

# UNIVERSITY OF SARGODHA, SARGODHA

## NOTIFICATION

No.UOS/Acad/ 2401

Dated: 15.09.2010

The Syndicate in its 2/2010 meeting held on 08.07.2010 has approved the schemes of studies and syllabi of following programs for implementation from the sessions mentioned against each:-

- i) *Scheme of Studies of MS/ M.Phil program in Botany for implementation on 2009-11 session (annexed-'A').*
- ii) *Revised Scheme of studies of MS /M.Phil & Ph.D program Botany for implementation from Fall Semester 2010 (annexed-'B').*
- iii) *Scheme of Studies of M.Sc Botany for implementation w.e.f 2010-12 session (annexed-'C').*
- iv) *Scheme of Studies of ~~BS 4 year program in Botany~~ for implementation from 2010-14 session (annexed-'D').*

  
 (Ch. FAROOQ AHMAD)  
 Assistant Registrar (Acad)  
 for Registrar

### Distribution:-

- Chairman  
Department of Biological Sciences
- Controller of Examinations
- Notification file

### C.C:

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

## Annexure IV

Annexure -

BS Botany (Session 2010-14)

Year-I

Semester-I

Semester-II

Code	Course Title	Cr.Hr.	Code	Course Title	Cr.Hr.
ZOL-101	Principles in animal life	4(3+1)	ZOL-102	Diversity of animals(invertebrates)	4(3+1)
BOT-101	Diversity of Plants	4(3+1)	BOT-102	Plant Systematics, Anatomy & Development ✓	4(3+1)
CHEM-101	Physical Chemistry	4(3+1)	CHEM-102	Inorganic Chemistry	4(3+1)
ENG-101	English-I	3(3+0)	ENG-102	English-II ✓	3(3+0)
ISL-101	Islamic Studies	2(2+0)	PKS-102	Pak-Studies	2(2+0)
		<b>Total</b>			<b>Total</b>
		<b>17</b>			<b>17</b>

Year-II

Semester-III

Semester-IV

Code	Course Title	Cr.Hr.	Code	Course Title	Cr.Hr.
ZOL-203	Diversity of animals(vertebrates)	4(3+1)	ZOL-204	Principles of animal physiology ✓	4(3+1)
BOT-203	Cell Biology, Genetics & Evolution	4(3+1)	MATH-201/ES-204	Mathematics/any other elective out of major courses	3(2+1)
CHEM-203	Organic Chemistry	4(3+1)	BOT-204	Plant Physiology & Ecology ✓	4(3+1)
ENG-203	English-III	3(3+0)	CHEM-204	Chemistry Special Topics ✓	4(3+1)
COMP-203	Computer Applications	3(0+3)	ENG-204	English (Communication Skills)	3(3+0)
		<b>Total</b>			<b>Total</b>
		<b>18</b>			<b>18</b>

KM

*[Signature]*

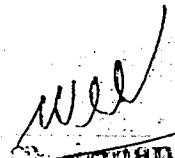
Chairman  
Department of Biological Science  
University of Jargotha

**List of Optional Papers in lieu of Thesis**

Semester 3			Semester 4		
Course	Title	Credit hours	Course	Title	Credit hours
BOT-425	Plant Water relations	4(3+1)	BOT-426	Plant Microtechniques	4(3+1)
BOT-427	Plant seed physiology	4(3+1)	BOT-428	Palynology	4(3+1)
BOT-429	Plant Tissue Culture	4(3+1)	BOT-430	Plant Biotechnology	4(3+1)
BOT-431	Advanced Environmental Biology	4(3+1)	BOT-432	Plant Conservation Management	4(3+1)
BOT-433	Conservation Genetics	4(3+1)	BOT-434	Ecological Genetics	4(3+1)
BOT-435	Medicinal Plants	4(3+1)	BOT-436	Ethnobotany	4(3+1)
BOT-437	Biodegradation & Bioremediation	4(3+1)	BOT-438	Water Pollution Management	4(3+1)
BOT-439	Air Pollution Management Strategies	4(3+1)	BOT-440	Conservation Ecology	4(3+1)
BOT-441	Plant Stress Physiology	4(3+1)	BOT-442	Advanced Plant Anatomy	4(3+1)

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**Chairman**  
 Department of Biological Science  
 University of Jharkhand

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## SCHEME OF STUDIES OF BS (4 years) BOTANY PROGRAM

BS-four Years Botany program comprises of 8 semesters with 136 credit hours. Outline of the courses is as under.

### Duration of the Program:

The duration of BS BOTANY IS FOUR YEARS (08 SEMESTERS)

General courses: 02 years (04 semesters)

Specialized Courses: 02 years (04 semesters)

### Main Features of BS Botany Program/Credit Requirements

Major Subject: Botany

Duration: 04 years (08 Semesters)

Eligibility: At least 45% marks in intermediate with biology as an elective subject.

Degree Requirements: Minimum 124 credit hours

Total numbers of credit hours for BS-Botany is 136

Note: (a) Each semester shall be of 16-18 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 03+01 Credit hour course means 03 credit hours of theory and 01 credit hour of practical.

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verified and verified

24/6/14

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UNIVERSITY OF SARGODHA  
 BS BOTANY (4 YEAR PROGRAM) 2014-18  
 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-101	Physical Chemistry	04 (3+1)
ENG-101	English-I	03
ISL-101	Islamic Studies	02
Total Credit hours		17

**II SEMESTER:**

Course Code	Description	Credit hours
BOT-102	Plant systematic, Anatomy and Development	04 (3+1)
ZOL-102	Diversity in Animals Invertebrates	04 (3+1)
CHEM-102	Inorganic Chemistry	04 (3+1)
ENG-102	English-II	03
PAK-102	Pak 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-203	Organic Chemistry	04 (3+1)
ENG-203	English-III	03
COM-203	Computer Application/ Introduction to Management	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-204	Special Topics in Chemistry	04 (3+1)
ENG-204	English (Communication skills)	03
MATH-201/ES 204	Mathematics/any other elective out of major courses	03
Total Credit hours		18

## V SEMESTER:

Course Code	Description	Credit hours
BOT-305	Biostatistics	3(2+1)
BOT-306	Bacteriology and Virology	3(2+1)
BOT-307	Phycology & Bryology	3(2+1)
BOT-308	Mycology & Plant Pathology	3(2+1)
BOT-309	Diversity of Vascular Plants	3(2+1)
BOT-310	Plant systematics	3(2+1)
Total Credit hours		18

## VI SEMESTER:

Course Code	Description	Credit hours
BOT-311	Anatomy of Vascular Plants	3(2+1)
BOT-312	Genetics-I	3(2+1)
BOT-313	Plant Biochemistry-I	3(2+1)
BOT-314	Plant Ecology-I	3(2+1)
BOT-315	Plant Physiology-I	3(2+1)
BOT-316	Molecular Biology	3(2+1)
Total Credit hours		18

## VII SEMESTER:

Course Code	Description	Credit hours
BOT-417	Plant Biochemistry-II	3(2+1)
BOT-418	Plant Ecology-II	3(2+1)
BOT-419	Plant Physiology-II	3(2+1)
BOT-420	Genetics II	3(2+1)
BOT-	Optional subject/ Thesis/ Research Report	4(3+1)
Total Credit hours		16

## VIII SEMESTER:

Course Code	Description	Credit hours
BOT-421	Seminar / Presentations	1(1+0)
BOT-422	Biodiversity & Conservation	3(2+1)
BOT-423	Environmental Biology	3(2+1)
BOT-424	Cell Biology	3(2+1)
BOT-	Optional subject / Thesis/ Research Report	4(3+1)
Total Credit hours		14

Total no of Credit Hours: 136

\* Theory + Lab

Special subjects will be offered as per available expertise of the University.

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At the beginning of VII semester every student shall opt one field of specialization as mentioned below including compulsory course/s.

Research will be offered on the basis of merit and facilities in the field of specialization while remaining students shall have to opt an additional theory course 4(3-1) credit from field other than specialization in lieu of research.

