١٣)
- ٦. يا ايها الذين امنوا اذا خالفتكم من ذكركم واتقوا الله ان الله عليم خبير. (الحجرات: ١٤)

احاديث

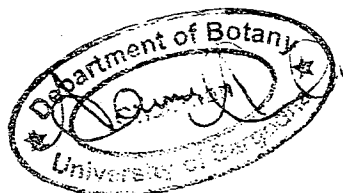
- ١. عن ابي هريرة ان رسول الله ﷺ قال ان الشفيع من امتي من ياتي يوم القيمة ثلاثة وعشرون كراة او اربعين كراة او اربعين كراة او اربعين كراة هذا واكل مال هذا. وشك دم هذا. وضرب هذا. فمطش هذا من حسنة. وهد من حسنة. وهذا من حسنة. ان ليس حسنة. ان يقص ما عليه اخذ من محظ اثم فطرح عليه ثم طرح في النار.

ذكريات واقاصم دين

- ١. ومن اظلم ممن افترى على الله الكذب وهو يدعي الى الاسلام والله لا يهدي القوم الضالين.
- ٢. يريدون ليطفنوا نواله باقوا جهنم. والله منهم برره ولو كره الكافرون. (الصف: ٢٠)
- ٣. هو الذي ارسل رسوله بالهدى ودين الحق ليظهره على الدين كله ولو كره المشركين. (الحجرات: ٢٢)

احاديث

- ١. عن ابي سعيد بن الخدري عن رسول الله ﷺ قال من واي منكم منكر اقله بغيره بيده فان لم يستمع حسنة فليسمع لنفسه ذلك اضعف الايمان. (مسلم)
- ٢. عن عبد الله بن عمر قال قال رسول الله ﷺ الا كلكم راع وكلكم مسؤول عن رعيته فالامه الذي على الناس. راعها مسؤول عن رعيته والرجل راع عائلته اهل بيته وهو مسؤول عن رعيته والمرأة راعية عن بيت زوجها وولده وهي مسؤول عن رعيته.



واخرى تحبها يصوم من الله وفتح قريب وبشر المؤمنين (الصفحة 12)

انما يش

1 عن ابن عمر قال: قال رسول الله ﷺ من اتى الله على حسن شهادة ان لا اله الا الله وان محمداً عبده ورسوله وادى الصلوة وادى الزكوة والحج وصوم رمضان (متفق عليه)

2 عن شمر بن عمار قال: قال رسول الله ﷺ من ادب مع مسلم من المسلمين عشرة سنين وادب مع عشرة سنين وادب مع عشرة سنين وادب مع عشرة سنين (جامع ترمذى)

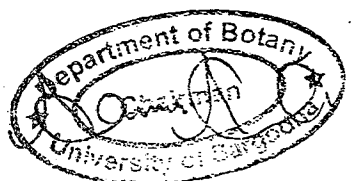
3 عن ابن هدير قال: قال رسول الله ﷺ من اتاه الله مالا فلم يود زكوة مثل له ماله يوم القيامة شجاعا افرح له وبينان يفرقه يوم الفناء ياخذ بلهزمه (يعنى شجاعه) ثم يقول انا مالك وانا كنزك ثم تلاه لا يحسن الذين سخلوا بعد ان تبهم الله من فضلته هو خير لهم من شراهم سيطرون ما يخلوا به يوم القيمة (الح وخبزى)

3 عن علي قال: قال رسول الله ﷺ من ملك وادراحتة تسفه شي بيت الله ولم يحج فلا عليه ان يموت بيوتها او يضرها وذلك تارك وتعلى يقول ذلك عن النبي صلى الله عليه وسلم من استطاع حجه فليحج حجه استطاع حجه استطاع حجه (جامع ترمذى)

صفات المؤمنين

آيات

- 1 وعاد الرحمن الذين خشون على الارض هم ما واداسطهم انما همون فتراسفم (الفرقان 1)
- 2 والذين يسون لربهم محضاً وقاماً (الفرقان 3)
- 3 والذين يقولون ربنا اصرف عنا عقاب جهنم ان عقابها كان عرماً (الفرقان 3)
- 4 انما ساءت مستقراً ومقاماً (الفرقان 3)
- 5 والذين اذا تصوا اليه يسرفوا ولم يسرفوا واوكلن من ذلك قداماً (الفرقان 5)
- 6 والذين لا يدعون مع الله الها الاحرار لا يقتلون النفس التي حرم الله ولا يذبحون ولا يمشون ومن فعل ذلك فمؤاناً (الفرقان 17)
- 7 يضعف له العذاب يوم القيمة ويخلد فيه مهاناً (الفرقان 4)
- 8 الا من تاب وامن وعمل صالحاً فاولئك يقول الله سيذهب عنهم سيئاتهم الله كريم (الفرقان 17)
- 9 ومن تاب وعمل صالحاً فاولئك يقول الله سيذهب عنهم سيئاتهم الله كريم (الفرقان 17)
- 10 والذين لا يشهدون الزور واذا مروا باللغو مروا كراماً (الفرقان 2)
- 11 والذين اذا ذكروا بايت ربهم لم يخروا عليها صماً وعمياناً (الفرقان 17)
- 12 والذين يقولون ربنا حسبنا من ازواجنا وذرياتنا قرعة اعين واجعتنا لنمتنعن انما (الفرقان 17)
- 13 اولئك يحزون القرعة بما مسروا ويلقون فيها تحية وسلاماً (الفرقان 13)
- 14 خلدن فيها حسب مستقراً ومقاماً (الفرقان 3)
- 15 من قبل ما يعضا بكم ريس لو لا دعناكم فقد كدتم فسوف يكون لزاماً (الفرقان 2)
- 16 والذين هم تقواهم حافظون (المؤمنون 3)
- 17 الا على اربابهم او ما ملكت بما بينه كانه غير مولى (المؤمنون 5)



ماں سیدو وهو مسئول عنہ الا فکلکم واع و کلکم مسئول عن رعیتہ (متفق علیہ)  
 ۳. قال رسول الله ﷺ: جاء الرجل يوم القيامة في النار فتندلق اذنيه في النار فيقطع فيها كظعن النخار ثم ينادي فيقول  
 النار عليه فيقولون: اى فلان ماشاءك، اليس كنت تأمرنا بالمعروف وتنهانا عن المنكر؟ قال: كنت امرکم ولا بد ویرا من المنکر  
 وانبه

احادیث

۱. عن عبدالله قال: قال رسول الله ﷺ: طلب كسب الحلال فربما بعد الفريضة (يعنى: شعت الامعان)  
 ۲. عن ابي سعيد قال: قال رسول الله ﷺ: التاجر الصدوق الامين مع البعین والصديقين والشهداء وجامع ترمذی،  
 باب دوم: مطالعہ سیرت (Seerah Study)

۱۰. بطالع سیرت کی اہمیت

۱۱. بزرگی، نفس اور تیز فطرت کی نیوی مشاج

۱۲. تشکیل و اثرات اور اسوہ حسنہ

۱۳. ہجرت مدینہ، واقعات اور نتائج مدینہ

۱۴. فتوحات نبویہ - قاصدہ حضرت

۱۵. خطبہ چبہ نواہ

باب سوم: مطالعہ تہذیب و تمدن (Study of Culture)

۱۶. تہذیب و تمدن، انسانی تہذیب کی خصوصیات

۱۷. بنیادیں انسانی تہذیب

۱۸. تہذیب انسانی کے ارتقا، کین مسلمانوں کا کردار

۱۹. انسان کا تصور

۲۰. طبی علوم - یا حیاتی علوم اور معاشرتی علوم میں مسلمانوں کا کردار

۲۱. کائنات میں ائمہ ادب

پروجہ میں ساریوں کی تفصیل شرح ذیل ہو گی

قرآن وحدیث: پندرہ سو ماہی متن

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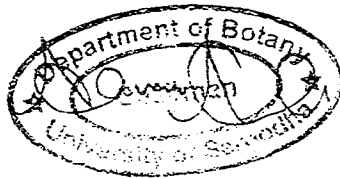
جہاں سے  
 اس کے لئے  
 میرا گروہ  
 تھا



**Recommended Book:**

- 1- ابو الحسن الماوردي، احكام السلطانيه
- 2- عبد الرحمن مباركپوری، الرحيق المختوم
- 3- شبلي نعماني، سيرت النبي
- 5- ڈاکٹر حميد الله، عهد نبوی کا نظام حکمرانی
- 6- ڈاکٹر محمد شہباز منج، تعليمات اسلام
- 7- محمد کرم شاه الازہری، ضياء القرآن
- 8- محمد کرم شاه الازہری، ضياء النبي
- 9- مولانا ابو الاعلی مودودي، تفہيم القرآن
- 10 سر سيد احمد خان، سيرت محمدی

11. Black, Anthony., The History of Islamic Political Thought.
12. Eanyat, Hamid., Modern Islamic Political Thought.
13. Hamidullah., Muslim Concept of State.
14. Sherwani, H.K., Studies in Muslim Political Thought.
15. Dr. Muhammad Mustafa Azami, tudies in early Hadith Literature
16. W. Montgomery Watt, Muhammad Prophet and statesman, Oxford university press Oxford 1961.



**BOTANY**2<sup>nd</sup> Year3<sup>rd</sup> Semester**BOT-203****Cell Biology, Genetics and Evolution****Cr. 4 (3+1)****Cr. 03****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 structure and function of the 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:****Cr. 01****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

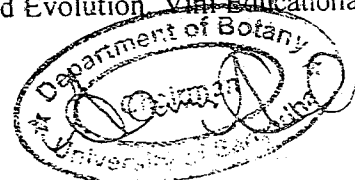
**Recommended Books:**

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



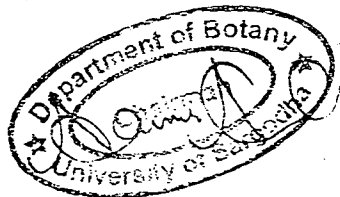
Books, New Delhi.

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.

WWW.SU.EDU.PK



ZOL-203: DIVERSITY OF ANIMALS (VERTEBRATES) Cr. 4 (3+1)

**Course Contents:**

Cr. 03

**1. Echinoderms**

Evolutionary perspective: relationships to other animals; echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development in asteroidea, ophiuroidea, echinoidea, holothuroidea and crinoidea; further phylogenetic considerations; some lesser-known invertebrates: the lophophorates, entoprocts, cyclophores, and chaetognaths.

**2. Hemichordates and Invertebrate Chordates**

Evolutionary Perspective: Phylogenetic Relationships; Classification up to subphylum or class where applicable; Further Phylogenetic Considerations.

**3. Fishes: Vertebrate Success in Water**

Evolutionary perspective: phylogenetic relationships; survey of super class agnatha and gnathostomata; evolutionary pressures: adaptations in locomotion, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

**4. Amphibians: The First Terrestrial Vertebrates**

Evolutionary perspective: phylogenetic relationships; survey of order caudata, gymnophiona, and anura. Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.

**5. Reptiles: The First Amniotes**

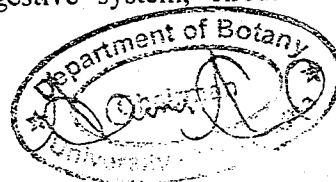
Evolutionary perspective: cladistic interpretation of the amniotic lineage; survey of order testudines or chelonia, rhynchocephalia, squamata, and crocodilia; evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

**6. Birds: Feathers, Flight, and Endothermy**

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

**7. Mammals: Specialized Teeth, Endothermy, Hair, and Viviparity**

Evolutionary perspective: diversity of mammals; evolutionary pressures: 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.

### Books Recommended

1. Hickman, C.P., Roberts, L.S. And Larson, A. Integrated Principles of Zoology, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. And Harley, J.B. Zoology, 5th Edition (International) 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. And Miller, S. Comparative Anatomy of vertebrates. 2001. New York: McGraw Hill.
5. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

### Lab Outline:

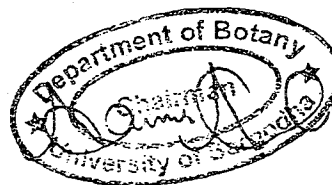
Cr. 01

1. Study of a representative of Hemichordate and Invertebrate Chordate.
2. Study of representative groups of class Fishes.
3. Study of representative groups of class Amphibia.
4. Study of representative groups of class Reptilia.
5. Study of representative groups of class Aves.
6. Study of representative groups of class 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. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5<sup>th</sup> Edition (International), 2002. Singapore: McGraw Hill.





**Course contents:**

Cr.03

**Basic Concepts:** Atomic, molecular and hybrid orbitals: multiple localized and delocalized bonds; properties of bonds; inductive; effect dipole moment. The concept of resonance, rules for resonance; resonance energy; steric inhibition of resonance; hyper conjugation; resonance effect; hydrogen bonding; tautomerism. Introduction to resonance, rules for resonance, resonance energy, steric inhibition of resonance, Introduction to spectroscopy with special reference to ultraviolet / visible and infrared spectroscopy.

**Hydrocarbons:** Classification of hydrocarbons. Nomenclature, methods of preparations, physical characteristics and chemical reactions of alkanes, cycloalkanes, alkenes and alkynes. Source of aromatic hydrocarbons. Structure of benzene and the concept of aromatic hydrocarbons. Structure of benzene and the concept of aromaticity Aromatic electrophilic substitution.

**Stereoisomerism:** Conformational Analysis of ethane and butane. Optical Isomerism. Optical activity, chiral carbon atom and optical isomerism; relative and absolute configuration, creation of chiral carbon and racemization, optical isomerism in compounds containing two chiral carbon atoms; diastereoisomers; elements of symmetry; resolution of racemic mixture. Geometrical Isomerism, *cis/trans* isomerism, designation of configuration, Determination of configuration.

**Alkyl Halides:** Nomenclature, methods of preparation and chemical reactions with special reference to nucleophilic substitution and elimination reaction of alkyl halides. Preparations, structure and synthetic applications of Grignard's reagents.

**The Hydroxyl group and Ethers:** Nature of hydroxyl group in alcohols and phenols.

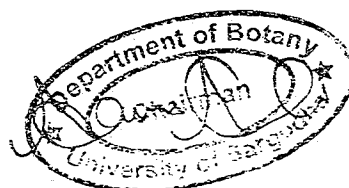
**Alcohols:** Classification and nomenclature of alcohols; methods of preparation and chemical reactions of alcohols; distinction between primary, secondary and tertiary alcohols. Polyhydric alcohols.

Phenols: Methods of preparation of phenols; acidity of phenols; chemical reactions of phenols. Ethers: Methods of preparation and reactions of ethers.

**The Carbonyl Group:** Nature of carbonyl group and its reactivity; nomenclature of aldehydes and ketones; methods of preparation of aldehydes and ketones; chemical reactions of aldehydes and ketones; distinction between aldehydes and ketones.

**Carboxylic Acids and their Derivatives:** Nomenclature of carboxylic acids; methods of preparation and chemical reactions of carboxylic acids, strength of carboxylic acids and the factors affecting it. Formation and hydrolysis of acid anhydrides, acid amides, acid halides and esters including glycerides. Introduction to amino acids.

