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<td>BSZ-472</td>
<td>Protozoology, Pathology and Immunology</td>
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<td>Ichthyology</td>
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<td>BSZ-482</td>
<td>Helminthology and Host-Parasite Relationship</td>
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<td>BSZ-483</td>
<td>Applied Fisheries</td>
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<td>BSZ-484</td>
<td>Research, Thesis and Presentation / Special Paper</td>
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|            | Total credit hours | 133     |

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**Detail of Courses**

**BS 4 year Programme (ZOOLOGY)**

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<th>SEMESTER-1</th>
<th>Pakistan Studies</th>
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</tr>
<tr>
<td>BSZ-115</td>
<td>Cell Biology</td>
<td>3-1</td>
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</table>

| BSZ-111 | Pakistan Studies | 3-0 |

**I. CREATION OF PAKISTAN**

a) **Ideology**: Conservative and liberal perspectives
   i) Significance before and after independence
   ii) Quaid-e-Azam’s vision about Pakistan

b) **POLITICAL DYNAMICS**
   i) Democracy and authoritarianism
      1. **Political Culture**: Parities and pressure groups
   iii) **National integration**: Resources and distribution
   iv) Governance and civil rights

**II. ECONOMY**

i) Agro-industrial growth
   ii) Irrigation projects
   iii) Economic development and poverty alleviation
   iv) Foreign aid and economic stability
   v) Characteristics of developing countries

**III. FOREIGN POLICY**

Determination of foreign policy, national interests, post-cold war environments of Pakistan: new world, order and nuclear non-proliferation

**IV. ENVIRONMENT**

i) Definition and dimensions, management and natural resources
ii) Environmental protection

**V. POPULATION**

Characteristics: Rural; urban; gender; age groups; and population growth, economic indicators: employment; education health and poverty, migration

**VI. SOCIETY**

Definitions, characteristics: multilingual, multi-ethnic and parochial, social stratification and social mobility, social problems

**VII. CULTURE**

Definitions, social organization; kinships; family; clan and tribe, material and non-material cultures, cultural institutions

**Books Recommended**

3. Safdar Mehmood Pakistan Kayyum Tooda Idara-Saqafat-e-Islamia, Club Road Lahore
Introducing ourselves
Describing places/things/subjects
Obtaining and giving information
Recounting past events
Gender discrimination in the work places in Pakistan
Literature or Science: impact on Society
Report writing
Presentation Skills

**Books Recommended**

**Books Recommended**
1. Algebra and Trigonometry (Mathematics XI), Punjab Text Book board
### BSZ-114  Organic Chemistry

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<tr>
<td>Introduction to organic chemistry</td>
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<tr>
<td>Importance of organic chemistry</td>
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<tr>
<td>Sources of organic compounds</td>
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<tr>
<td>Functional groups etc</td>
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<tr>
<td>Nomenclature, preparation and reactivity of aldehyde, ketones, alkyl halides, carboxylic acids, alcohols and phenols</td>
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</tbody>
</table>

**Practical**

1. Melting point and boiling point of organic compounds
2. Fractional distillation of organic compound
3. Preparation of aspirin, acetamide, nitro benzene, iodoform
4. Identification of organic compounds

**Books Recommended**

1. Organic chemistry for B. Sc by M. Younas
2. Organic chemistry by B. S. Bhal

### BSZ-115  Cell Biology

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Introduction to cell theory, structure, chemical constituents of cell and cell organelles and their functions, separation of cell organelles, Cell membrane, its molecular organization and functional role, The concept of the unit membrane, the fluid mosaic model, membrane receptors and transport mechanisms. Endoplasmic Reticulum. Lysosome, Micro-bodies, Mitochondrial ultra structure and function, Chloroplast ultra structure and the mechanism of photosynthesis, Cell movements, structure and function of cytoskeleton, centriole, cilia and flagella, the mitotic apparatus, The nucleus, structure and function of chromosomes, the cell cycle, mitosis, meiosis.</td>
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**Practical**

Handling and use of various microscopes

1. Demonstration of cell structure through photograph of electron microscope
2. Cell structure in the onion and staminal hair of Tradescantia
4. Mitosis: smear preparation of onion roots
5. Meiosis: smear preparation from anthers of plants such as onion, Wheat, maize et al.