**List of Optional Papers In lieu of Thesis**

Course	Title	Credit Hours	Course	Title	Credit Hours
BOT-425	Plant Water Relations	4(3+1)	BOT-426	Plant Micro Techniques	4(3+1)
BOT-427	Plant Seed Physiology	4(3+1)	BOT-428	Palynology	4(3+1)
BOT-429	Plant-Tissue Culture	4(3+1)	BOT-430	Plant Biotechnology	4(3+1)
BOT-431	Advanced Environmental Biology	4(3+1)	BOT-432	Plant-Conservation Management	4(3+1)
BOT-433	Conservation Genetics	4(3+1)	BOT-434	Ecological Genetics	4(3+1)
BOT-435	Medicinal Plants	4(3+1)	BOT-436	Ethnobotany	4(3+1)
BOT-437	Biodegradation and Bioremediation	4(3+1)	BOT-438	Water-pollution Management	4(3+1)
BOT-439	Air-pollution Management Strategies	4(3+1)	BOT-440	Conservation Ecology	4(3+1)
BOT-441 ✓	Plant Stress Physiology	4(3+1)	BOT-442	Advanced Plant Anatomy	4(3+1)

BOTANY  
1<sup>st</sup> Semester  
Diversity of Plants

4 (3+1)  
Cr. 03

BOT-101

**Course Outline:**

Comparative study of life form, structure, reproduction and economic significance of:  
 a) Viruses (RNA and DNA types) with special reference to TMV;  
 b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, 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)

1) Bryophytes

i. Riccia

ii. Anthoceros

iii. Funaria

g) Pteridophytes

i. Psilopsida (Psilotum)

ii. Lycopsidea (Selaginella)

iii. Sphenopsida (Equisetum)

iv. Pteropsida (Marsilea)

vi. Seed Habit

h) Gymnosperms

i. Cycas

ii. Pinus

iii. Ephedra

Cr. 01

**Lab Outline:**

- 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 & Plant: Diversity and Evolution. 2006 CUP
10. Taylor, T. N. & Taylor, E. D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N. Y.
11. Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire.

**Journals / Periodicals:**

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



## 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:

1. Tests for different carbohydrates, proteins and lipids.

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

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

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

3. Plasmolysis and deplasmolysis in blood.
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. Slingsby, D. And Cook, C., Practical Ecology. 1986. Mcmillan Education Ltd. UK.

**Course Outline:**

**Elementary Mathematics:** i.e., Function and their graphs. Equation of straight lines. Function and limits, continuous and discontinuous functions. Logarithm. Differentiation of elementary algebraic and trigonometry functions. Meaning of differentiation in term of rate of change. Simple method of integration and their physical significance.

**Physical States of Matter.**

**Gases:** Deviation from ideal behavior of real 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 :** Physical properties like viscosity, Parachor value, Refractive index, molar refraction Dipole moment, rheochor value and their applications.

**Solids :** The classification of crystals. Unit cell. Bragg's method of crystal structure analysis. X-rays crystallography of sodium chloride. The powder method of crystal structure analysis.

**Quantum theory and Atomic Structure i.e.,** Wave and particle nature of matter. De Broglie equation. Schrodinger wave equation, solution for particle in 1D box, quantization concept, Heisenberg Uncertainty Principle, Pauli Exclusion Principle, Hund's Rule of maximum multiplicity.

**Chemical Thermodynamics i.e.,** System and surrounding. First law of thermodynamics and its state functions, enthalpy change in physical and chemical system. Work done and the change in internal energy during the isothermal and adiabatic processes in ideal gases. Heat capacity at constant volume and pressure. Concept of reversible and irreversible processes. Spontaneous and non spontaneous processes. The second law of thermodynamics, Carnot cycle, change of entropy with change in temperature, pressure and volume.

**Chemical Equilibrium i.e.,** The concept of equilibrium. Law of Mass Action, equilibrium constant, relationship between  $K_c$ ,  $K_p$ ,  $K_x$  and  $K_a$  and LeChaterlier's Principle and the effect of variables e.g. temperature, concentration and pressure on equilibrium constant.

**Solutions i.e.,** Solution and concept of concentration units such as molarity, molality, ppb and ppm. The ideal and non ideal solutions. Raoult's law. colligative properties such as lowering of vapor pressure, elevation in boiling point ebullioscopy, cryoscopy, osmotic pressure, distillation and concept of azeotrops.

**Chemical Kinetics i.e.,** Order of reaction. Zero, first and second order reaction. Various method for determining the order of reaction. Depression of rate constant on temperature.

Arrhenius equation, activation energy and its determination, brief account of Lindermmann's mechanism for unimolecular reactions, brief account of collision theory and transition state theory of bimolecular reactions.

Electrochemical Sciences i.e., Equivalent and molar 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, Ostwald dilution law. Dissociation constant. Calculation of pH for a typical weak acid.

Cr. 01

#### Lab Outline

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  $KI + I_2 \rightleftharpoons KI_3$
14. Conductometric titration of strong acid and strong base.

#### RECOMMENDED BOOKS (PHYSICAL CHEMISTRY)

1. Chaudhry, G.R., *Text Book of Physical Biological Sciences*, 2<sup>nd</sup> Edition, New Kitab Markaz, Aminpur Bazar, Faisalabad; Pakistan, (2001).
2. Maron S. H. and Jerome, B. "Fundamentals of Physical Biological Sciences" Macruthan Publishing co. Inc. New York, (1995).
3. Atkins P.W. and Clugston, M.J. "Principles of Physical Biological Sciences" Pitam Publishing Company. NY (1998)
4. Moore, W.J., "Physical Biological Sciences", 5<sup>th</sup> Ed. Longmans Publishers, NY (1972)
5. Jones, M., "Elements of Physical Biological Sciences" 3<sup>rd</sup> Ed. Benjamin- Cummings Publishing Company Inc., NY (1993).
6. Adamson, A. W., "Understanding Physical Biological Sciences" 3<sup>rd</sup> Ed. Benjamin Cummings Publishing Company Inc. NY (1973)
7. Heald, C. and Smith, A.C.K. *Applied Physical Biological Sciences*. MacMillan UK (1973).
8. Akhtar, M.N. & Ghulam Nabi, "Text Book of Physical Biological Sciences" Ilmi Kitab Khawna, Lahore (2006)

9. Bhatti, H.N. and K. Hussain, "Principles of Physical Biological Sciences"; Carwan Book House, Lahore (2005).
10. Leitch, B.P., "Findlay's Practical-Physical Biological Sciences". 9<sup>th</sup> Ed. Longman, London (1973).
11. Das, R.C. and B. Behera, "Experimental Physical Biological Sciences", Tata McGraw Hill, Delhi (2003).
12. Crocleford, H.D., H.W. Biard, F.W. Getzen & J.W. Nowell, "Laboratory Manual of Physical Biological Sciences", 2<sup>nd</sup> Ed., John Wiley & Sons, London (1975).

ENG-101:

ENGLISH-I

3(3+0)

Cr: 03

Course Contents

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

Academic listening

Note taking from lecture

Type of note-taking

Effective questioning

After the lecture

Writing skills

Planning stages

Getting Started

Brainstorming

Sentence type

Basis for effective Writing

- Unity
- Support
- Organization
- Sentence

Making Rewriting Habit

Giving a presentation

Taking part in seminars

Reading list

Wallance.(1980) Study skills in English  
CUP

Lagan.(1981) English Skills. McGraw  
Hill Book Co.

McWhorter, K.T. (1983) college reading

and Study Skills: Little Brown & Co.