**Nitrogen Compounds: Amines:** Classification and nomenclature of amines; methods of preparation and chemical reactions of amines; distinction between primary, secondary and tertiary amines. Preparation and reactions of aniline. Basicity of aliphatic and aromatic amines and factors affecting it. Diazonium Salts and their synthetic applications.



**Recommended Books (Organic Chemistry)**

1. Younas, M., Text Book of Organic Chemistry, Ilmi Kutab Khana, Lahore. (2006).
2. Rehman, A., Text Book of Organic Chemistry, Caravan Book House, Lahore. (2006).
3. Shaheen, M.A. Jilani Manual of Practical Chemistry, Vol. III, Jilani Notes, Lahore Pakistan (2015).
4. March, J., Advanced Organic Chemistry, Wiley, New York. (1992).
5. Pine, S. H., Organic Chemistry, McGraw-Hill, New York. (1987).
6. Sykes, P., A Guide Book to Mechanism in Organic Chemistry, Prentice Hall. (1999).
7. Younas, M., Organic Spectroscopy, A. H. Publisher, Lahore. (2006).
8. Solomons, T. W. G., Fundamentals of Organic Chemistry, Wiley, New York. (1999).
9. Kemp, W., Organic Spectroscopy, Macmillan, London. (1990).
10. Chughtai, F. A., Organic Reactions, Majid Book Depot, Lahore/Faisalabad. (1995).
11. Vogel, A. I., A Text Book of Practical Organic Chemistry, Prentice Hall. (1996).
12. Clarke, H. T. and D. Haynes. A Hand Book of Organic Analysis, Edward Arnold, London. (1947).
13. Mann, F. G and B. C. Saunders. Practical Organic Chemistry, Longman, London. (1978).
14. Shriner, R. L., D.Y. Curtin, R.C. Fuson, and T.C. Morrill, The Systematic Identification of Organic Compounds, Wiley, New York. (1997).
15. Rehman, A., Experimental Organic Chemistry, The Caravan Book House, Lahore. (2006).
16. Morrison R. T. and R.N. Boyd, Organic Chemistry, Allyn and Bacon, London. (1987).

**Organic Chemistry Lab****(Cr. 01)**

1. Qualitative Organic Analysis: Systematic identification of organic compounds containing groups containing groups like COOH, OH, NH<sub>2</sub> and C=O.
2. Purification techniques viz solvent extraction distillation and Recrystallization, etc.
3. Preparation of simple organic compounds viz, Ethyl benzoate, benzoic acid, tribromophenol, aspirin and nitrobenzene.

**Recommended Books (Organic Chemistry)**

1. Younas, M. Text Book of Organic Chemistry, Ilmi Kutab Khana, Lahore (2006).
2. Rehman, A. Text Book of Organic Chemistry, Caravan Book House Lahore (2006).
3. Smith M.B. and March, J. March's Advanced Organic Chemistry, 5<sup>th</sup> Edition, John Wiley, NY. (2001).
4. Pine, S. H. Organic Chemistry, (5<sup>th</sup> Edition) McGraw-Hill, NY. (1987).
5. Sykes, P., A Guide Book to Mechanism in Organic Chemistry, Longman, London (1999).
6. Younas, M. Organic Spectroscopy, A. H. Publisher, Lahore (2006).
7. Solomons, T.W.G., Fundamentals of Organic Chemistry, Wiley, NY (2003).
8. Kemp, W., Organic Spectroscopy, Macmillan, London (1990).
9. Vogel, A.I. A Text Book of Practical Organic Chemistry, Longman, London (1968).
10. Mann, F.G and Saunders B.C. Practical Organic Chemistry, Longman, London (1978).
11. Shriner, R.L., Curtin, D.Y. Fuson, R.C. and Morrill, T.C. The Systematic Identification of Organic Compounds, Wiley, NY (1997).
12. Rehman, A. Experimental Organic Chemistry, The Caravan Book House, Lahore (2006).
13. Morrison, R.T. and Boyd, R.N. Organic Chemistry, Allyn & Bacon, Boston (1987).



**Course Objective**

Aim of the course is to enhance the speaking skills of the students so that they are able to use the language efficiency in academic and real life situations.

**Course contents:**

Cr. 03

**Speaking**

Managing communication problems

Taking part in discussions

Expressing opinions

Making judgment

Modifying people's behaviour

Expressing personal feelings

Requesting and giving information

Expressing thought processes

Interacting socially

Preparing for an interview

**Writing**

Narrative writing

Descriptive writing

Expository writing

Argumentative writing

Writing proposals

Writing Report

Personal letters

Official letters

**Reading List**

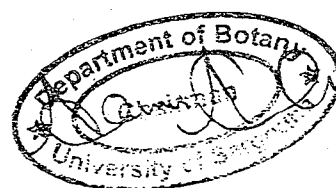
Blunde. Higgens & Middlemiss

Hudson (2002), Mastering English language. Me Millan.

Hedge. (1988), Writing. ELBS

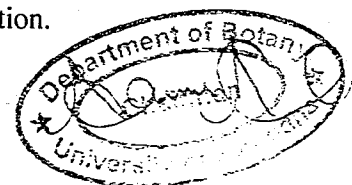
Mc Murry & Chapman (19843) Writing Fundamentals. McMillan.

Robey et al (2002) New Handbook of Basic Writing skills. Harcourt College Publishers.



**COMP-203 Introductions to Information & Communication Technologies Cr. 3 (2+1)****Course Outlines****Cr.2**

1. **Introductions to Computers:** Data and Information, Information Processing Cycle, The Components of Computer, Advantages and Disadvantages of using Computers, Networks and the Internet. Computer Software, Categories of Computers, Elements of an Information System, Examples of Compute Usage, Computer Applications in Society.
2. **The Internet and World Wide Web:** Key Concept of the Internet, Evolution of Internet, The World Wide Web, E-commerce, Other Internet Services, Netiquettes
3. **Application Software,** Business Software, graphics and Multimedia Soft Ware, Software for Home, Personal and Educational Use, Web Applications, Application Software for Communications
4. **The system unit:** Processor, Data Representation, Memory, Expansion Slots and Adapter cards, Ports and Connectors, Busses, Bays, Power Supply
5. **Input devices:** What is Input, What are Input Devices, The Key Board, Pointing Devices, Mouse, Other Pointing Devices, Touch Screens, and Touch Sensitive Pads, Pen Input, Other Inputs for Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners and Reading Devices , Biometric Input, Terminals , Putting it all together, Input Devices for Physically Challenged Users
6. **Output Devices:** What is Output, Display Devices, Printers, Speakers, Headphones, and Ear Buds, Other Output Devices.
7. **Storage:** Hard Disk, Flash Memory Storage, Cloud Storage, Optical Discs, Other Types of Storage,
8. **System Software:** Operating Systems, Operating System Functions, Types of Operating Systems, Stand Alone Operating Systems, Server Operating Systems, Embedded Operating Systems, Utility Programmes.
9. **Communications:** Use Of Computer Communications, Networks, Network Communications Standards Communications Software, Communications Over the Telephone Network, Communications Devices, Home Networks, Communications Channels,, Physical Transmission Media, Wireless Transmission Media.
10. **Databases:** Data and Information, The Hierarchy of Data, Maintaining Data, File Processing Verses Database, Database Management System, Relational, Object Oriented and Multidimensional Databases, Web Databases and Database Administration.



**11. Computer Security and Safety Ethics And Privacy:** Computer Security Risks, Internet and Network Attacks, Unauthorized Access and Use, Hardware Theft and Vandalism, Software Theft, Information Theft, System Failure, Backing Up, Wireless Security, Health Concerns of Computer Use, Ethics and Society

**Labs:**

**Cr. 01**

Lab work should be carried out to develop students Computer Skills, Operating Systems, and Utility Software Skills, E-Mail Skills, Word Processing Skills, Spreadsheet Skills, Electronic Presentations Skills, Web Surfing Skills

**Recommended books:**

Discovering Computers by Gary B Shelly & Emisty E Vermaat, Course Technology; 1<sup>st</sup> Edition (January 25, 2011)

Computing Essentials 2012 by Timothy J.O, Leary and Linda I.O, Leary, McGraw Hill Higher Education; 2<sup>nd</sup> Revised Edition (February, 1 2011)

Computers Understanding Technology by Fuller, Floyed; Larson, Brain, Fourth Edition. ISBN 978-076383-927-7.

Concepts of Information Technology By Imran Saeed, Afsan Raza, Tariq Mahmood And Zafar Hussain, 6<sup>th</sup> Edition, IT Seris Publications.

The Essential Guide to Computing: The Story of Information Technology by E.Garrison Walters, Prentice Hall PTC (August 11, 2000) ISBN-10; 0130194697

Computer Applications by Tasleem Mustafa, Tariq Mahmood, Imran Saeed, and Zahid Javed, IT Publication Series.



2<sup>nd</sup> Year4<sup>th</sup> Semester

**BOT-204**  
**Theory**

**Plant Physiology and Ecology**

**Cr. 4(3+1)**  
**Cr. 03**

**a) Plant Physiology**

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomata regulation.

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 C<sub>3</sub> and C<sub>4</sub> plants. Factors affecting this process, Products of photosynthesis.

4. Respiration: Definition and respiratory substrates. Mechanism of Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. aerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

**b) Ecology**

1. Introduction, 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. Quality of light, diurnal and seasonal variations. Ecophysiological responses.

4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.

5. Wind: Wind as an ecological factor and its importance.

6. Population Ecology: Introduction. A brief description of seed dispersal and seed bank.

7. Community Ecology

i. Ecological characteristics of plant community

ii. Methods of sampling vegetation (Quadrat and line intercept)

iii. Major vegetation types of the local area.

8. Ecosystem Ecology

i. Definition, types and components of ecosystem.

ii. Food chain and Food web.

9. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan.

**Lab Outline:**

**Cr. 01**

**a) Plant Physiology**

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.

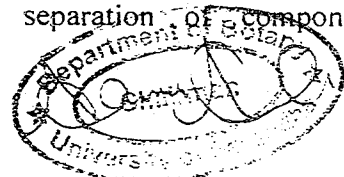
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.

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 potometer/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**

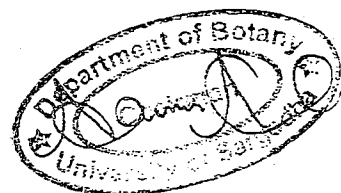
1. Determination of physical and chemical characteristics of soil.
2. Measurements of various population variables
3. Measurement of vegetation by Quadrata and line intercept methods.
4. Field trips to ecologically diverse habitats.
5. Measurements of wind velocity.
6. Measurement of light and temperature.
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. 4<sup>th</sup>. Ed. Sinauers Publ. Co. Inc. Calif.
4. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5<sup>th</sup> Edition. Wadsworth Publishing Co. Belmont CA.
5. Hopkins, W. B. 1999. Introduction to Plant Physiology. 2<sup>nd</sup> Ed. John Wiley and Sons. New York
6. Schultz, J. C. 2005. Plant Ecology. Springer-Verlag, Berlin.
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



**Course Contents:**

Cr. 03

**1. Protection, Support, and Movement**

Protection: the integumentary system of invertebrates and vertebrates; movement and support: the skeletal system of invertebrates and vertebrates; movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates.

**2. Communication I: Nerves**

Neurons: structure and function; neuron communication: introductory accounts of resting membrane potential, action potential (nerve impulse) and transmission of the action potential between cells; invertebrate and vertebrate nervous systems: the spinal cord, spinal nerves, the brain, cranial nerves and the autonomic nervous system.

**3. Communication II: Senses**

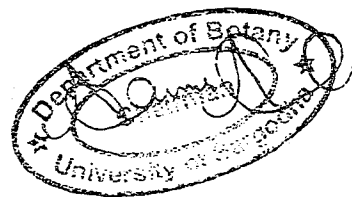
Sensory reception: baroreceptors, chemoreceptors, georeceptors, hygrometers, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates; lateral-line system and electrical sensing, lateral-line system and mechanoreceptor, hearing and equilibrium in air, hearing and equilibrium in water, skin sensors of damaging stimuli, skin sensors of heat and cold, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.

**4. Communication III: The Endocrine System and Chemical Messengers**

Chemical messengers: hormones chemistry, and their feedback systems; mechanisms of hormone action; some hormones of porifera, cnidarians, platyhelminthes, nemertean, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals.

**5. Circulation, Immunity, and Gas Exchange**

Internal transport and circulatory systems in invertebrates: characteristics of invertebrate coelomic fluid, hemolymph, and blood cells; transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response; gas exchange: respiratory surfaces; invertebrate and vertebrate respiratory systems: cutaneous exchange, gills, lungs, and lung ventilation; human respiratory system: gas transport.





**Books Recommended**

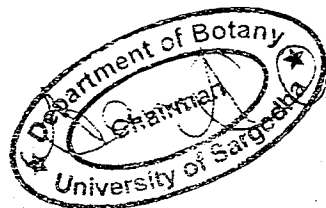
1. Hickman, C.P., Roberts, L.S. And Larson, A. Integrated Principles of Zoology, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. Comparative Anatomy of Vertebrates. 2001. New York: McGraw Hill.
5. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

**Lab Outline:****Cr. 01**

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
2. Study and notes of skeleton of Labeo, Ranatigrina, Varanus, fowl and rabbit.  
Note: Exercises of notes on the adaptations of skeletons to their function must be done.
3. Earthworm or leech; cockroach, freshwater mussel, Channa or *Catlacatla* or Labeo or any other local fish, frog, pigeon and rator mouse and rabbits are representative animals for study in dissections.
4. Study of models or preserved brains of representative animals and notes on adaptations.
5. Study of nervous system of earthworm and a fish.
6. Study of endocrine system in an insect and a rabbit.
7. Study of different types of blood cells in blood smear of rabbit.
8. Study of heart, principal arteries and veins in a representative\ vertebrate (dissection of representative fish/mammals).
9. Study of respiratory system in cockroach or locust and a vertebrate representative (Model).

**Books Recommended**

1. Hickman, C.P. And Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A. General Zoology Laboratory Manual. 5<sup>th</sup> edition (International), 2002. Singapore: McGraw Hill.



CHEM-292

BASIC BIOCHEMISTRY

Cr. 03(2+1)

Course outline:

Cr. 02

**Introduction:** Definition history and Scope of Biochemistry. The molecular logic of life,

**Bio-macromolecules:** composition and principles of organization, Origin and nature of biomolecules. **Water:** Non-covalent interactions, Properties of water, Acid/base properties, pH, buffer and buffering capacity.

**Carbohydrates:** (Definition and Classification, Monosaccharides: Pyranose and Furanose ring structures. Stereoisomerism and Optical isomerism. Disaccharides; Structures, Polysaccharides, starch, Glycogen and Cellulose. Modified Carbohydrates, Glycoproteins and Glycolipids)

**Proteins:** (Amino acids, classification and properties. Stereochemistry, Primary, Secondary, Tertiary and Quaternary structures Biological functions of proteins and peptides, Protein folding and Stability).