**Books Recommended**

2. Lodish, H. D. Baltimor, A. Berk, S.L. Zipursky, P. Matsudaira, J. Darnell,
### SEMESTER-2

<table>
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<td>BSZ-123</td>
<td>Morphology of Vascular Plants</td>
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<td>Inorganic Chemistry</td>
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<tr>
<td>BSZ-125</td>
<td>Invertebrate Zoology</td>
<td>3-1</td>
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| Total       |                                                  | 16      |

#### BSZ-121 Islamic Studies (3-0)

1. Tauheed
2. Prophet Hood
3. Belief in the world hereafter
4. Worship
5. Amar Bel Maroof WA Nahe Anel Munkar
6. Unity of Umma
7. Lawful earning
8. Fundamental human rights
9. Rights of women
10. Relations with non-Muslims

**PORTIONS OF AHADIS**

1. Ten ahadis translation and explanation
2. The last sermon of the prophet
3. Uswae hasna (life of the prophet)

**Books Recommended**

1. Islamiyat Compulsory by Dr. Saeedullah Qazi and Dr. Arif Naseem. new edition 2002
2. Islamiyat Compulsory by M. Mukhtar Hassan.
3. Islamic studies by M.D Zaffar

#### BSZ-122 Communication Skills (3-0)

**Communication**

Definition, nature and importance of communication, Types of communication (verbal, non-verbal communication etc), effective communication, barriers of communication.

**Technical Writing**

Report writing, c.v., letters, applications

**Oral Communication**

Bad listening habits, effective listening oral presentations, steps/procedures, instructional presentations, persuasive presentations, interviews and group discussions.

**Books Recommended**

1. Murray Cunningham, ‘Communication’ Macmillan
2. Allan A. Glathon, 1975 Pattern of Communication NP
4. Scott 1974: Experience and Communication Forqan and Company
5. Simon and Schuster Communication Essentials University of Phoenix.
7. Murphy et. Al., Effective Business Communication
BSZ-123 Morphology of Vascular Plants 2-1

Introduction: Primary and secondary plant body, different parts of a typical seed plant
Seed: Structure of dicot and monocot seed, germination, types of germination, germination of dicot and monocot seed
Root: Introduction, various types of roots; modification of different types of roots.
Stem: Definition and various types of stems
Leaf: Definition, detail study of its various types
The flower: definition, parts; calyx, corolla, androecium, gynoecium, floral formula and floral diagram.
The inflorescence: definition, types.
Pollination: definition, types. Fertilization and formation of seed and fruit
The fruit: definition, types. Dispersal of seed and fruit: different modes of dispersal of seeds and fruits.

Practical: To study various morphological Characteristics of:
I. Leaves II. Stems III. Roots
IV. Flowers V. Fruits etc

Books Recommended
Takhtajan.A. Flowering Plants .2009. Springer

BSZ-124 Inorganic Chemistry 2-1

INORGANIC CHEMISTRY
Periodic classification and periodic properties of elements
Chemical bonding (VB and MO) theories
Shape of atoms and molecules
Acid and bases
Noble gases and their compounds
Chemistry of halogens, Pseudohalogens and polyhalides
Laboratory work pertaining to above course
Books Recommended

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<th>BSZ-125</th>
<th>Invertebrate Zoology</th>
<th>3-1</th>
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1. **Introduction:** Classification; evolutionary relationships and tree diagrams; patterns of organization
2. **Animal-like protests (Protozoan):** General characteristics; movement, nutrition, reproduction, life style (symbiotic, parasitic etc), introduction to its classification, phylogenetic relationship.
3. **Invertebrates:** General characteristics as above. i. Sponges and cnidarians, ii. flatworms, roundworms, rotifers. iii. Arthropods, iv. Insects, v. evolutionary trends in invertebrates.

Books Recommended
8. **Farzana Perveen** and Anzela Khan (2012) Pearl Culturing Industry. 1-123; ISSN: 978-3-8465-8380-7; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com.

Practicals
1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, and Paramecium as representative of animal like protists. (Prepared slides)
2. Study of sponges and their various body forms.
3. Study of principal representative classes of phylum Coelenterata.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum Nematoda.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
10. Preparation of permanent stained slides of the following: Obelia, Daphnia, Cestode, Parapodia of Nereis.

**Books Recommended**

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### SEMESTER-3

<table>
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<tr>
<th>Course No.</th>
<th>Title</th>
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<td>BSZ-232</td>
<td>Computer Applications</td>
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<td>BSZ-233</td>
<td>Plant Systematics and Anatomy</td>
<td>2-1</td>
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<td>BSZ-234</td>
<td>Microbiology</td>
<td>2-1</td>
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<tr>
<td>BSZ-235</td>
<td>Biology of Chordates</td>
<td>3-1</td>
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</table>

| BSZ-231    | Introduction to Sociology                  | 3-0          |

1. **Introduction**
   - a. Definition, Scope, and Subject Matter
   - b. Sociology as a Science
   - c. Historical background of Sociology