O' Bien & Sordon . (1985) Developing  
Reference Skills. Collins

Prince-Machado,D. (1998) Skills for  
Success.CUP

ISL-101: ISLAMIC STUDIES

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

**نصاب برائے مطالعہ اسلامیات لازمی**

یونیورسٹی آف سرگودھا اور اس سے ملحق دیگر کالجوں و اداروں کی بی اے، بی ایس سی و دیگر مساوی تدریسی درجات کے لئے

**اجمالی نصابی خاکہ:**

۱۔ قرآن مجید	۲۰ نمبر	۲۔ حدیث مبارکہ	۱۰ نمبر
۳۔ سیرت النبی ﷺ	۱۰ نمبر	۳۔ اسلامی تہذیب و تمدن	۱۰ نمبر
۵۔ مہربانی سوالات	۱۰ نمبر (مہربانی سوالات پر سے نصاب پر مشتمل ہوں گے)		
تفصیلی نصاب:			

**1- قرآن مجید:-**

اس حصہ میں قرآن مجید کی مناسبت سے مختلف عنوانات ہیں جو کہ حسب ذیل ہیں۔

۱۔ مطالعہ قرآن مجید کی ضرورت و اہمیت

۲۔ آیات (توحید، رسالت، ملائکہ، کتب، آخرت کے اثبات پر دلائل، قسم، نبوت، اسوئہ رسالت)

۳۔ عبادات (نماز، زکوٰۃ، روزہ، حج، عید، جہاد) ۳۔ تفسیر و تہذیب اور اسلام کا تصور و اجتہاد ۵۔ خدمتِ خلق ۱۔ نبیوں کی صفات

۴۔ دعوت و دین کی ضرورت و اہمیت، اہمیت اور اسلام کی تہذیب و تمدن ۸۔ کتب و احادیث

(حصہ دوم، آیات کا ترجمہ و تشریح)

۱۔ البقرہ: آیات 284, 285, 286 (ایمانیات)

۲۔ آل عمران: آیات 190, 191 (تفسیر و تہذیب)

۳۔ اہل بیت: آیات 1-11 (صفیات و فضائل)

۴۔ انفقان: آیات 63-77 (موضوع آداب معاشرت)

۵۔ الاحزاب: آیات 6, 21, 40, 57, 58 (تخصیصات نبوی)

۶۔ الحجرات: آیات 1-18 (موضوع آداب نبوی ﷺ، معاشرتی احکام)

۷۔ البقرہ: آیات 19, 20 (تفسیر و تہذیب، عقیدت قرآن)

۸۔ التوبہ: آیات 1-4 (تفسیر و تہذیب، عبادت، بیعت، قسم، اہل بیت، دعوت اور امامت دین)

2- احاديث زيارته

ومن ذل احاديث كآثر جمده شرحه سليمان بن يسار

1. عن عبد الله قال قال رسول الله ﷺ طلب كسب الحلال فربضة بعد الفرائض (بيئقي شعب الايمان)
2. عن ابي سعيد قال قال رسول الله ﷺ التاجر الصدوق الامين مع النبيين والصدقيين والشهداء (جامع ترمذي)
3. عن ابن مسعود عن النبي ﷺ لا تزول قدما ابن آدم حتى يسئل عن خمس عن عمره فيما افناه وعن شبابه فيما ابلاه وعن ماله من اين اكتسبه وفيما انفق وما ذاعل فيما علم (جامع ترمذي)
4. عن علي قال قال رسول الله ﷺ من ملك زاد او راحلة تبليه الى بيت الله ولم يحج فلا عليه ان يسوت بيديها او تنصرا ابنا وذلك ان الله تبارك وتعالى يقول والله على الناس حج البيت من استطاع اليه سبيلا (جامع ترمذي)
5. عن ابي هريرة ان رسول الله ﷺ قال: اتدرون ما المنفل؟ قالوا: لا يا رسول الله ﷺ. قال: انما المنفل من لا درهم له ولا متاع يقال: ان المنفل من امسى من ياتي يوم القيامة يصلوه وضياهم ووزكوة، وياتي قد قسم هذا، وفقد هذا، واكل مال هذا، وسفك دم هذا، وضرب هذا فيمطي هذا من حسنه. فان نيت حسنه قبل ان يقضى ما عليه اخذ من خطاياهم فطرحت عليه ثم طرح في النار (صحيح مسلم)
6. عن شيراز بن ميمون قال قال رسول الله ﷺ مروا الصبي الصلوة اذا بلغ سبع سنين واذا بلغ عشر سنين فاضربوه عليهما. اخرجه ابو داود والترمذي والفظه عليهما الصلوة اذ بلغ سبع سنين واضربوا عليهما ابن عشر (صحيح البخاري)
7. قال رسول الله ﷺ تجدون شر الناس يوم القيامة ذلوا جبين الذي ياتي كحولا، يوجد وكحولا، يوجد (متفق عليه)
8. قال رسول الله ﷺ ان اقل شئ يرضع في ميزان السر من يوم القيامة خلق حسن. وان الله يفيض الفاحش البذخ (جامع ترمذي)
9. عن عثمان بن الخطاب قال قال رسول الله ﷺ حين سئل عن الايمان ان تزمن بالله وملائكته وكتبه ورسله واليوم الآخر وتؤمن بالقدر خيره وشره (متفق عليه)
10. عن العباس بن عبد المطلب قال قال رسول الله ﷺ ذاق طعم الايمان من رضى بالله رباً وبالاسلام ديناً وبمحمد رسولاً.
11. عن انس قال قال رسول الله ﷺ والذي نفسي بيده لا يؤمن عبد حتى يحب لآخره ما يحب لنفسه (متفق عليه)
12. عن النعمان بن بشير قال قال رسول الله ﷺ تروى المؤمن في تراحمهم وتوادهم وتماثلهم كمثل الجسد اذا اشتكى عضو تداعى له سائر الجسد بالسيف والحمى (متفق عليه)
13. عن ابن عمر قال قال رسول الله ﷺ بنى الاسلام على خمس شهادة ان لا اله الا الله وان محمداً عبده ورسوله واقام الصلوة وابتداء الزكوة والحج البيت وحوم رمضان (متفق عليه)
14. عن ابي سعيد الخدري عن رسول الله ﷺ قال من راي منكم منكراً فليغيره بيده فان لم يستطع فليقلبه وذلك اخف الايمان (مسلم)
15. عن عبد الله بن عمر قال قال رسول الله ﷺ الاكلكم راع وكلكم مسئول عن راعيته فالامام الذي على الناس راع وهو مسئول عن راعيته والرجل راع على اهل بيته وهو مسئول عنهم والبراة راعية على بيت زوجها وولده وهي مسئولة عنهم وعبد الرجل راع على ما قال سيده وهو مسئول عنه الا لكلكم راع وكلكم مسئول عن راعيته (متفق عليه)



3- سیرت النبیؐ کی ضرورت و اہمیت

1- اخلاقی تعلیمات

2- اخلاقی تعلیمات اور معاشرت اور اس وقت

3- اخلاقی تعلیمات اور معاشرت اور اس وقت

4- اخلاقی تعلیمات اور معاشرت اور اس وقت

5- اخلاقی تعلیمات اور معاشرت اور اس وقت

6- اخلاقی تعلیمات اور معاشرت اور اس وقت

7- اخلاقی تعلیمات اور معاشرت اور اس وقت

8- اخلاقی تعلیمات اور معاشرت اور اس وقت

9- اخلاقی تعلیمات اور معاشرت اور اس وقت

10- اخلاقی تعلیمات اور معاشرت اور اس وقت

1- اخلاقی تعلیمات اور معاشرت اور اس وقت

2- اخلاقی تعلیمات اور معاشرت اور اس وقت

3- اخلاقی تعلیمات اور معاشرت اور اس وقت

4- اخلاقی تعلیمات اور معاشرت اور اس وقت

5- اخلاقی تعلیمات اور معاشرت اور اس وقت

6- اخلاقی تعلیمات اور معاشرت اور اس وقت

7- اخلاقی تعلیمات اور معاشرت اور اس وقت

8- اخلاقی تعلیمات اور معاشرت اور اس وقت

9- اخلاقی تعلیمات اور معاشرت اور اس وقت

اہم نوٹ:- یونیورسٹی آف سرگودھا میں بی اے اسلامیات لازمی کا بھی ایجنڈا سہ ماہی کے تحت اس مذکورہ سلیبس سے سی 60 نمبر کا تیار کیا جائے گا اور پھر سہ ماہی میں بی اے اسلامیات کے لیے اس سلیبس کو تیار کر دیا جائے گا جس میں مذکورہ سلیبس کا نمبر 30 نمبر کا اور باقی نمبر 50 نمبر کا ہونا ہے اور 20 نمبر سہ ماہی میں (سہ ماہی میں ماضی، حسن اخلاق، اساتذت اور پروردگار کی عبادت پر دینیے جاتے ہیں)۔

WWW.STUDY.PK

## BOTANY

2<sup>nd</sup> Semester

BOT-102 Plant Systematic, Anatomy and Development/Embryology 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. Solanaceae	viii. Lamiaceae (Labiatae)	ix. Apiaceae (Umbelliferae)
x. Asteraceae (Compositae)	xi. Liliaceae	xii. Poaceae (Graminae)

### 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

#### Plant Systematics

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

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

### 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-MacGraw-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 MacGraw-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, Phytol.