**Enzymes:** (Chemical Nature, Nomenclature and Classification .Enzyme activity. Coenzymes and immobilized enzymes, Specificity of Enzymes, Enzyme Inhibition. Regulation of Enzyme activity).

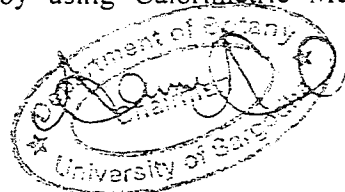
**Lipids:** (Structures and classification of Fatty Acids, essential and non-essential fatty acids, Phospholipids, Fats and oils; Hydrogenation, Oxidation and Rancidity, Beta-oxidation of fatty acids. Lipid Bilayer. Lipid Mobility).

**Nucleic Acids:** (Purines and pyrimidines, nucleosides and nucleotides, Structural and functional differences between DNA and RNA. Types of DNA and RNA. their functions in biological systems. Central Dogma and its significance Fundamentals of DNA Replication, Transcription and Translation).

**Vitamins:** (Introduction, classification, chemistry and biological significances of vitamins A, B, C, D, E and K).

#### BIOCHEMISTRY LAB (Cr.01)

1. Safety Lab Practices
2. Preparation of solutions (Molal, Molar, Normal, PPM, mM, % composition etc.)
2. Standard Buffer preparation and use of pH meter.
3. Operation and use of micropipettes
- 4 Qualitative Tests for carbohydrates (Mono-Di- and polysaccharides, Pentoses and Hexoses).
5. Quantitative Determination of Reducing Sugars by using Calorimetric Method (Spectrometric).



6. Enzymatic Hydrolysis of Glycogen and Starch.
7. Phenyl Hydrazine Test for Reducing Sugars (Osazone Test).
8. Effect of Alkalies on Sugars.
9. Qualitative tests for fats, Sterols and Phospholipids
10. Saponification Tests and Iodine Values of Fat.
11. Isolation of DNA from Plants and Animal Tissues
12. Qualitative tests for Amino Acids.
13. Estimation of protein by Kjeldahl, Lowery methods.
14. Separation of Amino Acids using Paper Chromatography and Thin Layer Chromatography (TLC).
15. Determination of Ash Contents of Food.
16. Determination of Percentage Moisture Contents of Dry Mass in Food
17. Determination of Ascorbic acid in Lemon Juice.

### RECOMMENDED BOOKS

1. Lehninger Principles of Biochemistry. (2012) 6<sup>th</sup> Ed. By David L. Nelson, Michael M. Cox W.H. Freeman; 6<sup>th</sup> Edition (November 21, 2012).
2. Principles of Biochemistry. (2011) 5<sup>th</sup> Ed. by Laurence A. Moran, Robert A Horton, Gray Scrimgeour and Marc Perry
3. Jilani Manual of Practical Chemistry, Vol-IV (2015) by Shaheen, M.A.
4. Fundamentals of Biochemistry (2010) 4<sup>th</sup> Ed. by D. J. Voet, G.J. Voet and C. W. Pratt. J. Wiley & Sons Inc. 4. Textbook of Practical Biochemistry. Joshi A. Rashmi. B. Jain Publishers, 2002
5. Introductory Practical Biochemistry. 2005. 2<sup>nd</sup> Ed. By S. K. Sawhney, Randhir Singh. Alpha Science International, Ltd.
6. Harpers Illustrated Biochemistry. (2012). 29<sup>th</sup> Ed. By Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Weil. McGraw-Hill Medical.
7. Biochemistry. 7<sup>th</sup> Ed. By Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. Publisher: Palgrave MacMillan; 7<sup>th</sup> Revised International Edition (April 01, 2011).



**Course outline:**

Cr.2

1. Biodiversity: Definition, types and threats.
2. Threats to Biodiversity; deforestation, over grazing, erosion, desertification, ecosystem degradation, bio invasion, pollution and climate change.
3. Biodiversity of Pakistan.
4. Measuring biodiversity: Alpha, Beta and Gamma diversity; Systematic and functional diversity.
5. Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of Bio resources).
6. Sustainable and unsustainable use of biological resources.
7. Biodiversity Hot spots of Pakistan and the world.
8. International treaties/agreements regarding Biodiversity and conservation; CBD, CITES, Ramsar.
9. Conservation strategies; *in situ*, *ex situ*, *in vitro* conservation.
10. Conservation vs preservation.
11. IUCN categorized protected areas in Pakistan; red listing.
12. Environmental Impact Assessment.
13. Use of herbarium and Botanical Garden in biodiversity and conservation.
14. Concept of pastures and wild life management.
15. Global Biodiversity Information Facility (GBIF).

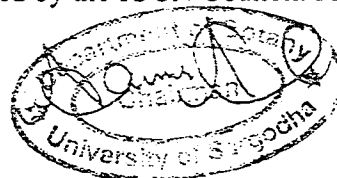
**Lab outline:**

Cr.1

1. Inventory of plant biodiversity in various habitats.
2. Field survey for baseline studies and Impact Assessment.
3. Identification of wild plant species used by local communities in different ecosystems.

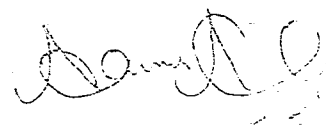
**Recommended Books:**

1. Abbasi, A. M., Khan, M. A., M. Ahmad and M. Zafar. 2012. Medicinal plant biodiversity of Lesser Himalaya Pakistan. Springer Publishers USA.
2. Hussain, F., 1991. Vegetation and ecology of lesser Himalaya. Department of Botany, Peshawar
3. Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.
4. Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.
5. Provincial conservation strategies
6. Heywood, V. (Ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.
7. Falk, D.A. & Holsinger, K.E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.
8. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. *The Conservation of Plant Biodiversity*. Cambridge University Press, Cambridge, UK.
9. IUCN. 1994. *IUCN Red List Categories*. As Approved by the IUCN Council. IUCN.



10. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.
11. Bush, M.B. 1997 Ecology of a changing Planet. Prentice hall. New Jersey.
12. French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W.W. Norton & Co
13. Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd.
14. Taylor, P. 2005. Beyond Conservation. Earth Scan Publication Ltd.

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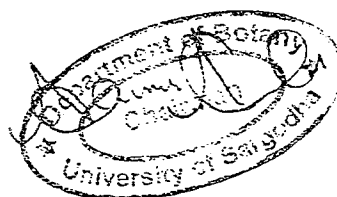
**MATH-204****Mathematics****3 (3+0)****Course Outline:**

Real Numbers, Relations and Functions, Quadratic Functions and Complex Numbers, Sequence and Series, Trigonometric Functions, Trigonometric Applications, Graph of Functions and Modelling, Limits and Continuity, Derivatives, Integration, Ordinary Differential Equations, Probability and Binomial Theorem.

**Recommended Books:**

1. Gantert, A. X., Algebra 2 and Trigonometry, AMCOS School Publication INC. New York, 2009.
2. Swokowski, E. W., Fundamental of Trigonometry, Latest Edition.
3. Kaufmann, J.E., College Algebra and Trigonometry, PWS-Kent Company, Boston, Latest Edition.
4. Anton H., 1999. Calculus: A New Horizon. 6th ed. NY: John Wiley.
5. Stewart J., 1995. Calculus. 5th ed. Brooks/Cole (suggested text).
6. Thomas G.B., Finney A.R., 2002. Calculus. 10th ed. USA: Addison-Wesley.

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PSY-201

Introduction to Psychology

3(3+0)

**Course Objectives:**

- To ensure an effective orientation of students towards the discipline of psychology so that they may come to appreciate the diversity of the subject and its pragmatic significance.
- To make students familiar with the essential features of research enterprise in Psychology.
- To inculcate a sense of personal relevance of Psychology as a subject with the potential of gaining better insight into one's own self

**1. Introduction to Psychology**

Nature and Application of Psychology with special reference to Pakistan

**2. Research Enterprise in Psychology (A brief sketch)**

- Goals of Scientific Enterprise and Steps in Scientific Investigation
- Advantages of Scientific Approach
- Experimental Research, Descriptive / Correlational Research
  - Naturalistic Observation
  - Case History Method
  - Survey Method
- Statistics and Research
  - Descriptive Statistics
  - Inferential Statistics
- Evaluating Research
  - Sampling Bias
  - Placebo Effects
  - Distortion in Self Report Data
  - Experimenter Bias
- Research Ethics
  - The Question of Deception
  - The Question of Animal Research

**3. Biological Basis of Behavior**

- Communication and Organization of the Nervous System
- The Brain and Behavior
- Right Brain / Left Brain: Cerebral Laterality
- The Endocrine System
- Heredity and Behavior (Nature & Nurture)
- The Evolutionary bases of Behavior

**4. Sensation and Perception**

- Psychophysics: Basic Concepts and Issues
- Our senses of Sight: The Visual System
- Our Senses of Hearing: The Auditory System
- Our Chemical Senses: The Taste and Smell
- Our Senses of Touch: Sensory Systems in the Skin
- The other Senses
  - The Kinesthetic System
  - The Vestibular System



## 5. Motivation and Emotion

- a. The Motivation of Hunger and Eating
- b. Affiliation: In Search of Belongingness
- c. Achievement: In search of Excellence
- d. The Elements of Emotional Experience
- e. Theories of Emotion
  - i) James Lange Theory
  - ii) Cannon-Bard Theory
  - iii) Schachter's Two Factor Theory
  - iv) Evolutionary Theories of Emotion

## 6. Learning & Memory

- a. Definition of Learning and memory
- b. Types of Learning (i. Classical Conditioning ii. Operant Conditioning)
- c. Changing Directions in Study of Conditioning; Observational Learning
- d. Types and process of memory (Encoding, Storage, Retrieval, Forgetting)
- e. In Search of Memory Trace: The Physiology of Memory
- f. Are There Multiple Memory Systems?

## 7. Language & Thinking

- a. The Cognitive Revolution in Psychology
- b. Language: Turning Thoughts into Words
- c. Problem Solving: In Search of Solutions
- d. Decision Making: Choices and Chances

## 8. Personality: Theory, Research and Assessment

- a. The Nature of Personality
- b. Psychodynamic Perspectives
- c. Behavioral Perspectives
- d. Humanistic Perspectives
- e. Biological Perspectives
- f. Contemporary Empirical Approaches to Personality Traits
- g. Culture and Personality

## 9. Nutrition Psychology: Food Choice and Eating Habits

- b. Introduction to food psychology
- c. Theoretical models of food choice
  - i. Why are models important?
  - ii. The Furst model of food choice
  - iii. The influence of factors such as Life course; Influences; Personal systems; Value negotiations; Strategies
- d. Models in health
  - i. Commonly used models in health initiatives
  - ii. 1. Theory of Planned Behavior (TPB)
  - iii. 2. Health Belief Model (HBM)

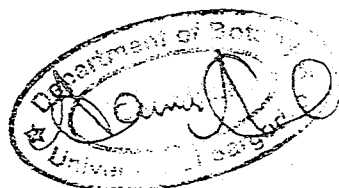




- iv. Other models
- v. Public health strategies
- e. Influence on eating habits and physiology
  - i. Eating as an automatic behavior
  - ii. Inhibition of the desire to overeat
  - iii. The effect of effort on food intake
  - iv. The effect of repetition of food and variety
- f. Eating, personality and motivational states
  - i. Emotional influences on food choice
  - ii. Impulse, inhibition, eating restraint and intake
  - iii. The influence of stress and coping
  - iv. Decision-making styles
  - v. The example of health campaigns
  - vi. Personal factors in weight control
  - vii. The Big 5; Personality and weight
  - viii. Why weight loss efforts falling short
- g. Motivation and weight control
  - i. The relevance of Locus of Control (LOC)
  - ii. Emotional response to experiences by locus of control
  - iii. How to develop an internal locus of control

**Recommended Books:**

- Weiten, W. 2012. Psychology: Themes and Variations (9<sup>th</sup> ed.). Woods worth Ltd.
- Kalat, J.W. 2011. Introduction to Psychology (9th Edition). Wadsworth Cengage learning Publishing inc.
- Atkinson, R. C. and Smith, E. E. 2000. Introduction to Psychology (13th ed.). Harcourt Brace College Publishers.
- Fernald, L.D. and Fernald, P. S. 2005. Introduction to Psychology. USA: WMC Brown Publishers.
- Glassman, W. E. (2000). Approaches to Psychology. Open University Press.
- Odgen, J. (2010). Psychology of eating (2<sup>nd</sup> edition). Blackwell Publishing.



**BOTANY**  
**3<sup>rd</sup>Year**  
**5<sup>th</sup> Semester**

**STAT-412**

**Biostatistics**

**Cr. 3 (2+1)**

**Theory:**

**Cr. 02**

**1. Introduction objectives and scope:**

- |                           |                            |
|---------------------------|----------------------------|
| i. Definition             | ii. Characteristics        |
| iii. Importance and limit | iv. Population and samples |

**2. Measures of central tendencies and dispersion:**

- |                       |                        |                                 |           |
|-----------------------|------------------------|---------------------------------|-----------|
| i. Arithmetic Mean    | ii. Median             | iii. Mode                       | iv. Range |
| v. Variance           | vi. Standard deviation | vii. Standard error of the mean |           |
| viii. Mean deviation. |                        |                                 |           |

**3. Standard distributions:**

- i. Binomial distributions.
- ii. Poisson and normal distributions.

**4. Basic experimental design:**

- |  |                               |
|--|-------------------------------|
| i. Concept and design                                    | ii. Principles of experiments |
| iii. Observational studies                               | iv. Planning of experiments   |
| v. Replication and randomization                         | vi. Field plot technique      |
| vii. Layout and analysis of completely randomized design |                               |
| viii. Randomized complete block design                   | ix. Latin square              |
| x. Factorial design                                      | xi. treatment comparison      |

**5. Tests of significance:**

- i. T-test: (Basic idea, confidence limits of means, significant difference of means.
- ii. Chi square test: Basic idea, testing goodness of fit to a ratio, testing association (contingency table).
- iii. F-test: Introduction and application in analysis of variance.
- iv. LSD test, Duncan's New Multiple Range test (for comparison of individual means). Bonferroni test.

**6. Introduction to comparing of means:**

Unit organization, Basic one way ANOVA, Types of sums of squares, How ANOVA works. The ANOVA Table. Two-way ANOVA-Factorial designs: (two-way factorial analysis, calculating and analysing the two-way ANOVA, Linear combination, multiple comparisons.

**7. Correlation and Regression.**

**Lab outline:**

**Cr.01**

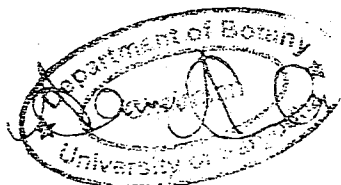
1. Data collection, arrangement of data in frequency table, calculating frequent cumulative frequency and preparation of curve.
2. Calculating different measure of central tendency such as arithmetic means, harmonic mean, geometric mean, median and mode.
3. Calculation of mean from grouped and ungrouped data.