2. **Basic Concepts**
   - a. Group, Community, Society
   - b. Associations
     - i. Non-Voluntary
     - ii. Voluntary
   - c. Organization
     - i. Informal
     - ii. Formal
   - d. Social Interaction
     - i. Levels of Social Interaction
     - ii. Process of Social Interaction
       - a) Cooperation
       - b) Competition
       - c) Conflict
       - d) Accommodation
       - e) Acculturation and diffusion
       - f) Assimilation
       - g) Amalgamation

3. **Social Groups**
   - a. Definition and Functions
   - b. Types of social groups
     - i. In and out groups
     - ii. Primary and Secondary group
     - iii. Reference groups
     - iv. Informal and Formal groups
     - v. Pressure groups

4. **Culture**
   - a. Definition, aspects and characteristics of Culture
     - i. Material and non material culture
     - ii. Ideal and real culture
   - b. Elements of culture
     - i. Beliefs
     - ii. Values
     - iii. Norms and social sanctions
   - c. Organizations of culture
i. Traits
ii. Complexes
iii. Patterns
iv. Ethos
v. Theme
d. Other related concepts
   i. Cultural Relativism
   ii. Sub Cultures
   iii. Ethnocentrism and Xenocentrism
   iv. Cultural lag

5. Socialization and Personality
   a. Personality, Factors in Personality Formation
   b. Socialization, Agencies of Socialization
   c. Role and Status

6. Deviance and Social Control
   a. Deviance and its types
   b. Social control and its need
   c. Forms of Social control
   d. Methods and Agencies of Social control

7. Collective Behavior
   a. Collective behavior, its types
   b. Crowd behavior
   c. Public opinion
   d. Propaganda
   e. Social movements
   f. Leadership

Recommended Books:

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<th>BSZ-232</th>
<th><strong>Computer Applications</strong></th>
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<tbody>
<tr>
<td>Brief history of computers and their applications: Major components of computer, computer and society, the social impact of computer age, computers in offices industry and education, office automation tools; word processing, graphic packages, data bases and spread sheets, current prints, research and future prospects, legal and moral aspects of computer science, using internet</td>
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**Laboratory work pertaining to above course**

**Books Recommended**
1. Using information technology 2nd Ed, William Sawyer, Hutchinson
2. Introduction to computer by Peter Norton
3. Introduction to computer by P.K. Ceena

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<th><strong>Plant Systematics and Anatomy</strong></th>
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<tr>
<td><strong>Plant Systematics; Introduction</strong>, aims, objectives and importance</td>
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<tr>
<td><strong>Classification</strong> brief history of various systems of classification with emphasis on Takhtajan</td>
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<tr>
<td><strong>Nomenclature</strong>: Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature.</td>
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<tr>
<td><strong>Morphology</strong>: a detailed account of various, morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types</td>
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<tr>
<td>Diagnostic characters, economic importance and distribution pattern of the following families: Ranunculaceae, Brassicaceae (Cruciferae), Fabaceae (Leguminosae), Rosaceae, Euphorbiaceae, Cucurbitaceae, Solanaceae, Lamiaceae (Labiatae), Apace (Umbelliferae), Asteraceae (Compositae), Liliaceae (Sen. Lato), Poaceae (Graminae)</td>
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<tr>
<td><strong>Anatomy</strong>: Cell wall: structure and chemical composition Concept, structure and function of various tissues like: Parenchyma, Collenchyma, Sclerenchyma, Epidermis Xylem, Phloem</td>
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<tr>
<td>Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm</td>
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<td><strong>Characteristics of wood</strong>: diffuse porous and ring–porous, sap and heart wood, soft and hard wood, annual rings</td>
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**Practicals**

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

Books Recommended

BSZ-234 Microbiology 3-1
Introduction and scope of Microbiology, Historical foundations of Microbiology, General characteristics of Microbes, methods of Microbiology, bacterial forms and ultrastructure, microbial nutrition, cultivation, reproduction and growth, Metabolic characteristics, symbiotic relationships, taxonomy, classification, nomenclature of microorganism/bacteria. Physical and chemical control of microbes. Role of microbes in industry, agriculture, health, basic research and environment.