ZOL-102      DIVERSITY OF ANIMALS (INVERTEBRATES)      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.

Cr. 01

### Lab Outline

1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, 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, Entamoeba histolytica, 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.

Periodic Classification of Elements and Periodic Table i.e., Modern Periodic Table: Classification of elements based on s, p, d, and f orbitals: placement of element on the basis of electronic configuration in periodic table. Group trends and periodic properties, ionization potentials, electron affinities and electronegativities; Redox potential, electrochemical series and its applications.

Chemical Bonding i.e., Nature of a bond, ionic, covalent and coordinate covalent bond Valence Bond Theory (VBT), Molecular Orbital Theory (MOT), Valence Shell Electron Pair Repulsion (VSEPR) theory and hybridization.

Acid Base Equilibria i.e.: General concept of Acids and bases including soft and hard acid base concept, relative strengths of acids, significance of pH, pKa, pKb and buffers, Indicators: (Acid-base, Redox; Adsorption), solubility product, common ion effect and co-precipitation.

Chemistry of p-block elements i.e., Chemistry of Boron, Aluminium, Carbon, Silicon, Nitrogen, Phosphorus, Oxygen, Sulphur, Halogens and Noble Gases; their structure, properties and application.

chemistry of d-Block Elements i.e., Electronic configuration. General characteristics of d-block elements Werner's theory, of coordination compounds nomenclature, nature of coordinate covalent bond. Applications of VBT, MOT and CFT of coordination compounds, introduction of chelates, Isomerism in coordination compounds.

#### 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 Biological Sciences', Ilmi Kitab Khana, Revised Edition (1998).
2. Chaudhry, G. R., 'Text Book of Inorganic Biological Sciences, 2<sup>nd</sup> Edition; New Kitab Markaz, Faisalabad, Pakistan (2001).
3. Bhatti, H.N. and Nasir, B.A. 'Modern Inorganic Biological Sciences, 1<sup>st</sup> Edition, The Carvan Book House, Lahore, (2000).
4. Albert, C.F., Wilkinson G. and Gaus, P.L. 'Basic Inorganic Biological Sciences, 3<sup>rd</sup> Edition, John Wiley & Sons, Inc. NY (1995).
5. Lee, J.D., 'Concise Inorganic Biological Sciences', 5<sup>th</sup> Edition, Chapman & Hall, UK (1996).
6. Jolly, W.L., 'Modern Inorganic Biological Sciences', Biological Sciences', 2<sup>nd</sup> Edition McGraw Hill, NY (1991).
7. Shriver, D.F., Atkins P.W. and Langord, C.H. 'Inorganic Biological Sciences', 2<sup>nd</sup> Edition, Oxford Press, UK (1994).
8. Housecroft, C.E. and Sharpe, A.G., 'Inorganic Biological Sciences', 3<sup>rd</sup> Edition, Longman, NY (1992).
9. Rayner-Canham, G. 'Descriptive Inorganic Biological Sciences', W.H. Freeman & Co. UK (1995).
10. 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).
11. Vogel, A.I., 'A Text Book of Macro and Semimicro Qualitative Inorganic Analysis', Longman Green & Co. NY (1995).
12. Skoog, D.A., West, D.M. and Holler, F.J. 'Analytical Biological Sciences, 6<sup>th</sup> Edition Saunders College Publications, UK (1994).
13. Graham, H. and Man, H. 'Biological Sciences in Context' 5<sup>th</sup> Edition, Thomas Nelson Ltd. U.K. (2000).
14. Philp M. 'Advance Biological Sciences, Cambridge Low Price Edition, U.K. (1996).
15. David H. 'Modern Analytical Biological Sciences, 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 & 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.ELBS

PKS-102 :

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)

BOTANY

2<sup>nd</sup> Year

3<sup>rd</sup> Semester

Cell Biology, Genetics and Evolution

4 (3+1)

Cr. 03

BOT-203

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. Ultra structure of with brief description of structure and function of the following cell organelles

- i. Endoplasmic reticulum      ii. Plastids      iii. Mitochondria      iv. Ribosomes  
v. Dictyosomes      vi. Vacuoles      vii. Microbodies (Glyoxysomes and Peroxisomes)-

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

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

6. Chromosomal aberrations; Changes in number of chromosomes, deficiency, duplication, inversion and translocation.

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.

ZOL-203: **DIVERSITY OF ANIMALS (VERTEBRATES)** 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, cycliophores, 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 chelonina, 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:

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.

## CHEM-203 - ORGANIC CHEMISTRY

4(3+1)

## Course contents:

Cr. 03

## Nomenclature:

Common & IUPAC names and rules of IUPAC.

## Basic Concepts in Organic chemistry:

Localized and delocalized bonding, concept of hybridization leading to bond angles, bond energies, and geometry of simple organic molecules, dipole moment, inductive effect; resonance energy, rule of resonance. Resonance effect steric inhibition, hyper conjugation; tautomerism, hydrogen bonding.

Hydrocarbons (open, closed and aromatic),

## Isomerism:

(Z, E convention, cis; trans, Geometrical, optical isomerism and chirality), optical activity, chirality and optical activity, racemisation, and resolution of racemic mixtures, R,S notation, diastereoisomers, conformational isomerism ;Brief introduction to conformation of ethane, n-butane and cyclohexane.

## Alkyl Halides

Preparation and reaction of alkyl halides with special reference to nucleophilic substitution

And elimination reactions, Grignard reagent; preparation, structure and application in the synthesis in the synthesis of alcohol and carboxylic acid.

## Chemistry of Hydroxyl Group and ethers.

Brief review of physical properties, preparation and reaction of alcohols, phenols; acidity, preparation and reaction of phenols. preparation and reaction ethers.

## Carbonyl Compounds

Structure, reactivity and preparation reactions of aldehydes and ketones

## Chemistry of Carboxylic Acids and their Derivatives

Physical properties of carboxylic acid, effects of substitution and structure on the strength of acidity of carboxylic acid, preparation, properties and reaction of carboxylic acids and their derivatives like esters, amides, acid halides and acid anhydrides

## Chemistry of amino group.

Structure of aliphatic and aromatic primary, secondary, tertiary amines. physical properties of amines, basicity and nucleophilicity of amines preparation and reaction of amines diazonium salts and preparation and application.

## Lab Outline:

(Cr. 01)

Qualitative Organic Analysis

Systematic identification of organic compounds containing groups

Containing groups like COOH, OH, NH<sub>2</sub> and C=O.

Purification techniques viz solvent extraction distillation and recrystallisation etc.

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 Biological Sciences*, Ilmi Kutab Khana, Lahore (2006).
2. Rehman, A. *Text Book of Organic Biological Sciences*, Caravan Book House Lahore (2006).
3. Smith M.B. and March, J. *March's Advanced Organic Biological Sciences*, 5<sup>th</sup> Edition, John Wiley, NY. (2001).
4. Pine, S. H. *Organic Biological Sciences*, (5<sup>th</sup> Edition) McGraw-Hill, NY. (1987).