4. Calculation of variance and standard deviation from grouped and ungrouped data.
5. Calculating dispersion, relative dispersion, standard deviation, standard error, standard score and co-efficient variation by hand and machine method.
6. Problems concerning probability, binomial distribution, T-test
7. Chi square test.
8. Analysis of variance - one factor design.
9. Multiple Analyses of Variance.
10. Determination of correlation by constructing different types of graphs such as scatter diagram, linear positive correlation, linear perfect negative correlation, no correlation and curvilinear correlation (second degree polynomial, third degree polynomial).
11. Linear Regression and multiple regression models.
12. MS Excel, MSTAT or relevant statistical software packages.

#### Recommended Books:

1. Harvey, M. 1995. Intuitive Biostatistics. Oxford University Press. NY. Kuzma J. W. and Bohnenblust, S. E. 2001, Basis Statistics for the Health Sciences, McGraw-Hill International Education.
2. Onton, P., Adams S. and Voelkar, D. H. 2001. Cliffnotes for statistics. Blackwell Scientific Publishers.
3. Pacano, M. and Gauvreau, K. 2000. Principles of Biostatistics.
4. Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.
5. Rosner, B. 2005. Fundamentals of Biostatistics. John Wiley & Sons.
6. Samuels, M. L. and Witmar, J. A. 2003. Statistics for life sciences. 3<sup>rd</sup> Edition. Cambridge University Press.
1. Triola, M. F. and Triola, M. M. 2005. Biostatistics for Biological and Health Sciences. Pearson Addison Wesley.
2. Zar, J. H., 1999. Biostatistical Analysis, Pearson Education.



BOT-306

Bacteriology and Virology

Cr. 3 (2+1)

Theory

Cr. 02

**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:**

Cr. 01

**a) Viruses**

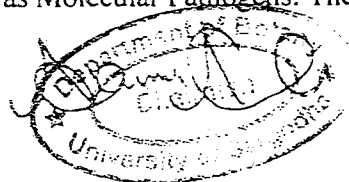
Observation of symptoms of some viral infected plant specimens.

**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. 2002. Plant Viruses as Molecular Pathogens. The Haworth Press,



Inc.

6. Hull R. Matthews, 2004, Plant Virology, Academic Press.
7. Tortora, G. J: Funke, B. R. and Case C. L., 2004, Microbiology. Pearson Education.
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

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BOT- 307

Phycology and Bryology

Cr. 3 (2+1)

Theory:

Cr. 02

**a) Phycology**

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

**b) Bryology:**

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

**Lab Outline:**

Cr. 01

**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 Winston, 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 8<sup>th</sup> 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. B.N.Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Algae. S. Chand & Co.
10. Bellinger, E. G. and D. C. Sigeo. 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.
13. Fida Hussain, Habib Ahmad and Syed Zahir Shah. 2012. The unicellular algae of District Peshawar, Pakistan. Lambert Publication, Germany. Chand & Co. New Delhi.

Journals / Periodicals:

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



**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, 4<sup>th</sup> 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. 4<sup>th</sup> Edn. Prentice Hall Inc., New Jersey, USA.
7. Trigiano, R. N., Windham, M. T. and Windham, A. S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

**Journals / Periodicals:**

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

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BOT-309

Diversity of Vascular Plants

Cr. 3 (2+1)

Theory:

Cr. 02

**a) Pteridophytes**

Introduction, origin, history, features and a generalized life cycle. Methods of fossilization, types of fossils, geological time scale and importance of pale botany. 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, Coniferales and Gnetales. Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms.

**c) 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:**

Cr. 01

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. Pteridophytes. S. Chand & Co. New Delhi
  12. Panday, B. P. 2006. College Botany. Vol.1 & II. S. 7<sup>th</sup> 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

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BOT-310

Plant Systematics

Cr. 3 (2+1)

Course contents

Cr. 02

**1. Introduction:** Importance and relationship with other sciences, Phases of plant taxonomy. Origin and radiation of angiosperm, their probable ancestors, when, where and how did the angiosperms evolve; the earliest fossil records of angiosperms.

**2. Concept of Species:** What is a species? Taxonomic species, Biological species, Micro and macro species, Species aggregate. Infra specific categories.

**3. Speciation:** Mechanism of speciation, Mutation and hybridization Geographical isolation, Reproductive isolation, Gradual and abrupt.

**4. Variation:** Types of variation, Continuous and discontinuous variation, Clinal variation.

**5. Systematics and Genecology / Biosystematics:** Introduction and importance, Methodology of conducting biosystematics studies, Various biosystematics categories such as ecophene, ecotype, ecospecies, coenospecies and comparium.

**6. Taxonomic Evidence:** Importance and types of taxonomic evidences: anatomical, cytological, chemical, molecular, palynological, geographical and embryological.

**7. 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.

**8. 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 Prantle, Bessey, Cronquist, Takhtajan, and Dahlgren).

**9.** Brief introduction of Numerical taxonomy.

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

- |                            |                              |
|----------------------------|------------------------------|
| 1. Apiaceae (Umbelliferae) | 2. Arecaceae (Palmae)        |
| 3. Asclepiadaceae          | 4. Asteraceae (Compositae)   |
| 5. Boraginaceae            | 6. Brassicaceae (Cruciferae) |
| 7. Capparidaceae           | 8. Caryophyllaceae           |
| 9. Chenopodiaceae          | 10. Convolvulaceae           |
| 11. Cucurbitaceae          | 12. Cyperaceae               |
| 13. Euphorbiaceae          | 14. Fabaceae (Leguminosae)   |
| 15. Lamiaceae (Labiatae)   | 16. Liliaceae                |
| 17. Magnoliaceae           | 18. Malvaceae                |
| 19. Myrtaceae              | 20. Orchidaceae              |
| 21. Papaveraceae           | 22. Ranunculaceae            |
| 23. Rosaceae               | 24. Salicaceae               |
| 25. Scrophulariaceae       |                              |

Lab Outline:

Cr. 01

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

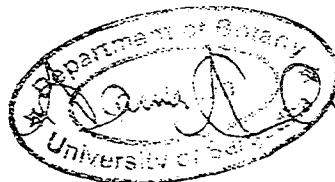
3. Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.



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 -to date. Flora of Pakistan. Karachi Univ. Press, Karachi.
  3. Greuter, W., McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Filguerras, T. S., Nilsson, D. H. Silva, P. C., Skog, J. E., Treharne, 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 Systematic. 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. Sivarajan, V. V and N. K. PeRobson 1991 Introduction to the Principles of Plant Taxonomy.
  15. Radford, A. E., W. C. Dickison, J. R. Massey, and C. R. Beil. 1998 Vascular Plant Systematic. Harper and Row, New York.
  16. Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.
  17. Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.
  18. Heywood V. H. 1978. Flowering Plants of the World. Oxford University Press.
  19. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press.
  20. Soltis, D. E. P. S. Soltis, P. K Endress, and M. W. Chase. 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.
  21. Pullaiah, T. 2007 Taxonomy of Angiosperms 3<sup>rd</sup> Ed. Regency Publication, New Delhi
- Journals / Periodicals:  
Pakistan Journal Botany, Flora of Pakistan, Taxon, Botanical Journal of the Linnaean Society



**BOTANY**  
3<sup>rd</sup>Year  
6<sup>th</sup>Semester

**BOT-311**  
**Theory**

**Plant Anatomy**

Cr. 3 (2+1)  
Cr. 02

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:**

Cr. 01

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.

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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 Eichhorn, E. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
12. Eames, A. J. and Mac Daniels, L. H. 2002. An introduction to Plant Anatomy. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Journals / Periodicals:

Pakistan Journal of Botany

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**BOT-312**  
Theory

**Genetics-I**

**Cr. 3 (2+1)**  
**Cr. 02**

- 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 meiosis, 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 Structure of DNA:** DNA: The genetic material, DNA replication in eukaryotes, DNA and the gene.
- 6. The Nature of the Gene:** How genes work, gene-protein relationships, genetic observations explained by enzyme structure, genetic fine structure, mutational sites, complementation.
- 8. DNA Function:** Transcription, translation, the genetic code, protein synthesis, universality of genetic information transfer, eukaryotic RNA.
- 9. 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.
- 10. Developmental Genetics:** Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.
- 11. Population Genetics:** Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

**Lab Outline:**

**Cr. 01**

**a) Arrangement of genetic material:**

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

**b) Population Genetics:**

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

**2. Blood group and Rh-factor**

**3. Drosophila**

- i. Culture technique
- ii. Salivary gland chromosome

**4. Fungal Genetics:**

Saccharomyces culture techniques and study.



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

### 6. Bacterial Genetics.

i Bacterial cultural techniques, Gram staining (E. coli, B. subtilis)

ii. Transformation.

iii. Conjugation.

#### Recommended Books:

1. Gelvin, S, B.2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
  2. Pierca, B. A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
  3. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D. C.
  4. Klug, W. S. and Cummings, M. R. 1997. Concepts of Genetics, Prentice Hall International Inc.
  5. Roth Well, N. V. 1997. Understanding Genetics, 2<sup>nd</sup> 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, 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-313

Plant Biochemistry -I

Cr. 3 (2+1)

**Course Outline:**

Cr. 02

Introduction to photosynthetic organisms, Bioenergetics and overview of photosynthesis, Photosynthesis: The Light Reaction Photosystems, ATP Synthesis, CO<sub>2</sub> 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. Electrochemical 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 defence 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.

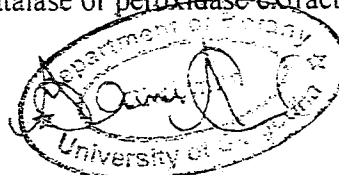
**Introduction to Enzymes:**

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. Isoprenoid metabolism, Biosynthetic pathways, Monoterpenes, sesquiterpenes, phytosterols, diterpenes, Enzymes with multiple functions -mechanisms and evolution.

**Lab Outline:**

Cr. 01

1. Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
2. To determine the R<sub>f</sub> 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<sub>f</sub> value of amino acids on a paper chromatogram.
10. Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.
11. To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant





source.

12. To determine the PKa and isoelectric point of an amino acid.

**Recommended Books:**

1. Conn E. E. and Stumpf P. K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Lehninger, A. L. 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. 3<sup>rd</sup> Edition, Academic Press, U. K.
13. Bowsher, C. 2008. Plant Biochemistry.
14. Campbell, M. K. and F. Shawn. 2008. Biochemistry 6<sup>th</sup> Edition.

Journals / Periodicals:

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



BOT-314

Plant Ecology-I

Cr. 3 (2+1)

Theory:

Cr. 02

**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.

**3. Light and temperature:** Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,

**4. Carbon dioxide:** Stomatal responses, water loss and CO<sub>2</sub>-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO<sub>2</sub> concentration. Functional significance of different pathways of CO<sub>2</sub> fixation. Productivity: response of photosynthesis to environmental factors, C and N balance.

**5. Water:** Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants. Water status in soil, Water and stomatal regulation, Transpiration of leaves and canopies.

**6. Oxygen deficiency:** Energy metabolism of plants under oxygen deficiency, Morph-anatomical changes during oxygen deficiency, Post-anoxic stress

**7. Wind as an ecological factor.**

**8. Fire as an ecological factor.**

**9. Carbon credit**

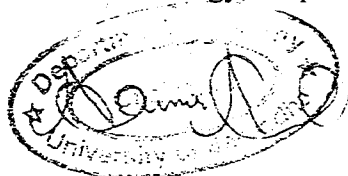
**Lab Outline:**

Cr. 01

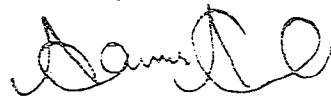
1. Determination of physico-chemical properties of soil and water.
2. Measurements of light and temperature under different ecological conditions.
3. Measurements of wind velocity.
4. Measurement of CO<sub>2</sub> and O<sub>2</sub> concentration of air and water.
5. Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.
6. Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem pressure potential, leaf area and rate of CO<sub>2</sub> 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-315

Plant Physiology-I

Cr. 3 (2+1)

Theory:

Cr. 02

**1. Photosynthesis:** History of photosynthesis. Nature and units of light. Determination of oxygenic and anoxygenic photosynthesis. Various pigments and photosynthetic activity. Ultra structure and composition of photo system-I and II. Absorption and action spectra of different pigments. Mechanism of photosynthesis - light absorption, charge separation or oxidation of water (water oxidizing clock), electron and proton transport through thylakoid protein-pigment complexes.

Photophosphorylation and its mechanism. CO<sub>2</sub> reduction (dark reactions) - C<sub>3</sub> pathway and Photorespiration, Regulation of C<sub>3</sub> pathway, C<sub>4</sub> pathway and its different forms, C<sub>3</sub>-C<sub>4</sub> intermediates, CAM pathway.

**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.

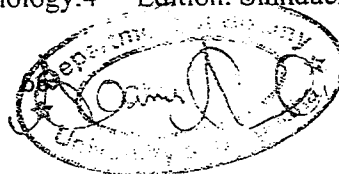
Lab Outline:

Cr. 01

1. To determine the volume of CO<sub>2</sub> evolved during respiration by plant material.
2. To determine the amount of O<sub>2</sub> used by respiring water plant by Winkler Method.
3. Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.
4. To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties.
5. To categorize C<sub>3</sub> and C<sub>4</sub> 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. 2<sup>nd</sup> 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. 3<sup>rd</sup> 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. 5<sup>th</sup> Edition. Wadsworth Publishing Co. Belmont CA.
10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4<sup>th</sup> Edition. Sinauer's Publ. Co. Inc. Calif.

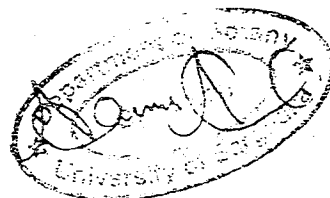


11. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2<sup>nd</sup> Ed. John Wiley and Sons. New York.
12. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2<sup>nd</sup> Edition. Sinauer Associates, California, USA.
13. Kirkham, M.B. 2004. Principles of 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

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BOT-316

Cell Biology

Cr. 3 (2+1)

**Course contents**

Cr. 02

Introduction of prokaryotes and eukaryote cell, Animal and Plant cell structure.  
 Brief description of ultra-structure and functions of plant cell organelles Endomembranous systems.  
 Cell cycle and cell division; meiosis in sexual reproduction in plants.  
 Cellular metabolism and enzymes.  
 Cellular respiration and photosynthesis.  
 Biological information flow; transcription and translation.  
 Informational molecules; carbohydrates proteins and nucleic acids.  
 Cytoskeleton in cell cycle and mitosis.  
 Extra cellular matrix; various types of extra cellular matrix proteins; elastic fibronectin, glycoprotein, collagen, dyanin and motor proteins.  
 Vesicular trafficking, cell migration, cell adhesion, cancer growth factors, disorders in cell cycle, apoptosis and gap junction.

**Lab Outline;**

Cr. 01

1. Study of mitosis and meiosis in onion root tip and pollen grains
2. Study of cell organelles in plant cell by compound microscope
3. Measurement of cell size
4. Separation of different sized DNA fragments on agarose gel.
5. Study of chromosomes morphology and variation in chromosomes number.
6. Counting of prokaryotic cells (bacteria) and blood cells by using haemocytometer.
7. Extraction and estimation of carbohydrates, proteins and DNA from plant sources.