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

Recommended Books:

<table>
<thead>
<tr>
<th>BSZ-235</th>
<th>Biology of Chordates</th>
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</table>

**Amphibian, Reptiles, Pisces, Aves, Hemichordates, Mammals**

Classification upto order, Evolution, adaptations, diversity, locomotion, feeding and nutrition, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; phylogeny, behavior, characteristics associated structures or mechanism, e.g., Specialized Teeth, Endothermy, Hair, and Viviparity in mammals; ancient birds and the evolution of flight; diversity of modern birds; migration and navigation in Aves, poison and non-poison snakes in Reptiles

**Practicals**

1. Study of a representative of Hemichordate and vertebrate 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

**Books Recommended theory**


Books Recommended for practical
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<th>Course Title</th>
<th>Credits</th>
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<td>Fundamentals of Biophysics</td>
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<td>BSZ-242</td>
<td>Histology</td>
<td>3-1</td>
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<tr>
<td>BSZ-243</td>
<td>Plants Physiology</td>
<td>2-1</td>
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<tr>
<td>BSZ-244</td>
<td>Biochemistry</td>
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<tr>
<td>BSZ-245</td>
<td>Genetics</td>
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</table>

**BSZ-341 Fundamentals of Biophysics**

Newton’s Laws of Motion, Momentum, conservation of momentum, Problems

**Gravitation** Newton’s law of gravitation, acceleration due to gravity, mass of earth mass of sun, variation of “g” with altitude and depth, satellites, problems

**Current electricity**; electric current, ohm’s law, resistance and resistivity, combination of resistors, power dissipated in resistors, problems

**Practicals**

1. To study the damping features of an oscillating, system using simple pendulum of variable mass.
2. To the determine the value of “g”by compound pendulum /kater, s Pendulum
3. The dependence of centripetal force on mass, radius, and angular momentum
4. Velocity of a body in circular motion
5. Determination of moment of inertia of a solid /hollow cylinder and, Sphere etc
6. Measurement of resistance using a Neon flash bulb and condenser
7. Conversion of Galvanometer into Voltmeter and an Ammeter
8. Study of electric circuits by black box

**Books recommended**

1. Principles of physics by Hodedayr Resnick
2. Biophysics by Adelman
3. Concepts of Modern Physics by A.Beiser
4. College Physics by Sears, Zamansky, and Young
5. Fundamental of Physics by Halliday. Resnick, and Krane

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>BSZ-242</td>
<td>Histology</td>
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Histology, tissue: Simple and compound tissue.

Simple tissue: epithelial tissue, types and functions; connective tissue, cartilage and bones, muscular tissue; types, striated, unstriated, cardiac muscles. Mechanism of skeletal muscle contraction and relaxation, mechanism of smooth muscles and cardiac muscles contraction and relaxation. Nervous tissue; types, functions

Compound tissue: basic plan of digestive tract, liver, pancreas, spleen, lungs, skin, urinary system, endocrines, male and female reproductive, sense organ

**Practical**

1. Isolation of epithelial tissue
2. Bones/blood as connective tissue
3. Isolation of nerve cell study by specific staining method
4. Voluntary and involuntary muscles
5. Microtomes
6. Section of skin, digestive tract, accessory digestive tract, respiratory, excretory and reproductive. (microtomy)
7. General laboratory aids
   a) Solution preparation, stock solution, stains solubility
   b) General-labeling and cleaning solids, re-staining faded slides, recovering broken slides, two different strains on one slide, removing stain from glassware

Books Recommended
1. Guyton, A.C. and Hall, J.E. TEXTBOOK OF MEDICAL PHYSIOLOGY, 10th Withers, P.C

<table>
<thead>
<tr>
<th>BSZ-243</th>
<th>Plant Physiology</th>
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<tbody>
<tr>
<td>Plant Physiology</td>
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<tr>
<td>Water relations: Properties of water, water potential, Absorption of water</td>
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<tr>
<td>Diffusion, Osmosis, osmotic potential, Stomata regulation</td>
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<tr>
<td>Mineral nutrition: Soil as a source of minerals. Essential mineral elements and their role in plants metabolism. Deficiency symptoms of macronutrient</td>
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<td>Photosynthesis: Introduction, Mechanism of photosynthesis; Differences between C₃ and C₄ plants, Factors affecting the process of photosynthesis</td>
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<td>Respiration: Mechanism; Glycolysis, Krebs cycle and Electron transport. Anaerobic respiration. Respiratory quotients</td>
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<td>Growth: Definition; role of auxins, gibberellins, cytokinins, abscisic acid and ethylene in controlling growth. Introduction to plant tissue culture</td>
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<td>Photoperiodism: Definition, Classification of plants based on photoperiod</td>
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<tr>
<td>Dormancy: Definition and causes of seed and bud dormancy</td>
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<td>Plant Movements: Classification of plant movements</td>
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Practical
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 beetroot cells lose their permeability
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/by cobalt chloride paper method
6. Chemical tests for the Starch, Cellulose, Lignin and Proteins
7. Extraction of amylase from germinating wheat seeds and study of its effect on starch breakdown
8. Measurement of carbon dioxide evolution during respiration of germinating seeds by the titration method
germination

Books Recommended


<table>
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<tr>
<th>BSZ-244</th>
<th>Biochemistry</th>
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A general introduction to the science of biochemistry: overview of biological molecules and their structure including carbohydrates, Lipids and Vitamins.