5. Sykes, P., *A Guide Book to Mechanism in Organic Biological Sciences*, Longman, London (1999).
6. Younas, M. *Organic Spectroscopy*, A. H. Publisher, Lahore (2006).
7. Solomons, T.W.G., *Fundamentals of Organic Biological Sciences*, Wiley, NY (2003).
8. Kemp, W., *Organic Spectroscopy*, Macmillan, London (1990).
9. Vogel, A.I. *A Text Book of Practical Organic Biological Sciences*, Longman, London (1968).
10. Mann, F.G and Saunders B.C. *Practical Organic Biological Sciences*, 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 Biological Sciences*, The Caravan Book House, Lahore (2006).
13. Morrison, R.T. and Boyd, R.N. *Organic Biological Sciences*, Allyn & Bacon, Boston (1987).

ENG-203

ENGLISH-III

3(3+0)

#### 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, Higgins & Middlemiss

Hudson(2002), Mastering English language, McMillan.

Hedge. (1988), Writing, ELBS

McMurry & Chapman (1984) Writing Fundamentals. McMillan.

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

COMP-203 COMPUTER APPLICATIONS 3(3+0)

1. What is Computer

Cr. 03

i. Use of Computer

ii. Parts of Computer System

2. Types of Computer

i. Super Computers

ii. Mainframe Computers iii. Mini Computers

iv. Workstation Computer v. Micro Computers vi. Handheld Personal

Computers vii. Tablet PC viii. Cellular Phones

3. Hardware Components

i. Microprocessors

ii. Mother board

iii. Bus and Bus Types

iv. Cache Memory



4. Memory and Storage Devices
5. Software and Types of Software
6. Operating Systems and its types
7. Input and Output Devices
8. Internet and use of Internet

i. Search Engine

i. E-Mail

#### Lab Outline

1. MS Word
2. MS Excel
3. MS Power Point

WWW.SU.EDU.PK

2<sup>nd</sup> Year

4<sup>th</sup> Semester

Plant Physiology and Ecology

4(3+1)

Cr. 03

BOT-204

Theory

a) Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal 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 Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

5. Growth: definition, role of auxins, gibberellins, cytokinins, abscisic acid and ethylene in controlling growth: Introduction to plant tissue culture.

6. Photoperiodism: definition, historical background, classification of plants based on photoperiodic response, role of phytochromes, and hormones and metabolites in photoperiodism.

7. Dormancy: definition and causes of seed and bud dormancy, methods of breaking seed dormancy. Physiological processes during seed germination.

8. Plant Movements: Classification, tropic movement phototropism. Gravitropism and their mechanisms: Nastic movement.

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:

- i. Causes, effects and control of water logging and salinity with respect to Pakistan.
- ii. Soil erosion: type, causes and effects( wind and water)
- iii. Brief concept of pollution types and effects (air, sediments and water pollution)
- iv. Brief introduction to biodiversity and conservation with emphasis on Pakistan.

Cr. 01

**Lab Outline:**

**a) Plant Physiology**

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium-chloride solution of different concentrations.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a 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 Quadrant and line intercept methods.
4. Field trips to ecologically diverse habitats.
5. Measurements of wind velocity.
8. Measurement of light and temperature.
9. 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. Sinauer's 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



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, nemerteans, 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, Rana tigrina, 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 *Catla catla* or Labeo or any other local fish, frog, pigeon and rat or 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-204 CHEMISTRY SPECIAL TOPICS

(Cr. 03)

#### Bio-molecules and Simple Heterocycles.

Brief introduction to the chemical nature of carbohydrates, proteins, lipids, nucleic acids, their importance in living systems. Nomenclature of simple heterocyclic structures containing O, N, S in five and six membered rings, furan, pyrrole and pyridine and thiophene and their properties, synthesis and reactions of simple heterocycles

#### Introduction to Spectroscopy

Spectroscopic method (IR & UV/Vis) structures elucidation of different organic compounds by these techniques.

#### Surface Phenomena and Colloids.

Physical adsorption and chemisorption. type of adsorption isotherms. Basic concept of Langmuir adsorption isotherm and application. type and properties of colloidal, suspension. preparation and application of colloidal suspensions.

#### Nuclear chemistry.

Natural and artificial radioactivity, stability of nuclei, nuclear transformation, rate of radioactive disintegration, a measurement of nuclear radiations, nuclear reaction, fusion, fission, nuclear reactor, uses of radioisotopes in various fields, nuclear hazards and safety measures.

Modern materials.

Brief introduction of liquid crystals, inorganic polymers, ceramics, fiber glass, thin films, semi conductors, composite materials.

Chemical industries.

Metallurgy of Al, manufacturing of sulphuric acid, nitric acid, fertilizers, cement and glass.

Lab outline

(Cr. 01)

1. Determination of adsorption parameters using Langmuir adsorption isotherm of acetic acid on charcoal.
2. Percentage determination of barium in barium nitrate by gravimetric method.
3. Gravimetric determination of nickel.
4. Structure elucidation of some simple organic compounds by spectroscopy (Spectrum interpretation).
5. Tests for lipids, proteins, carbohydrates.

#### RECOMMENDED BOOKS (CHEMISTRY SPECIAL TOPICS)

- 1: Voet, D. R and Voet, J. G. *BioBiological Sciences*, John Wiley & Sons, NY (2001).
- 2: Kent, J.A. Riegel's *Handbook of Industrial Biological Sciences*, CBS Publishers and Distributors, New Delhi, (1997).
- 3: Arnika, H.J. *Nuclear Biological Sciences*, Krishna Prakashan Media (P) Ltd. (1998).
- 4: Gurdeep R. "Advanced Physical Biological Sciences", Krishna Prakashan Media (P) Ltd. Delhi (2002).
- 5: Younas, M., *Organic Spectroscopy*, A. H. Publisher, Lahore (2005).

ENG-204

ENGLISH-IV

3(3+0)

Course Objectives:

credit hours 03

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

Essay

On the Love of the Country by W. Hazlitt

The Idea of a University by Henry & Cardinal Newman

Western Civilization by Bertrand Russell

Words and Behavior by D H Lawrence

Bachelor's Dilemma by Herbert Gold

Tolerance by E M Foster

To err in Human by Lewis Thomas

Short Plays

The Little willow by Francis tower

The Woman Who had Imagination by

H E Bates

The Shadow in the Rose Garden by D.H.

Lawrence

Araby by James Joyce

Breakfast by John Steinbeck

On Guard by Evelyn Waugh

Short Stories

Riders to the Sea by J M Synge

The Boy Comes Home By A A Milane

Poems

John Milton

Paradise Lost. Book, I, Line 1-26

Paradise Lost, Book IX; Line 896-916)

Literture

Wordsworth

Solitary Reaper

Intimation of Immortality

John keats

Ode to Autumn

thoery

The Last Ride Together

Meeting at Night

parting in the Morning

Novel

animal form by George Orwell

References

Gill, G. (1985) mastering English

Literture. McMillan

Burns & McNamara(1987)

A close Study, McMillan

Brooks,C. Et al an Approach to

Literture, Prentice Hall

Gudden,J A.(1975) Dictionar of

Literacy Terms and Literacy



## Course Contents

Credit Hours 03

1. **Introduction: Nature and Scope of Social Psychology**  
Understanding social behavior; social psychology: a working definition; origin & development of social psychology; how social psychology attains knowledge
2. **Social Perceptions: Knowing Others**  
Nonverbal communication: the unspoken language; Attribution: understanding the causes of others behavior; impression formation and impression management; combining and using social information
3. **Social Cognition: Understanding the Social World**  
Schemes and their effects; heuristics: mental shortcuts: potential sources of error: why total rationality is so rare? The interplay of affect and cognition
4. **Attitudes: Evaluating the Social World**  
Forming attitudes; how do we develop the views we hold? Persuasion: using messages to change attitudes: cognitive dissonance: when our behavior affects our attitude?
5. **Social Influence: Changing Others Behavior**  
Conformity: group influence in action: compliance: obedience: social influence by demand
6. **Groups and Individuals: The Consequences of Belonging**
7. **Groups: their nature and function: groups and task performance: decision making by groups: leadership: patterns of influence within groups.**

**Books Recommended:**

1. Baron R.A., Byrene, D., & Johnson, B.T. (1998). Exploring Social Psychology (4<sup>th</sup> Ed). London: Aylton and Bacon
2. Callon V.J., Gallois, C., Noller., & Kashima, Y. (1991). Social Psychology. (2<sup>nd</sup> Ed). Australia: Harcourt.
3. Myers, G.R. (2003). Social Psychology. (6<sup>th</sup> Ed). New York Prentice Hall.