**Books Recommended**

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. MOLECULAR BIOLOGY OF THE CELL, 1989. Garland Publishing Inc., New York.
2. Damell Jr. J., Lodisch, H. And Balimore, D. Molecular Cell Biology, 1990. Scientific American Inc. N.Y.
3. De Robertis, E. D. P. And De Robertis Jr. E. N. F. Cell and Molecular Biology, 1987. Lea &Febiger, New York.
4. Karp, J. Cell and Molecular Biology, Concepts and experiments, 2005. Jhon Wiley And Sons, Inc.
5. Geoffrey M.C., Robert E.H. The Cell: A Molecular Approach, 2007. Sinauer Associates, Inc.
6. Bruce Albert et al. 2009. Essential cell biology. Garland Sciences Publishers
7. Lodish. H. 2001. Molecular Cell Biology. W. H. Freeman



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**BOTANY**  
**4<sup>th</sup> YEAR**  
**7<sup>th</sup> Semester**

**BOT-417**

**Molecular Biology**

**Cr. 3 (2+1)**

**Theory:**

**Cr. 02**

1. **Nucleic Acids:** DNA-circular and super helical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA, Central Dogma
2. **Proteins:** Basic features of protein molecules. Folding of polypeptide chain,  $\alpha$ -helical and  $\beta$ -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 Genomics:** Transcriptomics; DNA libraries, their construction, and 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:**

**Cr. 01**

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. 5<sup>th</sup> Edition. WH Freeman & Co., New York.
5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4<sup>th</sup> 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. 5<sup>th</sup> Edition. Garland and Sons.
12. M. Madan Babu. 2013. Bacterial gene regulations and transcription network. Caister Publishers. Academic Publishers.



BOT-418

Plant Biochemistry-II

Cr. 3 (2+1)

Cr. 02

Theory:

**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:**

Cr. 01

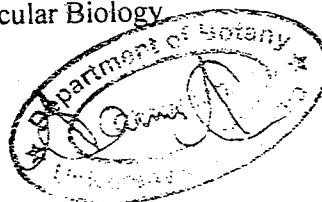
1. Separation of soluble proteins by polyacrylamide gel (PAGE) electrophoresis.
2. Separation of nucleic acids by gel electrophoresis.
3. To estimate the amount of vitamin C in a plant organ (orange, apple juice).
4. To determine potential alkaloids in plants.
5. To estimate terpenoids in plants.

**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., Philip. H and Abraham. W. 1983. Principles of Biochemistry, (General Aspects). 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. 4<sup>th</sup> Edition. Sinauer's 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. 3<sup>rd</sup> Edition, Academic Press, U. K.
14. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6<sup>th</sup> Edition.

Journals / Periodicals:

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





BOT-419

Plant Ecology-II

Cr.3(2+1)

Theory:

Cr. 02

**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:**

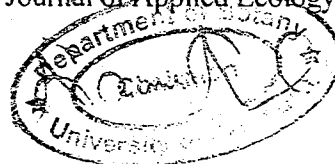
Cr. 01

1. Determination of seed bank in various populations.
2. Seed dispersal pattern of local populations.
3. Demography and life history of local annual population.
4. Study of community attributes. Sampling of vegetation including Quadrate, plotless, transect and Braun-Blanquet.
5. Field trip to study different communities located in different ecological regions of Pakistan.
6. Slide show of the vegetation of Pakistan.
7. Slide show of the major formations of the world.
8. Soil physical and chemical properties
9. Correlation of soil properties with vegetation type

**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.S. 1992. Pakistan Manual of plant Ecology. Islamabad, Pakistan: National Book Foundation.
10. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad.
11. Lambers, H., Chapin F. S. and Pons, T. L. 2008. Plant Physiological Ecology, Springer-Verlag New York.
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

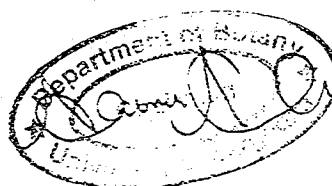


Research Methods ( planning research, various methods, analysing results, giving reports etc) research process including: formulating research questions; sampling ( probability and no probability); measurements ( surveys, scaling, qualitative, unobtrusive); research design ( experimental and quasi-experimental) 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

#### BOOKS RECOMMENDED

1. Shank, G.D. 2002. Qualitative research: a personal skills approach. Upper Saddle River, N.J. Clumus, 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.
4. Paul Leedy, 2004. Practical Research: Planning and Design (8<sup>th</sup> Edition) Jeans Ellis Ormrod.

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**BOTANY**  
**4<sup>th</sup> YEAR**  
**8<sup>th</sup> Semester**

**BOT-421**  
**Theory:**

**Plant Physiology-II**

**Cr. 3 (2+1)**  
**Cr. 02**

**1. Plant Growth Regulators:** Major natural hormones and their synthetic Analogues. Bioassay, structure, biosynthesis, receptors, signal transduction and mode of action, transport, physiological effects of Auxin, 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. Hoflerdiagram - 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 energetic. Essential and beneficial elements-their functions and deficiency symptoms in plants. Fertilizers and their significance in Agriculture.

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

**5. Control of Flowering:** Autonomous versus environmental regulation. Circadian rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering. Biochemical signalling 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.**

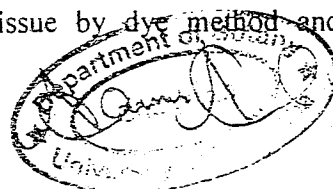
**7. Dormancy;** definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process of seed germination.

**8. Plant Movements;** Tropic movement-phototropism, gravitropism and their mechanism. Nastic movements.

**Lab Outline:**

**Cr. 01**

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

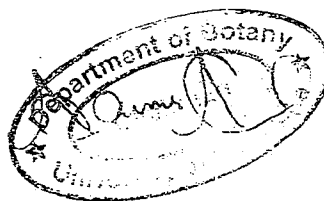


apparatus.

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. 2<sup>nd</sup> 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. 3<sup>rd</sup> 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. 2010. Plant Physiology. 5<sup>th</sup> Edition. Wadsworth Publishing Co. Belmont CA.
  9. Hopkins, W. B. 1999. Introduction to Plant Physiology. 2<sup>nd</sup> Ed. John Wiley and Sons. New York.
  10. Epstein, E. and Bloom, A. J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2<sup>nd</sup> 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. 4<sup>th</sup> Edition. Sinauer's 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-422

Genetics-II

Cr. 3 (2+1)

Theory:

Cr. 02

**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.

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

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

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

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

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

**10. Bioethics:** Moral, Religious and ethical concerns

#### Lab Outline:

Cr. 01

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

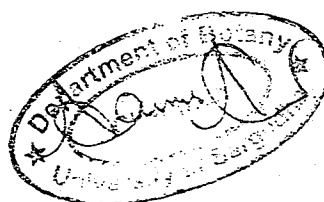
iv. Protein.

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 (6<sup>th</sup> 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, William M and 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-423

Environmental Biology

Cr. 3 (2+1)

Cr. 02

Theory:

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, and remediation. Photochemical smog. Smog. Acid rain: Theory of acid rain, ii. 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. **Environment 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).

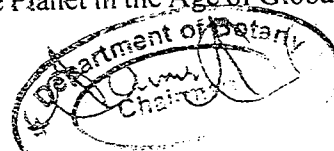
Lab Outline:

Cr. 01

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

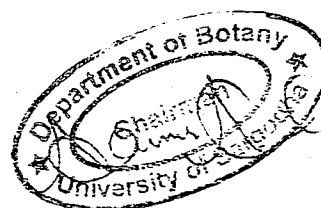
Recommended Books:

1. Newman, E. I. 2001. Applied Ecology. Blackwell Science. UK
2. Mooney, H. A. and Saugier, B. 2000. Terrestrial Global Productivity. Academic Press, UK.
3. Eugene, E. D. and Smith, B. F. 2000. Environmental Science: A study of interrelation ships.
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. Ashfaq, M., Mushtaq, A. and Saleem, M. A. 2004. Environmental Pollution and Agriculture. B.Z Press, Multan, Pakistan.
  11. Wang, L. K., Pereira N. C. and Hung, Y. T. 2005. Advanced Air and Noise Pollution Control, Humana Press,
  12. Schnelle, K. B. and Brown, C. A. 2002. Air Pollution Control Technology Handbook, CRC Press, Lambert Publishers Germany.
  13. Cheremisin, N. P., 2003. Handbook of Solid Waste Management and Waste Minimization Technologies, off, Butterworth-Heinemann.
- Journals/Periodicals: Environmental Biology, Environment, Bioremediation.

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## Optional Courses

**BOT-424**

**Plant Water Relations**

**Cr. 3 (2+1)**

**Theory:**

**Cr.02**

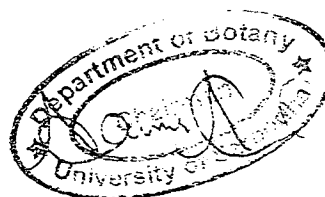
Plant water relations: The soil-plant-atmosphere continuum - an overview. Structure of water. Physico-chemical properties of water, water in the soil, water potential, osmotic potential and pressure potential - their relationships. Water in cell components. Absorption of water in plants (pathways and 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 Stomatal physiology. transpiration flux. antitranspirants.

Source-sink relationships in translocation of solutes Mineral nutrition: Hydroponics prospects and problems, nutrient solutions, chelating agents. Mineral ion uptake -passive and active uptake and transport, Nernst equation. Donnan's potential, role of H<sup>+</sup> ATP ase as a carrier, co transport.

**Practicals:**

**Cr. 01**

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 potometer/cobalt chloride paper method.
6. To regulate stomatal opening by light of different colors and pH.



BOT-425

Plant Micro Techniques

Cr. 3(2+1)

**Theory:**

Cr.02

Light microscopy –optical principle, resolution, magnification, aberration. Phase contrast microscopy Dark field illumination. Electron microscope (TEM &SEM) Principle and preparation techniques. Special techniques Maceration, Squashes, Smears, Whole mount and clearing techniques.

Micro technique steps Fixation and fixatives, dehydration, clearing, infiltration, embedding, block making and sectioning. Microtome's types Principles and operating mechanisms, Stains and staining techniques, Camera Lucida – types, Principles and their uses. Micrometry

**Practicals:**

Cr.01

1. Preparation of hand sections, maceration and clearing
2. Temporary and permanent mounting of whole specimens and Sections using different types of mountants.
3. Calibration of microscope and micrometry
4. Microtomy and microtome sectioning
5. Examination of different cell and tissue types with help of techniques
6. Study of structure of (primary and or secondary) leaf, root, stem and floral parts (including fruit).
7. Examination of vascular cambium and study of its activity.
8. Examination of Structural and identification of Wood of some common trees such as *Dalbergia sissoo* . *Acacia arabica* etc

**Recommended Books:**

1. Cutter, E.G. 1970. Plant Anatomy: Experimental and Interpretation. Edward Arnold Pub.Ltd., London.
2. Cutter, E.G. 1971. Plant Anatomy, Edward Arnold Pub. Ltd., London.
3. Cutter, E.G. 1978. Plant Anatomy, Experimental and Interpretation. Edward Arnold Pub. Ltd., London
4. Esau, K. 1960. Plant Anatomy, Wiley Eastern Private Ltd., New Delhi.
5. Esau, K.1977. Anatomy of Seed Plants. Wiley Eastern Publication, New Delhi.



BOT-426

## Plant Seed Physiology

Cr. 3 (2+1)

Cr. 02

**Theory**

Physiology of seed development and maturation; chemical composition, synthesis and accumulation of seed reserves, induction of desiccation tolerance, hormonal regulation of seed development.

Seed germination; Types of germination, factors affecting germination; role of embryonic axis; growth hormones and enzyme activities, effect of age, size and position of seed on germination. Physiological processes during seed germination; seed respiration, breakdown of stored reserves in seeds, mobilization and interconversion pathways. Seed dormancy- types, significance, mechanism, endogenous and exogenous factors regulating dormancy, role of phytochrome and PGR, genetic control of dormancy.

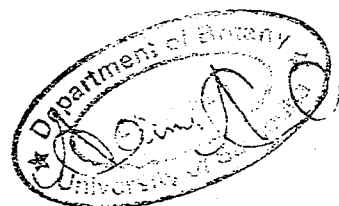
Seed viability and longevity, pre-and post-harvest factors affecting seed viability; seed ageing: physiology of seed deterioration; lipid peroxidation and other viability theories; means to prolong seed viability; mechanism of desiccation sensitivity and recalcitrance with respect to seed longevity.

Seed vigour and its concept, vigour test methods, factors affecting seed vigor, physiological basis of seed vigour in relation to crop performance and yield. Seed, invigoration and its physiological and molecular control.

Cr.01

**Practicals:**

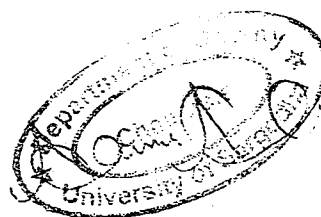
1. Proximate analysis of chemical composition of seed;
2. Different types of seed germination and evaluation,
3. Methods for breaking seed dormancy
4. Seed vigour test
5. Accelerated aging test
6. Priming and invigoration treatment for improving germination and vigor



**Books Recommended:**

1. Agrawal, P.K and Dadlani, M. (Eds.). 1992. Techniques in Seed Science and Technology. South Asian Publ.
2. Baskin, C.C. and Baskin, J.M. 1998. Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination. Academic, Press.
3. Basra, A. S. 2006. Handbook of Seed Science and Technology. Food Product Press.
4. Bench, A. L. R. and Sanchez, R. A. 2004. Handbook of Seed Physiology. Food Product Press.
5. Bewley, J. D. and Black, M. 1982. Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I. II. Springer Verlag.
6. Bewley, J.D and Black, M. 1985. Seed: Physiology of Seed Development and Germination. Plenum, Press.
7. Copeland, L.O. and Mc Donald. M. B. 1995. Principles of Seed Science and Technology. 3<sup>rd</sup> Ed. Chapman and Hall.
8. Khan, A. A. 1977. Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Co.
9. Murray, D. R. 1984. Seed Physiology. Vols. I, II. Academic Press.
10. Sadasivam, S. and Manickam, A. 1996. Biochemical Methods. 2nd Ed. New Age.

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**BOT-427****Palynology****Cr. 3(2+1)****Theory:****Cr.02**

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

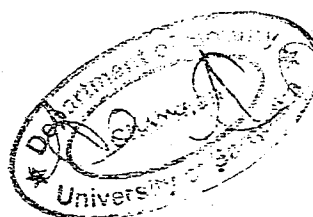
Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores; Morphology and functional significance of spores and pollen, Palynomorphs of the Paleozoic, Palynomorphs of the Mesozoic, Mega and microspores, Gymnosperm pollen-major types through time. diagnostic features of angiosperm pollen, and the early fossil record, Anita group and Magnolid pollen, Monocot pollen, Lower Eudicot pollen types. Selected Rosid pollen types, Selected Asterid pollen types. Applications: forensics, honey, paleo environment, Case histories. Fagales, Geometrically bizarre and fun pollen types.