**Carbohydrates:** Introduction of carbohydrates, classification, structure and function of mono, oligo and polysaccharides, Sugar derivates, structural and storage polysaccharides and glycoprotein’s; Lipids

**Protein:** Introduction of proteins, General properties, introduction of Amino acid, primary, secondary and tertiary structure of proteins on the basis of structure and function

**Nucleic acid:** General structure and function of DNA, RNA and their differences, different types of RNA and their function

**Practical**

Identification of carbohydrates, Preparation of Fehling’s reagent. Preparation of Benedict’s, Qualitative Reagents. Estimation of reducing and non reducing sugar by Fehling and Benedict reagents

Determination of sugar in urine, Determination of acid value, Saponification value and iodine value of Lipid. Extraction of Ascorbic acid in citrus fruits

Determination of proteins by Benedict method, Study of some properties of biological molecules, Hydrolysis of a protein and qualitative tests for Paper chromatography of amino acid, Extraction of proteins from animal and plant tissue, Protein estimation by Lowery’s dye –binding and Kjeldahl’s methods, Titration curves of amino acid.

Isolation of Nucleic acid by different techniques, identification of nucleic acid by Diphenylamine and Orcinal reagents

Books recommended

**BSZ-245**  |  **Genetics**  |  3-1

Mendelian Genetics, principle of segregation, symbols and Terminology, Monohybrid crosses, Dominance, Recessiveness, codominance, Semidominance, Principle of independent Assortment, Dihybrid Ratios, Trihybrid Ratios, Gene interaction, Epistasis, Multiple Alleles, ABO blood Type Alleles in Humans, Rh factor Alleles in humans, Probability in Mendetion inheritance, chi-square, structure of chromosomes and Genes, Function of DNA and RNA, classes of RNA, Nucleotide units of DNA and RNA, DNA as storage of Genetic information, Friedrich Miescher Experiment, Avery, Macleod and McCarty Experiment, Hershey and chase experiment, Watson and crick DNA model, physical and chemical structure of DNA, Difference between Prokaryotic and Eukaryotic Genetic material, sex determination, identification of sex chromosomes, Environmental factors and sex determination, Linkage and crossing over.

**Practicals:**
- Introduction to Fast plants and Drosophila.
- Set up a Drosophila opened-ended cross,
- Pollinate Fast Plants,
- ABO blood group,
- Isolation of DNA from Drosophila.

**BOOKS RECOMMENDED**

1) Principal of Genetics by D.PeterSnustad and Michael J. Simo
2) Principles of Genetics by Eldon John Gardner, Michael J. Simons, and D. Peter Snustad

Farzana Perveen and Anzela Khan (2013) Consanguineous Marriages in Khyber Pakhtunkhwa, Pakistan. 1-100; ISSBN: 978-3-659-35561-5; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com/catalog/details//store/gb/book/978-3-659-28448-9/red-eared-slider-turtle,-trachemys-scripta:-model-for-the-research

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### Course List

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<tr>
<th>Course No.</th>
<th>Title</th>
<th>Credit Hours</th>
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<tr>
<td>BSZ-352</td>
<td>Zoogeography and Paleontology</td>
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<td>BSZ-353</td>
<td>Developmental Biology</td>
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<td>BSZ-354</td>
<td>Animal Behaviour and Evolution</td>
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<td>BSZ-355</td>
<td>Molecular Genetics</td>
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</tbody>
</table>

### Course Details

**BSZ-351 Animal Morphology and Physiology**

1. **Nutrition**
   - Classification of animals on the basis of modes of nutrition

2. **Digestive System**
   - Regulation of Digestive Secretion; Morphology and Physiology of digestive tract especially in case of human beings; Metabolism of carbohydrates Proteins and lipids

3. **Excretory System**
   - Different types of nitrogenous waste products in animals; Comparative anatomy of excretory organs; Vertebrate nephron / glomerular filtration tubular absorption and secretion

4. **Respiratory System**
   - Comparative anatomy of respiratory organs; Transport of O₂ and CO₂ between Respiratory Surfaces

   1. **Endocrine System**
      - Comparative anatomy and Physiology of glands (Pituitary, Thyroid, Parathyroid, Pancreas Adrenal, Ovary Testis, pineal Gland)

6. **Muscular System**
   - Structure, Physiology, Regulations of muscles contraction

**Practical**

1) Detection of blood groups
2) Preparation of blood smear for the identification of blood cells
3) Measurement of blood clotting time
4) Measurement of bleeding time
5) Urine test for the detection of glucose albumin and pH