**MATH-204 MATHAMATICS FOR BIOLOGICAL SCIENCES.**

Cr . 03

I;Algebra:

Preliminaries: Real and complex numbers, Introduction to sets, set operations, functions, types of functions. Matrices: Introduction to matrices, types of matrices, inverse of matrices, determinants, system of linear equations, Cramer's rule. Quadratic equations: Solution of quadratic equations; nature of roots of quadratic equations, equations reducible to quadratic equations. Sequence and Series: Arithmetic, geometric and harmonic progressions. Permutation and combinations: Introduction to permutation and combinations, Binomial Theorem: Introduction to binomial theorem. Trigonometry: Fundamentals of trigonometry, trigonometric identities. Graphs: Graph of straight line, circle and trigonometric functions.

## 2. Statistics:

Introduction: Meaning and definition of statistics, relationship of statistics with social science, characteristics of statistics, limitations of statistics and main division of statistics. Frequency distribution: Organisation of data, array, ungrouped and grouped data, types of frequency series, individual, discrete and continuous series, tally sheet method, graphic presentation of the frequency distribution, bar frequency diagram histogram, frequency polygon, cumulative frequency curve: Measures of central tendency: Mean, median and modes, quartiles, deciles and percentiles. Measures of dispersion: Range, inter quartile deviation, mean deviation, standard deviation, variance, moments, skewness and kurtosis.

### Recommended Books:

1. Swokowski, E. W., 'Fundamentals of Algebra and Trigonometry', Latest Edition.
2. Kaufmann, J. E., 'College Algebra and Trigonometry', PWS-Kent Company, Boston, Latest Edition.
3. Walpole, R. E., 'Introduction of Statistics', Prentice Hall, Latest Edition.
4. Wilcox, R. R., 'Statistics for The Social Sciences',

BOT- 305

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

Cr.3 (2+1)

**1. Introduction objectives and scope:**

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

**2. Frequency distribution:**

- i. Variable types
- ii. Formation of frequency table from raw data
- iii. Summation, notation and statistical inference
- iv. Data transformation.

**3. 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.

**4. Organizing and describing data (Standard distributions):**

- i. Random sampling and the binomial distribution
- ii. Probability, Types of Probabilities, Random variables, Combining probabilities, Probability distributions. Binomial distributions.
- iii. Poisson and normal distributions, properties and applications.

**5. 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

**6. 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.

**7. 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 analyzing the two-way ANOVA, Linear combination, multiple comparisons.

Lab outline:

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. Oton, P., Adams, S. and Voelker, D. H. 2001. Cliffnotes for statistics. Blackwell Scientific Publishers.

3. Pacano, M. and Gauvreau, K. 2000. Principles of Biostatistics. Cambridge University Press.

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.

8. Triola, M. F. and Triola, M. M. 2005. Biostatistics for Biological and Health Sciences. Pearson Addison Wesley.

9. Zar, J. H. 1999. Biostatistical Analysis, Pearson Education.

BOT-306

Cr. 02

3 (2+1)

Bacteriology and Virology

Theory

## 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

b) Plant microbe interaction

Lab outline:

a) Viruses

Observation of symptoms of some viral infected plant specimens.

b) Bacteria, Actinomycetes and Cyanobacteria

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

Recommended Books:

1. Bläck, J. G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. Microbiology McGraw-Hill Companies, Inc.
3. Arora, D. R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
4. Ross F. C. 1995 Fundamentals of Microbiology. John Willey & Sons, New York.
5. Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens. The Haworth Press, Inc.
6. 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.  
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

## 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, Anthoceropsida and Bryopsida.

Cr. 01

## Lab Outline:

## a) Phycology:

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

## b) Bryology

Study of the following genera:

Pellia, Porella, Anthoceros and Polytrichum.

## Recommended Books:

1. Bold, H. C. and M. J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs
2. Lee, R. E. 1999. Phycology. Cambridge University Press, U.K.
3. Dawson, E. Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.
4. Chapman, V. J. and D. J. Chapman. 1983. Sea weed and their uses. MacMillan and Co. Ltd. London.
5. Vashishta, B. R. 1991. Botany for degree students. Bryophytes 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. Sigee. 2010. Fresh water algae (Identification and use as bioindicators). John Wiley & Sons.
11. Hussain, F. 2013. Phycology. A text book of Algae. Pak Book Empire Lahore.
12. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Bryophytes. S. 13. 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.

## a) Mycology

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

## b) Pathology

1. Introduction and classification of plant diseases.
2. Symptoms, causes and development of plant diseases.
3. Loss assessment and disease control
4. Epidemiology and disease forecast
5. Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. damping off, mildews, rusts, smuts, dieback, red rot of sugarcane etc.
6. Systemic resistance: Induced systemic resistance (ISR), Acquired Systemic resistance (ASR).

Cr. 01

## Lab Outline:

## a) Mycology

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

## b) Pathology

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

## Recommended Books:

1. Agrios, G. N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A. R., 2004: Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.
3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M., 1996: Introductory Mycology, 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. Trigianno, R. N., Windham, M. T. and Windham, A. S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

Journals / Periodicals:

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

**BOT-309**

**Diversity of Vascular Plants**

3 (2+1)

Cr. 02

**Theory**

**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. Rhynia General characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida (Psilotum), Lycopsidea (Lycopodium, Selaginella), Sphenopsida (Equisetum), Pteropsida (Ophioglossum, Dryopteris and Azolla/Marsilea).

**b) Origin and Evolution of seed habit.**

**c) Gymnosperms:**

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

**c) Angiosperms:**

Origin, general characteristics, Importance, and life cycle of angiosperms. Evolution of fruit habit.

**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-I&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. Fægri, K., P. E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, John Wiley & Sons. N: Y.
  11. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Pterodophyta. S. Chand & Co. New Delhi
  12. B. P. Panday. 2006. College Botany. Vol I & 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

BOT-310

Plant Systematic

3(2+1)

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 Genealogy / 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 Prantl, 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. Cappariaceae            | 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. Poaceae (Gramineae)      |
| 23. Ranunculaceae          | 24. Rosaceae                 |
| 25. Salicaceae             | 26. Scrophulariaceae         |
| 27. Solanaceae             |                              |

#### 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 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Greuter, W., McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Filguerras, T. S., Nielson, D. H. Silva, P. C., Skog, J. E., Trehane, P., Turland, N. J. & Hawksworth, D.L.,(eds.) 2000. International code of botanical nomenclature (Saint Louis Code) adopted by the Sixteenth International botanical congress St. Louis Missouri, July -August 1999. Koeltz, Konigstein. (Regnum Veg.138.)
4. Davis, P. H. & Heywood, V. H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants; Chapman & Hall. London
6. Nasir, E. & Ali, S. I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold.
8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh
9. Jones, S. B. and Luchsinger, A. E. 1987. Plant 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. University Press.
15. Sivaraman V. V and N. K. Prabson 1991 Introduction to the Principles of Plant Taxonomy.
16. Radford, A. E., W. C. Dickison, J. R. Massey, and C. R. Bell. 1998 Vascular Plant Systematic. Harper and Row, New York.
17. Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.
18. Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.
19. Heywood V. H. 1978. Flowering Plants of the World. Oxford University Press.
20. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press.
21. Soltis, D. E. P. S. Soltis, P. K Endress, and M. W. Chase, 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.
22. 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

Anatomy of Vascular Plants

3(2+1)

BOT-311

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.