**Practicals:****Cr. 01**

1. Microscopic Study of Spores and Pollen. Herbarium sheets.
2. Acetolysis.
3. Slide preparation, temporary and permanent slides of Spores and Pollen
4. Photomicrography, HF Safety Training, Maceration and Dissolution. Gravity Separation. Counting Techniques.

**Recommended Books:**

1. Agashe, S. N. 1997. Aerobiology. Oxford and IBH Publishing Company, Pvt. Ltd. New Delhi.
2. Agashe, S. N. 2006. Palynology and its Applications. Oxford and IBH Publication Company, Pvt. Ltd. New Delhi.
3. Agashe, S. N. and E. Caulton. 2009. Pollen and Spores. Applications with Special Emphasis on Aerobiology and Allergy. Science Publisher New Hampshire, USA. Netherlands.
4. Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy of Angiosperms. Almquist and Wiksell, Stockholm.
5. Ogden, E. C. and Rayner, G. S. 1974 Manual for sampling Airborne Pollen. Hafner Press, Macmillan Publishing Co. Inc, New York.
6. Moore, P.D., Webb, J. A. and Collinson, M. E. 1991. Pollen Analysis. Blackwell Scientific Publications, Boston.

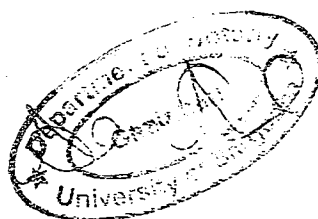


**BOT-428****Plant Tissue Culture****Cr. 3 (2+1)****Theory:****Cr.02**

- 1) Plant Tissue Culture-An Introduction
- 2) Cellular Totipotency, differentiation and de-differentiation
- 3) Selection of a suitable explant material in different plant groups
- 4) Initiation and maintenance of callus cultures
- 5) Organogenesis
- 6) Somatic embryogenesis
- 7) Micropropagation
- 8) Role of Somaclonal variation in crop improvement
- 9) Cell suspension cultures
- 10) Isolation, purification and culture of plant protoplasts
- 11) Role of plant protoplasts in crop improvement
- 12) Production of pathogen-free plants using tissue culture techniques.

**Practicals:****Cr. 01**

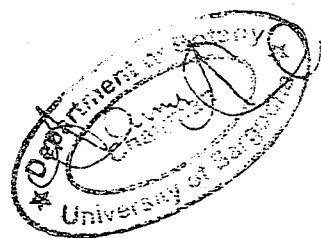
- 1) An introduction to a Plant Tissue Culture lab.
- 2) Laboratory facilities and their use.
- 3) Aseptic techniques.
- 4) Preparation and use of Stock solutions.
- 5) Media composition and preparation protocols.
- 6) Preparation of selected media, pouring and sterilization.
- 7) Procurement, preparation and sterilization of explants.
- 8) Initiation and maintenance of callus cultures and regeneration studies in selected species.
- 9) Culture initiation and maintenance for Micropropagation of selected species.



**Books Recommended (Latest Edition):**

1. John, H. Dodds and Lorin, W. Roberts. Experiments in Plant Tissue Culture. Third Edition. Cambridge University Press, New York. USA.
2. Bhojwani, S. S. and Razdan, M. K. Plant Tissue Culture: Theory and Practice. Developments in Crop Sciences. Elsevier, New York. USA.
3. Dixon, R. A. and Gonzales, F. A. (Eds). Plant Cell Cultures. A Practical Approach. Oxford University Press, Oxford. New York.
4. Kumar, U. Methods in Plant Tissue Culture. Agro Botanica Publishers, Vyas Nagar. Bikaner.

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**BOT-429****Plant Biotechnology****Cr. 3(2+1)****Theory:****Cr.02**

Biotechnology: Definition and history – scope and significance – principles and applications of genetic recombinant technology in medicine, agriculture, veterinary and food industry – Production of biotechnological products – food SCP (algae, yeast, mushroom) – Biofertilizers – Biofuel – Biopesticides – Biogas production – waste and sewage management – effective microorganisms – Enzyme biotechnology – sources and production of commercially important enzymes cellulase, amylase, pectinases, proteinases. Immobilization of enzymes and its applications.

Amplification of genes by PCR. cDNA and construction of cDNA libraries. Blotting techniques (Southern, northern and western blotting) non radioactive probe DNA diagnostics (RFLP, AFLP and RAPD). DNA sequencing.

Recombinant DNA technology - gene transfer in plants. Vectors – types, plasmids (PBR 322, PBR 327). Phage – 1. 113. cosmid insertion vectors, replacement vectors, shuttle vectors and high expression vectors.

Strategies for development of transgenic plants specific and non-specific methods of gene transfer - organization of Ti plasmid in *Agrobacterium tumefaciens* - Ti plasmid mediated gene transfer. DNA transfer by particle bombardment, micro and macro injection methods - lipofection - electroporation.

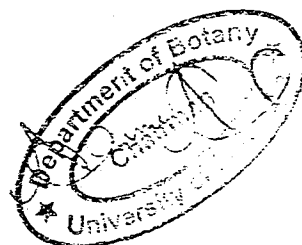
Gene cloning in *E.coli*. Isolation of DNA – insertion of DNA – use of linkers and adapters – Transformation – uptake of DNA by host cell – selection of clones. Identification of recombinants. Insertional inactivation.

Plant tissue culture - concept of totipotency - organization of tissue culture laboratory.

Sterilization methods - callus induction, subculture and maintenance. Organogenesis - anther culture and production of haploids - somatic embryogenesis - isolation, culture and fusion of protoplasts - cybrids - micro-propagation – encapsulated seeds.

**Practicals:****Cr. 01**

1. Extraction and estimation of plant DNA.
2. Basic biotechnology techniques
3. Preparation of different types of standard tissue culture media.

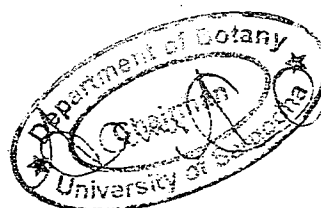




4. Establishment of aseptic cultures following appropriate sterilization procedures using seeds.
5. Preparation of culture medium (MS, N&N, SH, B5), sterilization and inoculation.
6. Demonstration of Agarose gel electrophoresis.
7. Encapsulation of seeds/embryos in calcium alginate.
8. Visits of Biotechnology labs at NIBGI, Faisalabad, AARI, Faisalabad and School of Biological Sciences Lahore, Center of Excellence in Molecular Biology, Lahore: National institute for Genomics and Advance Biotechnology (NIGAB)

#### Recommended Books:

1. Pelczar Jr. M.J. Chan E.C.S. and Kreig N.R. 2001 Microbiology – McGraw Hill Inc. New York.
2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R. 1999. General Microbiology – Macmillan Education Ltd. London.
3. Biotechnology Fundamentals and Applications – Purohit Mathur.
4. Gene Cloning and Introduction – T.A. Brown.
5. Higgins I.J., Best G.J., and Jones J. 1996. Biotechnology – Principles and Applications, Blackwell Scientific Publications. Oxford. London.
6. Gupta P.K. Elements of Biotechnology 2001. Rastogi Publications, Meerut.
7. Subra Rao, N. S., Balagopalan. C. and Ramai Crishma. S. V. 1992. New Trends in Biotechnology. Oxford & IBH Publishing Co. UK.
8. Bloom. M. V., Freyer. G.A. and Micklos. D.A. 1996. Laboratory DNA Science .The Benjamin/ Cumming Publishing Co.
9. Freifelder. D. 1995. Essentials of Molecular Biology. Jones and Bartlet Publishers, UK.
10. Hacket. P. B., Fuchs, J. A. and Messing, J.W. 1988. An Introduction to Recombinant Technologies. The Benjamin/ Cumming Publishing Co.



BOT-430

Advanced Environmental Biology

Cr. 3(2+1)

Theory:

Cr. 02

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, and remediation. Photochemical smog. Smog.
  - ii. Acid rain
    - a) Theory of acid rain
    - b) 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. and 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).**



13. **Physical conditions and availability of resources:** Introduction, environment conditions, effect of condition, animal responses, microorganisms, plant resources and animal resources.

14. **Applied issues in conservation:** Sustainability, forming of monoculture and pest control.

15. **Role of natural resources in conservation:** Types of resources (renewable and non-renewable), wild life management, species conservation, conservation of habitat, introduction of exotic species, natural parks, forest resources, soil and water resources, food and agriculture resources.

**Practicals:**

**Cr. 01**

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.
5. Visits to disturbed ecosystems
6. Survey of different important species for conservation.
7. Visits to different sanctuaries.

**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.
4. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. 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 University 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., Pons, T. L. and Stuart, F. 2008. Plant Physiological Ecology.
  10. Ashfaq, M., Mushtaq, A. and Saleem, M. A. 2004. Environmental Pollution and Agriculture..B.Z. Press, Multan, Pakistan.
  11. Wang, L. K., Pereira, N. C. and Hung, Y. T. 2005. Advanced Air and Noise Pollution Control, Humana Press,
  12. Schnelle, K. B. and Brown, C. A. 2002. Air Pollution Control Technology Handbook, CRC Press, Lambert Publishers Germany.
  13. Cheremisin N. P. 2003. Handbook of Solid Waste Management and Waste Minimization Technologies. off. Butterworth-Heinemann.
  14. Mahajan, S. P. 1985. Pollution Control in Process Industries, Tata McGraw-Hill.
  15. Sell, N. J., Nostr, V. and Reinhold, 1992. Industrial Pollution control: issues and techniques.
  16. Thakur, I. S. 2006. Environmental Biotechnology: Basic Concepts and Applications. International Publishing House Pvt. Limited.
  17. Vandermeer, and John, H. 2011. The ecology of agro-ecosystems Jones and Bartlett Publishers: Sudbury, Mass: - xv, pp: 387.
  18. Greipsson, and Sigurdur, 2011. Restoration ecology - Jones and Bartlett Publishers.
  19. Santra, S. C. 2010. Fundamentals of ecology and environmental biology –New Central Book Agency: London.
  20. Singh, M.P. 2007 Forest environment and biodiversity Daya; New Delhi.



BOT-431

Plant Conservation Management

Cr. 3(2+1)

Theory:

Cr. 02

**1- Plant Conservation;**

Introduction, Philosophy; Origin, Scope, objectives. Definitions

**2- Understanding of Conservation:**

Biodiversity (types). Species (number). Advantages of Conservation (Food, drugs and medicine

**3- Extinction of Plant Species:**

Natural causes of Extinction, Anthropogenic (man-made) extinction, habitat destruction, Invasive species. Pollution, over harvesting, commercial products and life specimen, introduced species, predator and pest control, threats to species, over exploitation, introduced species, genetic problems in small population, risks reviews and dynamics of small population

**4-Threats to Communities:**

Chains of extinctions, emergence of new species from old. Functional integrity in relation to fragment size

**5-Conservation in Practice:**

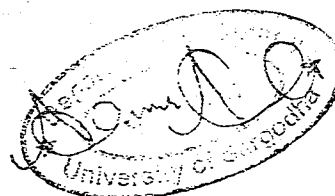
Endangered species management and biodiversity protection, categorization of plant species, endangered species law. Bunting and fishing laws, the endangered species act, recovery plans, captive breeding and management plans. types of conservation (Ex-situ conservation). protected areas, conservation towards restoration of ecology, healthy approach to save biodiversity, saving rare species in the wild, habitat protection, private land and land critical habitat. Reauthorizing the endangered species.

**6-Conservation Techniques:**

Parks and natural preserves, trouble in our parks and management. New parks establishment. Wildlife in parks, wilderness areas, wildlife refuges, refuge management, world conservation strategy.

**7-Conservation and Economic Development:**

Indigenous communities and biosphere reserves. International wildlife preserves. transboundary peace parks, preserving functional ecosystem and landscapes, landscape dynamics, size and design of nature preserves, wetland conservation.

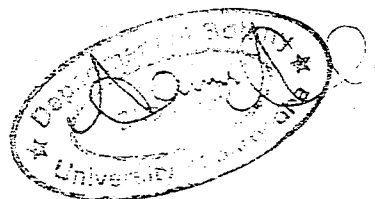


**Practicals:****Cr. 01**

- 1- Visit to botanical garden. Governor House, Lahore
- 2- Visit to Bagh-e-Jinnah Lahore
- 3- Visit to Soon Valley, Pakistan
- 4- Visit to Botanical Garden, University of Agriculture. Faisalabad

**Recommended Books:**

- 1-Cunningham W.P., Cunningham, M., and Saigo, B.W. 2005. Environmental Science. McGraw Hill. New York.
- 2- Singh. S. K .2005. Plant Ecology. Campus Books International. New Delhi.
- 3- Townsend. C. R., Begon. & I. L Harper, 2003, Essentials of Ecology, Blackwell publishing company, Oxford, UK.
- 4- Odum. E. P.2001. Fundamentals of Ecology, W.B Saunders Company, London. Toronto.
- 5- Shukla. R. S. and Chandel. P. S. 2006. A Text Book of Plant Ecology. S. Chand and Company Ltd. New Delhi. India



BOT-432

Conservation Genetics

Cr. 3 (2+1)

**Theory:**

Cr.02

Introduction to Plant conservation genetics, Scope of conservation genetics, Values of biodiversity and loss of biodiversity, Hardy-Weinberg Principle, Genetic Drift, Effective Population Size, Population subdivision, Quantitative Genetics, Molecular Phylogenetics, Genetic Tools for Conservation, Genetic markers, Inbreeding Coefficients, Conservation Issue, Metapopulation and Fragmentation, Evolutionary Significant Units, Conservation Breeding.

Types of conservation: Forest conservation, Wild plant conservation, Invasive species study and control, Medicinal plant conservation,

Conservation methods/techniques/management. Natural and human-caused factors that cause plant species to be rare or imperiled, and the genetic and ecological implications of rarity in plant species, conservation strategy for a rare or imperiled plant species, and applications of ecological and population genetics principles to evaluate the long-term viability of such a plant species with and without conservation measures.

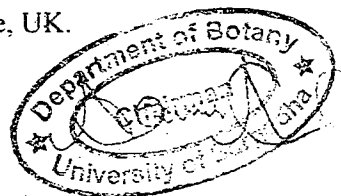
**Practicals:**

Cr. 01

1. Extraction of DNA from plant material by using CTAB method.
2. Molecular markers: SSR, Intron-polymorphisms, CAPS, AFLP, RAPD etc.
3. Analysis of morphological and molecular diversity in different cultivars/varieties of a crop plant.
4. QTL mapping (Theoretical using available data)
5. Field trips to the location of rare or threatened plant populations.