**Books**

Animal distribution
Cosmopolitan, endemic, discontinuous, Barries and dispersal, Zoogeographical regions, geographical limits, climate, zoological, characters fauna, sub-regions, affinities of fauna with other regions. Palearctic region; Nearctic region; Neotropical region; Ethiopian region; Australian region; Oriental region; Theories of continental drift
Principals of Paleontology
Practical
1. Study of fauna of various zoogeographical region world and Pakistan
2. Study of invertebrates fossils of coelenterates, trilobites, ammonite, molluscs, echinoderms
3. Study of vertebrates fossils (horse, elephant and camel)
4. Study and identification of igneous, sedimentary and metamorphic rocks
Books
Zoogeography
Paleontology

Books Recommended

Latest Publications

Practicals
Study of model eggs of different invertebrates and vertebrates. Dactylography, and its uses in embryology. Isolation, identification and culture of various developmental stages of *Ascaris lumbricoides* eggs from human/ *Neoascaris vituolarum* eggs from cattle dung (kept for 3 weeks at 240C in desiccator) by using Telman’s centrifugation technique. Study of prepared slides for the development of Amphioxus, mammals, frog and chick. Semen analysis by using improved Neubar Hemocytometer, Use of dactylography in developmental biology

| BSZ-354 | Animal Behaviour and Evolution | 3 |

1. **Animal Behaviour**
   - Introduction of Animal Behaviour
   - Classification of Animal Behaviour
     - Inborn or stereotyped animal behaviour
     - Acquired animal behaviour – Learning behaviour and Reasoning behaviour
   - Social Behaviour in Insects
     - Honey bee and Ants
   - Communication Animal Behaviour
     - Auditory communication
     - Chemical communication
     - Mimicry and Colouration

2. **Evolution: A historical perspective**; Pre-Darwinian theories of change; Lamarck: an early proponent of evolution; early development of Darwin’s ideas of evolution and evidences; the theory of evolution by natural selection; evolutionary thought after Darwin; biogeography

3. **Evolution and Gene Frequencies**; The modern synthesis: a closer look; the Hardy-Weinberg theorem; evolutionary mechanisms: population size, genetic drift, natural selection, gene flow, mutation, and balanced polymorphism; species and speciation; rates of evolution; molecular evolution; mosaic evolution

**Books Recommended**
Molecular Biology of DNA (B-DNA and Z-DNA), RNA (mRNA, tRNA, rRNA and siRNA) and Proteins, DNA Replication (Double helix and rolling circle models) and Repair, Transcription and Translation, Gene expression in Prokaryotes and Eukaryotes. Viruses and Yeast, Molecular Immunology (Antigen recognition, antibody class switching, Introduction to dendritic cells), Oncogenes and Cancer.

Books Recommended (latest editions):
3. Avers, Cell Biology (1976), D Von Nostrand Co.

Practicals
1. Detection and quantitative determination of chromosomal DNA and RNA.
2. Cultural and staining of bacteria and yeast.
3. Identification of different type of blood cells in human blood through smear technique.
4. Counting of prokaryotic cells (bacteria) and blood cells by using haemocytometer.
5. Isolation and characterization of proteins on polyacrylamide gel electrophoresis (native and sub-unit molecular weights).
6. Separation of different sized DNA fragments on agarose gel.

Books Recommended

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**BSZ-361** | **Bioinformatics** | **1-1**
--- | --- | ---
**BSZ-362** | **Taxonomy and Biosystematics** | **3-1**
**BSZ-363** | **Biostatistics** | **3-1**
**BSZ-364** | **Ecology** | **3-1**
**BSZ-365** | **Wild Life Biology** | **3-1**
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Introduction to computer hardware and software, computer applications for zoologists, Spreadsheet work, Word processing; Graphical and Statistical analysis packages.


Introduction to Bioinformatics, its Definition and History, Introduction to Data Mining and its Application, Database Hierarchies, Genomic and Proteomic Sequence Database and their Interpretation (UCSC Genome Database, NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc)

**Books Recommended**


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**BSZ-362** | **Taxonomy and Biosystematics** | **3-1**

**Taxonomy:** Method of collection, preservation, identification of different kind of animals

**Systematic Zoology:** Contribution of systematics to Biology, History of Taxonomy
(Downward classification, upward classification, impact of the origin of species, population systematics, current trends); Microtaxonomy, phenon, Taxon; Taxonomic categories: specific category, infraspecific category, higher categories; species concepts (Typological concept; nominalistic concept, Biological concept, evolutionary concept), species mate recognition concept; nondimensional species concept; Multidimensional species concept; Cohesion species concept; Difficulties in the application of biological species concepts; polytypic species, subspecies, super species, sibling species; study of major type of variation within a single population. Speciation and taxonomic decision, various types of characters, cladistic analysis, Macrotaxonomy; different kinds of taxonomic characters; Taxonomic collection and identification; definitions of Synonym, Homonym, Keys; Evolution of the theory of Nomenclature; interpretation and application of the code (stability, priority, first revisor principle) range of authority of code; concept of availability, type method formation of specific names