Cr..01

Lab outline:

1. Study of organization of shoot and root meristem, different primary and secondary tissues from the living and preserved material in macerates and sections, hairs, glands and other secondary structures.
2. Study of abnormal/unusual secondary growth.
3. Peel and ground sectioning and maceration of fossil material.
4. Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides.

Recommended Books:

1. Dickison, W. C. 2000. Integrative plant anatomy. Academic Press, U. K.
2. Fahn, A. 1990. Plant Anatomy. Pergamum Press, Oxford.
3. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
4. Metcalfe, C. R. and Chalk, L. 1950. Anatomy of the Dicotyledons. Clarendon Press, Oxford.
5. Anon. Manual of Microscopic Analysis of Feeding Stuffs. The American Association of feed Microscopists.
6. Vaughan, J. G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.
7. Metcalfe, C.R. 1960. Anatomy of the Monocotyledons. Gramineae. Clarendon Press, Oxford.
8. Metcalfe, C. R. 1971. Anatomy of the Monocotyledons. V. Cyperaceae. Clarendon Press.

- Oxford.
9. Cutler, D. F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford.
  10. Cutler, D. F. 1978. Applied Plant Anatomy. Longman Group Ltd. England
  11. Raymond, E. S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
  12. Eames, A. J. and L. H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat McGraw-Hill Publishing Company Limited, New Delhi.

Journals / Periodicals:

Pakistan Journal of Botany

BOT-312

Genetics-I

3 (2+1)

Cr. 02

Theory

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 symbolisms, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,
3. Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.
4. Recombination in Bacteria and their Viruses: Bacterial chromosome, bacterial conjugation, bacterial recombination and mapping, the E.coli chromosome, bacterial transformation, bacteriophage genetics, transduction, mapping of bacterial chromosomes, bacterial gene transfer.
5. The 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: Variations 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. Sudbury, 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 Education.
  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 Bartlett.
  18. Noureddine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.
- Journals/Periodicals:
- J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

**Course Outline:**

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 defense proteins and peptides, Defensins and related proteins, Synthesis and functions of non-ribosomal peptides

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

Introduction to Enzymes: Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Enzyme kinetics. Nature of active site and mode of action. Allosteric enzymes and feedback mechanism. Enzymes with multiple functions - mechanisms and evolution. 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

3 (2+1)  
Cr. 02

Theory :

1. **Introduction:** history and recent developments in ecology
2. **Soil:** Nature and properties of soil (Physical and Chemical). Water in the soil-plant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion
3. **Light and temperature:** Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,
4. **Carbon dioxide:** Stomatal responses; water loss and CO<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.

Cr . 01

#### Lab Outline:

1. Determination of physico-chemical properties of soil and water.

2. Measurements of light and temperature under different ecological conditions.

3. Measurements of wind velocity.

4. Measurement of 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.

## Theory :

1. **Photosynthesis:** History of photosynthesis. Nature and units of light: Determination of oxygenic and anoxygenic photosynthesis. Ultra structure of thylakoid vesicle. 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. Methods of measurement of photosynthesis.
2. **Respiration:** Synthesis of hexose sugars from reserve carbohydrates. Mechanism of respiration- Glycolysis, Differences between cytosolic and chloroplastidic glycolysis, Oxidative decarboxylation, Krebs cycle; Regulation of glycolysis and Krebs cycle, Electron transport and oxidative phosphorylation. Aerobic and anaerobic respiration. Energetics of respiration. Pentose phosphate pathway. Glyoxylate cycle. Cyanide resistant respiration.
3. **Translocation of Food:** Pathway of translocation, source and sink interaction, materials translocated, mechanism of phloem transport, loading and unloading.
4. **Leaves and Atmosphere:** Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation.
5. **Assimilation of Nitrogen, Sulphur and Phosphorus:** The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

## Lab Outline:

1. To determine the volume of 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. Ihsanllahi, 1991. Plant Growth, UGC Press, Islamabad.
6. Ihsanllahi, 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. Sinauers Publ. Co. Inc. Calif.
11. W.B. Hopkins. 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

BOT-316

Molecular Biology

3 (2+1)

Cr. 02

Theory:

1. Nucleic Acids: DNA-circular and superhelical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA, Central Dogma.
2. Proteins: Basic features of protein molecules. Folding of polypeptide chain,  $\alpha$ -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.

Cr. 01

Lab Outline:

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

1. Extraction of RNA, DNA and proteins
2. Electrophoreses: One and two dimensional
3. Purification of proteins, RNA and DNA.
4. Amplification using PCR.
5. Northern, Western and Southern Blotting.

Recommended Books:

1. Cullis, C. A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.
2. Gibson, G. and S. V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.
3. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.

4. Lodish, H. et al., 2004: Molecular Cell Biology. 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

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

BOT-417 Plant Biochemistry-II

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:

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.

Cr . 01

Recommended Books:

1. Conn E. E. and Stumpf, P. K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Albert L. Lehninger, 2004. Principles of Biochemistry. Worth Publishers Inc.
3. Voet, D. Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.
4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
5. Smith, E. L., Hill, R. L., Lehman, R. I., Lefkowitz, R. J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.
6. Zubay, G. 2003, Biochemistry, MacMillan Publishing Co., New York.
7. Chesworth, J. M., Strichbury T. and Scaife, J. R. 1998. An introduction to Agricultural Biochemistry. Chapman and Hall, London.
8. Mckee, T. and Mckee, J. R. 1999. Biochemistry - An Introduction. WCB /McGraw-Hill, New York, Boston, USA.
9. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 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
12. Bartlett, London.

13. Goodwin T. W. and Mercer, E. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
  14. Heldt, H. W. 2008. Plant Biochemistry. 3<sup>rd</sup> Edition, Academic Press, U. K.
  15. 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-418

Plant Ecology-II

3(2+1)  
Cr. 02

**Theory**

**A. Population Ecology**

1. Population structure and plant demography: Seed dispersal, Dormancy, Seed Bank, Seed dormancy, Recruitment, Demography
2. Life history pattern and resource allocation: Density dependent and Density independent factors, Resource allocation, Reproductive effort, Seed size vs seed weight, Population genetics, Evolution

**B. Community Ecology:**

Historical development of community ecology, Community concepts and attributes, Methods of sampling of plant communities, Ecological succession, Community soil-relationship, Local Vegetation, Vegetation of Pakistan, Major formation types of the world

**C. Ecosystem Ecology:**

Ecological concepts of ecosystem, Boundaries of ecosystem, Compartmentalization and system concepts, Energy flow in ecosystem, Biogeochemical cycles: water carbon and nitrogen Case studies: any example

**Lab Outline:**

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

**Recommended Books:**

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

11. Larcher, W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag.  
Journals/Periodicals: Ecology, Journal of Ecology, Journal of Applied Ecology

BOT-419-

Plant Physiology-II

3 (2+1)

Cr. 02

Theory:

- 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. Hofler diagram - analysis of change in turgor, water and osmotic potential with changes in cell volume. Modulus of elasticity coefficient, Hydraulic conductivity. Osmoregulation, Methods for measurement of water, osmotic and turgor potentials- Pressure chamber, psychrometry, pressure probe, pressure volume curve.
- 3. Plant Mineral Nutrition:** Inorganic composition of plant and soil. Absorption of mineral nutrients - roots, mycorrhizae. Effect of soil pH on nutrient availability. Ion traffic into root. The nature of membrane carriers, channels and electrogenic pumps. Passive and active (primary and secondary) transports and their 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 signaling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.
- 6. Signal transduction in prokaryotes and eukaryotes.**
- 7. Dormancy;** definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process of seed germination.
- 8. Plant Movements;** Tropic movement-phototropism, gravitropism and their mechanism. Nastic movements.