**Books Recommended**

1. Heywood, V. H. and Iriondo, J. M. 2003. Plant conservation: old problems, new perspectives. *Biological Conservation*, 113 (3):321-335.
2. Krupnick, G. A. and Kress. 2005. Plant conservation: a natural history approach. Chicago: University of Chicago Press
3. Soulé, M. 1985. What is Conservation Biology? *Bioscience*. 35:727-734.
3. Falk, Donald, A., and Kent. E. Holsinger. eds. 1991. Genetics and Conservation of Rare Plants. Oxford, United Kingdom: Oxford University Press.
4. Falk, Donald A., Constance, L., Millar and Margaret Olwell, eds. 1996. Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Washington, D.C. Island Press.
5. Guerrant., Edward, O., Kayri, H. and Mike, M. 2004. Ex Situ Plant Conservation: Supporting Species Survival in the Wild. Washington, D.C. Island. Press.
6. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge, UK.



BOT-433

Basic Ecological Genetics

Cr. 3(2+1)

**Theory**

Cr. 02

## Ecological genetics

What is ecological genetics? Why study ecological genetics.

## 2 Markers and sampling in ecological genetics

Introduction, Methods of data generation, Principles of sampling within and among population.

## 3. Genetic diversity and differentiation.

Introduction, factors influencing diversity and differentiation, The Hardy Weinberg Equilibrium, genetic diversity, genetic differentiation, genetic distance, statistical approaches, use of genetic diversity statistics.

## 4. Gene flow and mating system.

Introduction, Factors governing gene flow. Considerations for measuring gene flow, measuring gene flow -indirect estimates, measuring gene flow -direct estimates, The importance of biological and environmental factors on gene flow.

## 5. Intraspecific phylogenies and phylogeography.

Introduction, Homology, gene trees and species trees, Tree form and building, Tree interpretation, Organelles versus nuclear intraspecific phylogenies.

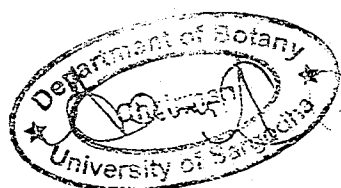
## 6. Speciation and hybridization.

Introduction, Species, Speciation, Hybridization. Analysis of speciation and hybridization

**Practicals:**

Cr. 01

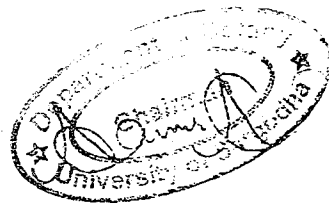
1. Extraction of DNA from plant material.
2. Separation of DNA by gel electrophoreses.
3. Gene amplification through PCR
4. Graphical representation of speciation and hybridization data by UPGMA
5. DNA sequencing.





### Recommended Books.

1. Avise, J.C. 2000. Phylogeography. The history and formation of species. Cambridge .M. A. Harvard University Press.
2. Avise, J.C. 1994. Molecular markers, natural selection, and evolution. New York: Chapman and Hall
3. Berry, R. J., Crawford, T. J., and Hewitt, G. M. 1992. Genes in Ecology. Oxford: Blackwell Science
4. Real, L.A.1994. Ecological Genetics. Princeton University Press.
5. Baker, A. J. 2000. Molecular Methods in ecology. Oxford: Blackwell science.
6. Bishop, M. J. and Rawlings, C. J. 1997.DNA and Protein Sequence Analysis. Oxford: IRL Press.
7. Briggs. D. and Walters, S.M.1997. Plant Variation and Evolution. Cambridge: Cambridge University Press.
8. Brown, T.A.1994. DNA Sequencing. The Basis. Oxford: IRL Press.
9. Frankham, R., Ballou, J. D., and Briscoe. D. A. 2002. Introduction to Conservation Genetics. Cambridge: Cambridge University Press.
11. Lewin, B.2000.Genes VII. Oxford: Oxford University Press.
12. Darwin. C.1859. The Origin of Species. London. Murray.
13. Grant, V.1981. Plant Speciation. second addition. New York: Columbia University Press
14. Endler, J. A. 1977. Geographic variation. speciation, and clines. New Jersey: Princeton. University Press.
15. Anderson. E. 1949. Introgressive hybridization. New York: Willey.
16. Godwin, H. 1975. The history of the British Flora. Second. Edition. Cambridge: University Press.



BOT-434

Medicinal Plants

Cr. 3(2+1)

**Theory**

Cr. 02

History of Medicinal plants - - Traditional Medicinal systems: Ayurvedha, Siddha, Unani and Naturopathy.

Cultivation, therapeutical and pharmaceutical uses of selected medicinal plants of Sargodha region:

Historical account of medicinal plants in Pakistan. Establishment of medicinal plant gardens.

Definition of Drug - Classification of natural drugs: Alphabetical, Morphological, Pharmacological and Chemical. Traditional and Folklore medicine- Native medicine

Drugs from leaves, Flower, Fruits and seeds, Roots, Bark (Cinchona) and Wood (Ephedra)

Pharmacognosy - Definition and scope. Drug adulteration, Drug evaluation, Chemical evaluation and Biological evaluation of drugs, Phytochemical investigations - Quality control of herbal drugs.

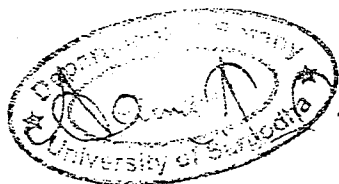
**Practicals:**

Cr. 01

1. Ethnomedicinal survey of various places
2. Preparation of herbarium sheets of ethnomedicinal plants.
3. Phytochemical analysis of ethnomedicinal plants.
4. HPLC of selected plant extracts

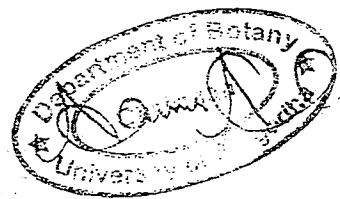
**Recommended Books:**

1. Huang, K. C1993. The Pharmacology of Chinese Herbs, CRC Press, Boca Raton,.
2. Von Reis, S. and Lipp, F. J. Jr. 1982. New Plant Sources for Drugs and Foods from The New York Botanical Garden Herbarium. Harvard University Press, Cambridge.
3. Gibbs, R. D. 1974. Chemotaxonomy of Flowering Plants, Vols I - IV, Mc Gills-Queen's University Press, Montreal.
4. Johnson, L. 1884. A Manual of the Medical Botany of North America, William Wood & Co., New York.
5. Ghazanfar, S. A. 1994. Handbook of Arabian Medicinal Plants, CRC Press, Boca Raton,



6. Hocking, G. M. 1955. A Dictionary of Terms in Pharmacognosy, Charles C. Thomas, Springfield.
7. Foster, S. and Duke, J. A. 1990. A Field Guide to Medicinal Plants, Houghton Mifflin.
8. Amruth, The Medicinal Plants Magazine (All volumes) Medplant Conservatory Society, Bangalore. India.
9. Arumugam, K.R. and Muruges, N. 1990. Text book of Pharmacognosy. Sathya Publishers, Chinnalapatti (Tamilnadu) India.
10. Bhattacharjee, S.K. 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur. India.
11. Gokhale, S.B., Kokate, C.K. and Purohit, A.P. 2003. Pharmacognosy. Nirali. Prakashan, Pune. India.
12. Guha Bakshi, D.N., Sen Sharma, P. and Pal. D.C. 1996. A Lexicon of Medicinal Plants in India. Naya Prakash, Calcutta. India.

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BOT-435

Ethnobotany

Cr. 3(2+1)

**Theory:**

Cr. 02

Definition-Scope History of ethnomedicinal plants. Traditional Medicinal systems: Ayurvedha, Siddha, Unani and Naturopathy.

Definition of Drug - Classification of natural drugs, (Alphabetical, Morphological, Pharmacological, Chemical and Chemo taxonomical). Traditional and Folklore medicines - Native medicine.

Major tribes of the Sargodha region and their ethnobotanical and ethno-biological heritage.

Ethno Medicines. Ethnobotany and conservation of plants with special reference to Pakistan - mythology and conservation of ecosystems, conservation of selected plant species: sacred grove, forestry and unique ecosystems and their ethnobiological values, plants and animals in art, tradition and ethnography: Ethnobotanical field methods.

Pharmacognosy-Definition and Scope. Drug adulteration. Drug evaluation, Chemical evaluation, Physical evaluation and Biological evaluation. Phytochemical investigations. standardization and quality control of herbal drugs.

Cultivation. collection and preparation of natural drugs - Macroscopic characters: physical and organoleptic characters, therapeutical and pharmaceutical uses of the local ethnomedicinal plants: Commercial value.

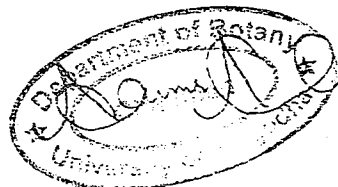
**Practicals:**

Cr. 01

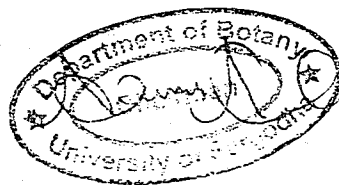
1. Ethnobotanical survey of various places
2. Preparation of herbarium sheets of ethnobotanical plants.
3. Phytochemical analysis of ethnobotanical plants.
4. HPLC of selected plant extracts.

**Recommended Books:**

1. Huang, K. C1993. The Pharmacology of Chinese Herbs. CRC Press, Boca Raton.
2. Von Reis, S. and Lipp, F. J. Jr. 1982. New Plant Sources for Drugs and Foods from The New York Botanical Garden Herbarium, Harvard University Press, Cambridge.
3. Gibbs, R. D. 1974. Chemotaxonomy of Flowering Plants, Vols I - IV, McGills-Queen's University Press, Montreal.



4. Johnson, L. 1884. A Manual of the Medical Botany of North America, William Wood & Co., New York.
5. Ghazanfar, S. A. 1994. Handbook of Arabian Medicinal Plants, CRC Press, Boca Raton,
6. Hocking, G. M. 1955. A Dictionary of Terms in Pharmacognosy, Charles C. Thomas, Springfield.
7. Foster, S. and Duke, J. A. 1990. A Field Guide to Medicinal Plants, Houghton Mifflin.
8. John Jothi Prakash, E. 2003. Medicinal Botany and Pharmacognosy. JPR Publication, Vallioor, Tirunelveli.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Chopra, R.N. 1980. Glossary of Indian Medicinal plants. CSIR, New Delhi.
11. Handa, S. S. and V. K. Kapoor, 1993. Pharmacognosy. Vallabh Prakashan. New Delhi.
12. Harbourne, J. B. 1998. Phytochemical methods: A Guide to Modern Techniques of Plant Analysis (3rd edition). Chapman and Hill Co., New York.
13. Jaibala, S. and Balakrishnan, G. 1975. A Hand book of common remedies based On Siddha system of Indian medicines. St. Louis Institute Press, Chennai.
14. Raychaudri, S.P. 1991. Recent advances in Medicinal, Aromatic and Spice crops (Vol. I). Today & Tomorrow publication, New Delhi.
15. Johnson. T 1999. CRC Ethnobotany desk Reference, CRC Press, New York.



BOT-436

Biodegradation and Bioremediation

Cr. 3(2+1)

Cr. 02

**Theory:**

1. The environment and pollution:  
Introduction, Environmental laws.
2. Treatment technologies:
  - a) Traditional approaches to pollution control.
  - b) Biotreatment technologies for pollution control.
3. Biocatalyst selection and genetic modification:
  - a) Enrichment and screening strategies.
  - b) Design of enrichment strategies relating to the environmental source.
  - c) Microbiological techniques for enrichment and selection.
  - d) Genetical approach.
4. The carbon cycle and xenobiotic compounds:
5. Biodegradation and microbial technologies by microorganisms:
  - a) Acclimation
  - b) Detoxification
  - c) Activation
  - d) Sorption
  - e) Bioavailability: Sequestering and complexing.
  - f) Cometabolism
  - g) Environmental effects.
6. Effects of metals and radionuclide on environment:
7. Metal and radionuclide microbial treatment:
8. Biotechnology for metal and radionuclide removal and recovery:
9. Recalcitrant molecules:

**Practicals:**

Cr. 01

1. Isolation of bacteria from oil wastes, polluted water from industries and sewage.
2. Spray plate technique for testing the degradation ability of bacteria for different aromatic hydrocarbons.
3. Bioremediation from culture by metal resistant bacteria.

**RECOMMENDED BOOKS:**

1. Mitchell, R. Ed. 1992 Environmental Microbiology. Wiley Liss, New York.
2. Metal Microbe Interaction. Poole, R.K. and Gadd. G. M. IRL Press, Oxford.
3. McEldowney, S., Hardmen, D. J. and Waite. S.1993. Pollution Ecology and Biotreatment. Longman Scientific Technical, Harlow, UK.
4. Alexander, M, 1994. Biodegradation and Bioremediation. Academic Press, Inc. San Diego, USA.



BOT-437

Water Pollution Management

Cr. 3(2+1)

**Theory:**

Cr.02

Water pollution – sources, types and their impacts; Pollution problems of groundwater resources, sources of contamination, management issues; Pollutants - sewage, pesticides, oils, metals, radioactive wastes, biomedical wastes, etc. Common transport processes of pollutants in the aquatic environment; dispersal of pollutants; Algal blooms and their management, Methods of pollution surveys; Waste disposal and water quality criteria used in different parts of world national and international standards; ISO-14000(EMS), EIA, Management strategies'

Waste waters - classification and characteristics of sewage and industrial effluents; treatment methods for water and waste water; Principles of aeration, chlorination, ozonation and U.V. irradiation; Waste recycling and utilization in aquaculture; Design and construction of water filtration devices; aerobic and anaerobic treatment of wastewater; Wastes from fish processing units and their treatment; solid waste management; removal of nitrogen and phosphorus from waste water; Role of aquatic macrophytes in treatment of waste water.

**Practicals:**

Cr.01

1. Determination of DO, BOD and COD of water.
2. Determination of total dissolved solids (TDS) of ground and surface water.
3. Estimation of amount of phosphate, sulphate, nitrate, nitrite, iron and magnesium and calcium in the ground and surface water.
4. Estimation of Ca, Mg, organic matter and phosphates in soil.
5. Collection and preservation of waste water samples; Physicochemical analysis of waste water total dissolved and suspended solids, colour, odour, DO, BOD, COD, H<sub>2</sub>S, NH<sub>3</sub>-N, NO<sub>2</sub>-N, NO<sub>3</sub>-N, PO<sub>4</sub>-P, CH<sub>4</sub>, heavy metals and pesticides.
6. Use of algae for organic waste treatment.
7. Visit to sewage treatment plants, fish processing units and other industries.



**Recommended Books:**

1. Baird, D.J., Beveridge, M.C.M., Kelly, L. A. and Muir, J. F. 1996. Aquaculture and Water Resources Management. Blackwell Science Ltd., Oxford.
2. Cheremisinoff, N.P., 2002. Handbook of Water and Waste Water Treatment Technologies. Butterworth – Heinemann, Woburn.
3. Eckenfelder, W.W., 2000. Industrial Water Pollution Control. McGraw Hill, New York.
4. Gray, N.F., 2004. Biology of Waste water Treatment. Oxford University Press, London.
5. Trivedy, R.K., 1998. Advances in Waste water Treatment Technologies. Global Science, Aligarh.