Practicals
Study of preserved invertebrate species and their classification upto class level. Collection, preservation and identification of common species with the help of keys. Methods of statistical analysis of samples from populations T-test, Analysis of variance etc. Preparation of keys for the identification of specimens

Books Recommended

BSZ-363 | Biostatistics | 3-1
---|---|---
Collection: arrangement, classification, diagrammatic representation of data; Simple statistics of dispersion (range, mean, mode, median, variance, standards deviation, standard error, coefficient of variation); Concept of degree of freedom;
probability and normal distribution curve. Comparing means of two samples, confidence limits of mean; Chi-square distribution, Z-distribution, F-distribution; Correlation; Simple multiple regression; Analysis of variance, statistical designing, random, and multifactorial.

**Books Recommended**

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

**Books Recommended**

<table>
<thead>
<tr>
<th>BSZ-364</th>
<th>Ecology</th>
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<tbody>
<tr>
<td>Introduction, branches of ecology, levels of ecological organization, species, population, community and ecosystem, role of light, soil, water, temperature, topography and air as ecological factors, biotic factors, Concepts of Limiting factors, habitat and niche. Populations; Population distribution and abundance, population dynamics, distribution limits, carrying capacity and environmental resistance Community: organization, various concepts of community, community dynamics. Ecosystem: structure and function, energy flow and material cycling within ecosystem. Biomes of the world, characteristics of urban, agricultural and industrial ecosystems.</td>
<td>Ecology</td>
<td>3-1</td>
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</tbody>
</table>
Terrestrial and aquatic ecosystems in Pakistan, their distribution and potential threats to these ecosystems, plant geography and animal distribution.

Ecological production: primary and secondary productivity, productivity of different ecosystems, Systems ecology, ecological modeling, landscape ecology, landscape changes and their importance

**Practicals**


Development of an ecological management plan of some selected area

**Books Recommended**


<table>
<thead>
<tr>
<th>BSZ-365</th>
<th>Wild Life Biology</th>
<th>3-1</th>
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<tbody>
<tr>
<td>1.</td>
<td>Wildlife: Definition and values, ecosystem concept, characteristics and management requirements for different eco-systems in Pakistan.</td>
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<td>2.</td>
<td>Population Dynamics of Wildlife</td>
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<td>5.</td>
<td>The Wildlife of Pakistan, its distribution, status and importance.</td>
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<td>7.</td>
<td>Protected areas: Wildlife Sanctuaries, National Parks, Game Reserves and Community Controlled Hunting Areas.</td>
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</tbody>
</table>
8. Study of endangered species as listed in CITES, IUCN Red Data Book and species listed as threatened under provincial legislation.
10. International treaties and conventions on biodiversity, illegal trade of wildlife.

Practical
1. To identify different important Wildlife species on the basis of specific taxonomic characteristics.
3. Assignments on wildlife survey techniques (identification, counting from various direct and indirect signs).
4. Field tour: Visit to a protected area to review its management and prepare case studies.

Recommended Books
7. IUCN, Pakistan (1996). Management Conflicts in Protected Areas. IUCN.

**************************
Morphology and Physiology:

Taxonomy and Ecology
Classification of insects up to orders. Insect ecology with special reference to factors effecting the population, population estimations. Insect societies.

Practical
Part I: Morphology and Physiology
1. Dissection of various insects, to expose their internal anatomy.
2. Preparation of mouth parts, antennae, wings, legs and genitalia of different insects.
3. To study the whole mounts of Collembola, silverfish, thrips, aphids, lice and fleas.
4. Preparation of killing bottles, preservation, pinning and setting of insects.
5. Study of metamorphosis and different types of insects’ larvae and pupae, life history of an insect.

Books Recommended:
protozoa of medical and veterinary importance.

**Pathology and Immunity**

**Practical**
A study of parasitic Protozoa of medical veterinary importance with special reference to differential morphological features. Preparation of permanent mounts of parasitic Protozoa. Examination of human feces and from domesticated animals by using standard laboratory techniques. Techniques and study of blood parasite study of different types of pathological tissues from prepared slides.