Lab Outline:

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. 1992. Plant Physiology. 5<sup>th</sup> Edition. Wadsworth Publishing Co. Belmont CA.
  9. W. B. Hopkins. 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-420

Genetics-II

3 (2+1)

Cr. 02

Theory:

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

Cr. 01

**Lab Outline:**

Problems relating to the theory

1. Isolation and separation of DNA and protein on Gel electrophoresis.
  - i. Bacterial chromosome
  - ii. Plasmid DNA (minipreps)
  - iii. Plant DNA
  - iv. Protein.
2. DNA Amplification-by PCR

**Recommended Books:**

1. Trun, N. and Trempey J. 2004, Fundamental Bacterial Genetics, Blackwell Publishing House.
2. Winnacker, E. L. 2003, From Gene to Clones Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.
3. Beaycgamp, T. L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.
4. Brown, T. A. 2002 Genomes, Bios Scientific Publishers Ltd.
5. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.
6. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India.
7. Lwein, B. 2004, Gene VIII, Pearson Education Int.
8. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India.
9. Hartt, D. L. and Jones, E. W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA
10. Gelvin, S. B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
11. Primrose, S. B., Twyman, R. M. and Old R. W. 2004. Principles of Gene Manipulation, an Introduction to Genetic Engineering (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, and William M Gelbart. W. H. 2009. An Introduction to Genetic Analysis, 7th Edition. Freeman and Company.
15. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.
16. MahmutCaliskan: 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 Bartlett.
  22. Nouredine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

Journals / Periodicals:

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

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

BOT-421 Seminar/Presentations

1(1+0)

Each student will be allotted a topic from about sixty latest and advance topics according to current needs.

Bot-422

Biodiversity and Conservation

3 (2+1)  
Cr, Hr 02

Course contents:

1. Introduction and importance of biodiversity: Species diversity, Ecological diversity, Genetic diversity and Social diversity.
2. Causes and depletion of biodiversity: habitat loss, habit fragmentation, over exploitation, climate changes, invasive species, sea water intrusions.
  - ii. The value of species.
  - iii. How species become endangered.
  - iv. Extinction of species, present rate. Theory of mass extinction.
  - v. Inventory and monitoring of biodiversity.
  - vi. Importance of red data book.
  - vii. *In situ* and *ex situ* conservation of plants.
  - viii. Implementations of laws (protection and conservation of various taxa).
  - ix. Sustainable use of biodiversity (plant wealth).
  - x. Protected areas of Pakistan.
  - xi. Criteria for determining different categories of protected areas.
  - xii. Baseline study.
  - xiii. Impact Assessment.
  - xiv. Management plan for protected areas.
  - xv. IUCN categorized for of threatened species.
  - xvi. Criteria for recognising different categories of threatened species.
  - xvii. Gene bank management and operation.
  - xviii. Public awareness strategies.
  - xix. Population explosion.
  - xx. Biodiversity action plan for Pakistan
  - xxi. Role of herbarium and Botanical Garden in biodiversity conservation.

Lab outline:

Cr.Hr.01

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

Recommended Books:

1. Bush, M. B. 1997. Ecology Of Changing Planet. Parentiee Hall.
  2. Cunningham, A.B., 2001. Applied Ethnobotany: People Wild Plant Use And Conservation. Earthspan Publications.
  3. Cotton, C. M. 1996. Ehtnobotany Principle Application. John Wiley & Sons Chechester. UK.
  4. De Klém. C. 1990. Wild Plant Conservation, IUCN, Gland.
  5. Dyke, E. V. 2003. Conservation Biology. Cambridge University Press, Cambridge, UK.
  6. Grombridge, B. And Jenkins, M. D. 2002. World Atlas of Biodiversity. Earth Living Resources In The 21 Century University, California Press, Berkley.
  7. Heywood, V. H. 1995 Global Biodiversity Assessment. Cambridge University Press And UNEP.
  8. Krishma Murthy K V. 2003. A Textbook Of Biodiversity, Science Publishers Inc Enfield, Nh, Usa.
  9. Levine, D.A. The Origin Expansion And Demise Of Plant Species. Oxford University Press.
  10. Ministry Of Environment, IUCN, WWF, 1998. Biodiversity Action Plan for Pakistan.
  11. Primmack, R.B. 1998. Essential of Conservation Biology. Sinaur Association Pb, Mass USA.
  12. Virchow, D. (1998). Conservation of Genetic Resources. Springer-Verlag, Berlin.
- Journals /Periodicals :  
Systematics and Biodiversity, Biological Conservation.

BOT-423

Environmental Biology

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, 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. **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).

Cr. 01

**Lab Outline:**

1. Examination of industrial waste water and Municipal sewage and sludge for

- i. Total dissolved solids.
- ii. PH and EC...
- iii. BOD/COD.
- iv. Chlorides, carbonate, and Nitrates.

2. Examination of water samples forms different sites for the presence and diversity of organisms;

3. Effect of air pollutants on plants.

4. Visits to environmentally compromised sites and evolution of remediation methods.

**Recommended Books:**

1. Newmān, 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. McGraw-Hill USA. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. W. W. Norton and Company, NY.
  5. Hall, C. A. S. and Perez, C. L. 2000. Quantifying Sustainable Development. Academic Press, UK.
  6. Bazzaz, F. A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.
  7. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.
  8. Marsh, M.W. and Grossa Jr., J.M. 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.
  9. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
  10. Mohamamd Ashfaq and Mushtaq A. Saleem. Environmental Pollution and Agriculture.
  11. Shah Faisal Muhamamd and Sultan Mehmood; 2012. Lambert Publishers Germany.
  12. Advanced Air and Noise Pollution Control, L. K. Wang, N. C. Pereira and Y. T. Hung, Humana Press, 2005.
  13. Air Pollution Control Technology Handbook, K. B. Schnelle and C. A. Brown; CRC Press, 2002. Handbook of Solid Waste Management and Waste Minimization Technologies, N. P. Cheremisin off, Butterworth-Heinemann, 2003.
  14. Pollution Control In Process Industries, S. P. Mahajan, Tata McGraw-Hill, 1985.
  15. Industrial Pollution control: issues and techniques, N. J. Sell, Van Nostrand Reinhold, 1992.
  16. Environmental Biotechnology: Basic Concepts and Applications, I. S. Thakur, I.K. International Publishing House Pvt. Limited, 2006.
  17. Vandermeer, John H. 2011. The ecology of agro-ecosystems - Jones and Bartlett Publishers; Sudbury, Mass; 2011 - xv, 387 p.
  18. Greipsson, Sigurdur. 2011. Restoration ecology - Jones and Bartlett Publishers; Sudbury, MA; 2011 - xvi, 408 p.
  19. Santra, S. C. 2010. Fundamentals of ecology and environmental biology - NewCentral Book Agency; London; 2010 - 353p.
  20. Singh, M.P. 2007 Forest environment and biodiversity Daya; New Delhi; 2007 -556p.
- Journals/Periodicals: Environmental Biology, Environment, Bioremediation

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., Lodish, H. And Baltimore, 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

## INTRODUCTION TO STATISTICS

Credit Hours: 3 (3+0)

BOT

### 1. What is Statistics?

Definition of Statistics, Population, sample Descriptive and inferential Statistics. Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

### 2. Presentation of Data

Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

### 3. Measures of Central Tendency

Introduction, Different types of Averages, Quintiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection Exercises.

### 4. Measures of Dispersion

Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

### 5. Probability and Probability Distributions.

Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

### 7. Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

### 8. Testing of Hypothesis- Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

### 9. Testing of Hypotheses- Two or more Populations

Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

### 10. Testing of Hypothesis- Independence of Attributes

Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

### 11. Regression and Correlation

Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation.  $r$  and  $R^2$ . Correlation. Coefficient of linear

correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

#### Recommended Books

1. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., inc. New York.
2. Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar- Faisalabad.
3. Note: General Courses from other Departments
4. Details of courses may be developed by the concerned universities according to their Selection of Courses as recommended by their Board of Studies.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: Wm Dawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and Cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.