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BOT-438

Air Pollution Management Strategies

Cr. 3(2+1)

**Theory:**

Cr.02

Nature and classification of Pollutants, Sources and Effects of Pollutants on Plant Growth viz; Fluoride, Sulphur dioxide (SO<sub>2</sub>), Ozone, Pan + Smog, Ammonia, Chlorine, Ethylene, Dusts etc., Nature, Causes, Prevention and Control of Air Pollution (Vehicular Pollution and Industrial Chimney Wastes).

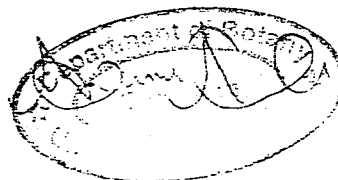
Air Pollution sources: Origin, dispersion and impact on human, crops and forest of Particulates, Sulphur oxides, Nitrogen oxides & volatile organic compounds, Carbon monoxide, carbon dioxide, Smog & PAN, MTBE (methyl tertiary butyl ether) & CFCs (chlorofluorocarbons),

Basic principles of air pollution management, ambient concentrations of air pollutants and trace gases, national environmental policies, implementation of policies and organization of management agencies, national air monitoring programme, effects of air pollution on human health, air quality criteria and case study, emergency preparedness, safety planning and management, vehicular pollution, monitoring and abatement technologies. Air pollution control equipments, objectives and types of control equipments, efficiency of separating devices, control of particulate emission settlers, cyclones, filters, scrubbers and esp: control of sulphur dioxide from lean and rich waste gases (recovery of sulphur and sulphuric acid); control of NO<sub>x</sub> through absorption and other newer methods; control of vehicular emission (catalytic conversion devices); Indoor air pollution and its control; Hazardous air pollutants and their management. Biological abatement of air pollution, scope of green belt development, economical aspect of air pollution abatement technologies.

**Practicals:**

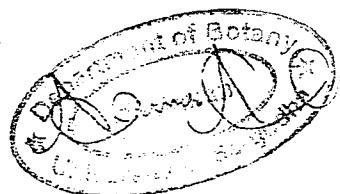
Cr.01

1. Estimation of foliar dust deposition in samples collected from sites exposed to air pollution.
2. Determination of settled particulate matter in air.
3. Biomonitoring of heavy metals in the environment.
4. Mapping of vegetation of selected region by using Remote sensing data.
5. Field visits to industrial areas for on-spot biodiversity assessment and to prepare status report.



**Recommended Books:**

1. Agarwal, K.C. 2001. Environmental Biology. Nidi Publications Ltd. Bikaner, India.
2. Anonymous Pollution Control Acts: Rules and notifications issued there under. Central Pollution. Control Board, Govt. of India, New Delhi.
3. Atlas, R.M. 1998. Microbiology - Fundamentals and Applications. MacMilan Co. London
4. Canter, L.W. 1994. Environmental Impact Assessment. 2nd Ed. McGraw Hill, New York
5. Carless Jennifer, 1993 Renewable Energy: A concise Guide to Green alternative. Walker, New York.
7. Gleick, H. 1993. Water in Crisis, Pacific Institute of Studies in Development, Environment and Security. Stockholm Env. Institute. Oxford University Press. New York.
8. Heywood, V. H. & Watson, R. T. 1995 Global Biodiversity Assessment. Cambridge University Press. UK.
9. Hunter, Malcolm L. Jr. 1990. Wildlife, Forests and Forestry: Principles of Managing forests for biodiversity. Englewood Cliffs, N. J. Prentice Hall. London.
10. Jadhav, H. and Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press. Moeller Dave, W. 1992. Environmental Health. Harvard University. U.K.
11. Mc Eldownery, S., Hardman, D. J. and Stephen Waite. 1993. Pollution: Ecology and Biotreatment. Longman Scientific and Technology, England.
12. Oehme, W. F. 1998. Toxicology of heavy metals in environment, Marcel Dakkar Inc. New York.
13. Perry, G. 1980. Introduction of Environmental Toxicology. Elsevier, Netherlands.
14. Richard, T. Wright and Bemard, J. Nebel 2002. Environmental Science: Towards a Sustainable Future. Prentice Hall, London.



BOT-439

Conservation Ecology

Cr. 3(2+1)

**Theory:**

Cr. 02

Introduction to conservation ecology, history Importance of Edaphic factors in conservation. Importance of topographic factors, biotic factors. Ecosystem. Physical conditions and availability of resources. Applied issues in conservation: Role of Natural Resources in conservation ecology. Pollution. Types of natural resources (renewable m non-renewable), wildlife management, species preservation, conservation of habitat, Introduction of exotic species, natural parks, forests resources, soil and water resources, food and agriculture resources.

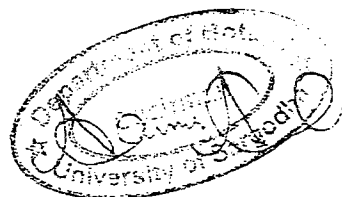
**Practicals:**

Cr. 01

1. Visits to different disturbed ecosystem
2. Survey of different important species for conservation
3. Visit to different sanctuaries

**Books Recommended:**

1. Ecology Concepts and Applications. Molles, M. C. 2005. McGraw Hill Companies, New York, America
2. Basic Ecology. Odum, E. P. 2001. CBS College Publishing, London, Toronto.
3. Instant Notes in Ecology. Mackenzie. A. Andy S.B and Sonia R. V. 1998. BIOS Scientific publishers LTD. Guildford, UK.
4. Environmental Science, Cunningham W.P., M, Cunnigham. B.W. Saigo, 2005, McGraw Hill. New York.
5. Plant Ecology, Singh S.K. 2005. Campus Books International. New Delhi.



BOT-440

Plant Stress Physiology

Cr.3(2+1)

**Theory:**

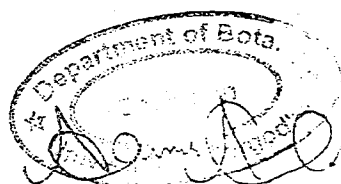
Cr. 02

- (1) The history of stress research, general theory of stress.
- (2) Stress at plants at subcellular, cellular, organ.
- (3) Stress factors, classification of biotic, abiotic factors, methods of measurement
- (4) Signal transduction, molecular biological foundations of anti-stress reaction
- (5) Stress proteins, antioxidants - anti-stress response mechanisms
- (6) Stress lack / excess of available water (mechanisms to avoid stress)
- (7) Stress of substrate salinity, osmotic stress
- (8) Stress caused by toxic and foreign substances
- (9) Stress caused by cold, frost
- (10) Thermal stress (heat effects of physical, chemical, molecular and biological)
- (11) Radiation stress (regularly, classification, mechanisms of formation, mechanisms for protection)
- (12) Acclimation / adaptation to stress in extreme environments (deep oceanic waters, submarine volcanic eruptions, oceanic coastal areas, an extremely toxic habitats, alpine and polar regions, and desert biomes, extraterrestrial systems). Plant responses to stress at multiple levels of integration - from the molecule to the whole plant . Global issues related to environment and plant stresses. Use of the primary scientific literature as a basis for the in-depth study of plant responses to environmental stress

**Practicals:**

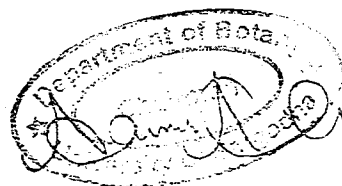
Cr. 01

1. Determination of water potential by pressure chamber
2. Determination of osmotic potential by osmometer
3. Investigation of osmolytes from plants growing under stress conditions
4. Estimation of antioxidant activity in plants under stress conditions



**Recommended Books:**

1. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2<sup>nd</sup> 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. 3<sup>rd</sup> Edition, Academic Press, U.K.
5. IhsanIllahi, 1991. Plant Growth, UGC Press, Islamabad.
6. IhsanIllahi, 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. 5<sup>th</sup> Edition. Wadsworth Publishing Co. Belmont CA.
10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4<sup>th</sup> Edition. Sinauer's Publ. Co. Inc. Calif.
11. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2<sup>nd</sup> Ed. John Wiley and Sons. New York.



BOT-441

Advanced Plant Anatomy

Cr. 3 (2+1)

Cr.02

**Theory**

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.

**Practicals:**

Cr. 01

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.

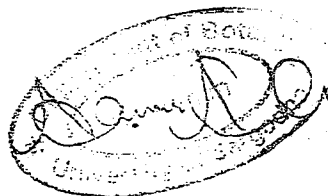


**Recommended Books:**

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 Eichhorn, E. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
12. Eames, A. J. and Mac Daniels, L. H. 2002. An introduction to Plant Anatomy. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Journals / Periodicals:

Pakistan Journal of Botany



BOT-442

## Quality Seed Production

Cr. 3(2+1)

## Theory:

Cr. 02

Reproductive process in plants. Define seed and planting material. Anatomy and chemistry of seed. Introduction to seed industry of Pakistan. Variety development, registration and maintains system. Modern concept of quality & seed management. Production of early generation seed. Seed generation system from pre-basic to basic and certified. Seed quality system, legislation under seed (Amendment). Act-2015, crop inspection, seed testing, seed processing and storage. Production of true to type disease free fruit nursery plant, hybrid seed production, establishment, planning and management of seed business, seed marketing and prices network. Comparative study of various seed management system in the world.

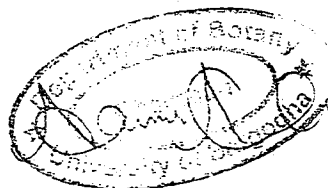
## Practicals:

Cr. 01

1. Lay out of seed adaptability and demonstration plot.
2. Visit to seed production plot and seed testing Laboratory to know the physical and analytical purity of seed lot.
3. Variety purity identification by using electrophoresis and DNA figure printing techniques.
4. Assessment of seed viability and planting value by using tetrazolium test and vigor test.
5. Visit to variety breeding institute, seed farm and seed processing plant and seed storage.
6. An assignment / Mini project to assess the profit and loss of seed production entrepreneur.

## Recommended Books:

1. Bhutta, A. R. 2010. Introduction Seed Pathology, HSC, Islamabad 55>p.
2. Bhuna, A. R., Hussain, A and Rehman, M. R. 2004. Seed Processing and Storage, FSC&RD, GoP, Islamabad 103 pp.
3. Dharendra Khare and Shale. M. S. 2014 Seed Technology (2<sup>nd</sup> edition). Scientific Publisher, India.
4. Gurnam Singh. 2014. Seed Testing . Gene Tech Book. New Delhi
5. Hussain, A and Bhutta, A. R. 2004. Seed Industry in Pakistan. FSC&RD/PSF. Islamabad.
6. Shagufta, 2012. Seed Science & Seed Technology, APH Publisher, India.
7. Supriyo Chakarborty, 2013. Plant Molecular Genetic, Scientific Publisher India.





BOT-443

Seed Pathology

Cr. 3(2+1)

**Theory:**

Cr:02

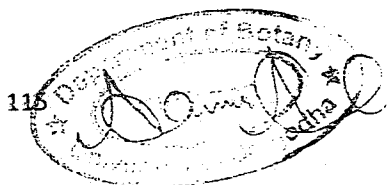
Emergence of seed pathology as an independent discipline and its significance. Morphological and anatomical studies of healthy and infected seed and planting material by using molecular techniques. Effect of seed borne disease on seed viability and planting value. Histopathological study of infected seed, transmission of seed borne pathogens and their establishment in host and then to seed.

Mycotoxicological problems induce by seed borne pathogens and their health hazards. Identification of economical important seed borne disease and their post-harvest losses in agriculture and horticulture crops. Seed health technology and seed health certification system for production of disease free seed and inspection of seed consignments during export / import and testing of germplasm material. Concept of GMO in management of seed borne disease. Management of commercial scale production of disease free forest nursery and fruit plant certification. Seed and planting material national health standard under the seed (Amendment) Act-2015. Bioterrorism. SPS measures and international obligations.

**Practicals:**

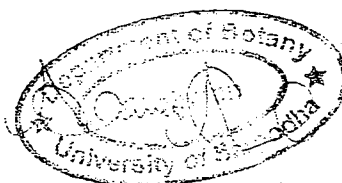
Cr. 01

1. Collection of seed samples as per ISTA rules.
2. Isolation of pathogen, identification and preservation of culture.
3. Histopathology of healthy and infected seed.
4. Effect of different chemicals and antagonistic microorganisms on seed borne pathogens and seed germination.
5. Field crop inspection for disease assessment.
6. Visit to seed health testing lab, seed processing plants and seed storage.



**Recommended Books:**

1. Agrios, G. N. 2005. Plant Pathology. Elsevier Academic Press, New York USA.
2. Agarwal, V. K. and Sinclair, J.B 1993. Principles of Seed Pathology Vol I-II CBS Publisher and Distributors New Dehli.
3. Albrechtsen, S. E. 2006. Testing Methods for Seed Transmitted Viruses, CABI. UK.
4. Basher, M, Z. Ahmed and Murate, N.2000. Seed Borne Viruses Detection, Identification and Control, PARC, Islamabad.
5. Bhutta, A.R and Ahmed, I. 2000 Seed Pathology Techniques and their Application, NBF, Islamabad 155 PP.
6. Bhutta, A. R. 2010. Introductory Seed Pathology, HEC, Islamabad, 557 PP.
7. FAO 2000 Multilateral Trade Negotiations on Agriculture. A Resource Manual-III-SPS and TBT Agreement, FAO-UN Rome.
8. Singh. D. 2004 Histopathology of Seed Infection CRC. Press
9. Shahid Ahmed. 2009. Plant Disease Management for Sustainable Agriculture, Daya Publishing House Delhi.
10. Sharma, R. C. and Sharma J. N. 2011. Integrated Plant Disease Management Scientific Publishers, India.
11. Agarwal. V. K. 2014. Management of Seed Borne Disease. Agrobios-India.



**SCHEME OF STUDIES OF MSc BOTANY SEMESTER/ TERM SYSTEM PROGRAM  
(2016 and Onward)**

Sc-Two Years Botany program comprises of 4 semesters with 66 credit hours. Outline of the courses is as under.

**Duration of the Program:**

The duration of MSc BOTANY IS TWO YEARS (04 SEMESTERS)

General courses 01 years (02 semesters)

Specialization 01 year (02 semesters)

**Main Features of MSc Botany Program/Credit Requirements**

Major Subject: Botany

Duration: 02 years (04 Semesters)

Eligibility: At least 45% marks in BSc with Botany & Zoology (compulsory) & Chemistry /Psychology/ Geography) etc. as an elective subject.

Degree Requirements: 66 credit hours

**Total numbers of credit hours for MSc- Botany is 66**

Note: (a) Each semester shall be of 16 to 18 weeks for teaching, no of courses per semester 4-6, one week for the conduct of examination and one week for the preparation of results;

(b) A 02+01 Credit hour course means as course of 3 credit hours i.e. 02 credit hours of theory and 01 credit hour of practical.