**Books Recommended:**

Brief history, Taxonomy, Biology of commercial food fishes of Pakistan (morphology, anatomy, ecology and distribution) Scales in fishes (structure, types, importance in identification, classification and age determination); Physiology of digestion (food, feeding habits, absorption, conversion.); Respiration (structure of gills, other types of respiration.); Excretion and Osmoregulation (renal, gill, differences between fresh water and marine fishes.); Reproduction (development of ovary and testes, sex differences, sexual maturity, fecundity, breeding habits, parental care.); Fish migration.; Fish ecology (effects of different factors on fish development and distribution especially the effects of temperature, light etc.)

Practical:
1) Identification of common fishes of Pakistan /KPK with the help of keys
2) Learning vernacular (local) and scientific names of common fishes of Pakistan /KPK
3) Dissection of a common fish to study major anatomical features (digestive system, respiratory system, reproductive system, afferent and efferent vessels, cranial nerves.)
4) Fish Collection Preparation and study of fish skeleton and scales

Books Recommended:
4. Evans, D.H. 1997 The Physiology of Fishes, 2nd ed. CRC Press, N.Y.

Research Methodology:
Research Methods (planning research, various methods, analyzing results, giving reports, etc). Research process including: formulating research questions; sampling (probability and nonprobability); measurement (surveys, scaling, qualitative, unobtrusive); research design (experimental and quasi-experimental); data analysis; and, writing the research paper, the major theoretical and philosophical underpinnings of research including: the idea of validity in research; reliability of measures; and ethics

Books Recommended

Those students who would like to do research; they should start their research in this semester (7th semester). Otherwise, they have to appear for special paper. The research will be extended to the 8th semester.
### BSZ-481: Applied Entomology and Pest Management

**Applied Entomology**

**Pest management**
The principles of pest control/management viz., physical, mechanical, culture, legislative biological, genetic, chemical and integrated control. Relative merits of various types of insect control. Pest’s management practices in Pakistan-oriental review.

**Practical**
1. Collection, identification and preservation of different pests and other insects of medical and veterinary importance.
2. Study of sericulture and apiculture.
3. Operation of various types of sprayers. Dusters, fumigation emulsions.
4. Preparation of insecticide emulsions in different concentration.

The record of laboratory and fieldwork will be maintained and presented at the time of examination.

**Books Recommended:**

### BSZ-482: Helminthology and Host-Parasite Relationship

**Helminthology**
Basic principles and concepts in Parasitology, Taxonomy, etiology, biology,
epidemiology, pathology and pathogenesis, diagnosis, control and treatment of Digenetic Trematodes, Monogenetic trematodes, Cestodes and Creeping eruption.

**Host Parasite Relationship**


**Practical**

1. Stage and ocular micrometry for measurement of helminths.
2. Preparation of temporary and permanent mounts of parasites from the following animals:
   a. Fish     b. Frog/toad       c. Fowl/Pigeon       d. Rat/Mouse.
3. Study of helminths from prepared slides.
4. Study of eggs/larvae from feces and prepared slides.
5. Diagnosis of medically important parasites in fecal specimen by using: Tillman’s centrifugation technique, by Lugol’s iodine staining technique

**Books Recommended:**

13. Vaccination against Schistosomaisis and Malaria.
History and significance of aquaculture; Study of management techniques and habitat improvement; Designing, construction, fertilization, manuring, stocking and harvesting of a fish pond; Study of native and exotic fishes of Pakistan; Shellfish and fin fish; Fishing gears and crafts/nets used in Pakistan; Fish ways; construction and importance. Bye products of fish industry; Methods of processing fish such as drying, salting smoking, curing, freezing etc; Study of fish parasites, common diseases and enemies of fishes. Pollution and its effect on fish population; Methods of population estimation by direct count, catch effort, mark re-capture method, tagging of fish; Artificial propagation induced spawning techniques; Marketing strategies; transport of fish and seed; Major problems of fishermen in Pakistan;

Practical
1. Collection and identification of common zooplanktons
2. Study of gut contents of fish
3. Statistical analysis of fish growth, length-weight relationship
4. Study of farm fishes of KPK
5. Visit to a fish farm/hatchery to study installations/methods of breeding
6. Prepared slides of fish parasites
7. Analysis of physical properties (temperature, light, colour, turbidity, conductivity etc.) and chemical properties (pH, oxygen, carbon dioxide, salinity, dissolved solids/salts) of water;
8. General methods of age growth studies; reading of age from scales, opercula, otolith and back calculation from bones;

Books Recommended:
2. Rath, R.H.1993 Freshwater Aquaculture, Scientific Publishers, Delhi, India.

The research will be continued from the 7th semester. In this semester (8th semester), students have to complete their research, write thesis and defend through presentations and viva voce.

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