SCHEME OF STUDIES FOR ZOOLOGY
FOUR YEARS BS 4 YEARS PROGRAMMEME
(Semester System)

SEMESTER	Course No	Title	Credit Hours
SEMESTER-1	BSZ-111	Pakistan Studies	3-0
	BSZ-112	English for Academic Purposes	3-0
	BSZ-113	Basic Mathematics	3-0
	BSZ-114	Organic Chemistry	2-1
	BSZ-115	Cell Biology	3-1
			16
SEMESTER-2	BSZ-121	Islamic Studies	3-0
	BSZ-122	Communication Skills	3-0
	BSZ-123	Morphology of Vascular Plants	2-1
	BSZ-124	Inorganic Chemistry	2-1
	BSZ-125	Invertebrate Zoology	3-1
			16
SEMESTER-3	BSZ-231	Introduction to Sociology	3-0
	BSZ-232	Computer Applications	2-1
	BSZ-233	Plant Systematics and Anatomy	2-1
	BSZ-234	Microbiology	2-1
	BSZ-235	Biology of Chordates	3-1
			16
SEMESTER-4	BSZ-341	Fundamentals of Biophysics	2-1
	BSZ-242	Histology	3-1
	BSZ-243	Plants Physiology	2-1
	BSZ-244	Biochemistry	2-1
	BSZ-245	Genetics	3-1
			17
SEMESTER-5	BSZ-351	Animal Morphology and Physiology	3-1
	BSZ-352	Zoogeography and Paleontology	2-1
	BSZ-353	Developmental Biology	3-1
	BSZ-354	Animal Behaviour and Evolution	3
	BSZ-355	Molecular Genetics	2-1
			17
SEMESTER-6	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

			18
SEMESTER-7	**BSZ-471**	**Entomology**	**3-1**
	BSZ-472	**Protozoology, Pathology and Immunology**	**3-1**
	BSZ-473	**Ichthyology**	**3-1**
	BSZ-474	**Research Methodology**	**3-0**
	BSZ-475	**Research / Special Paper**	**3-0**
			18
SEMESTER-8	**BSZ-481**	**Applied Entomology and Pest Management**	**3-1**
	BSZ-482	**Helminthology and Host-Parasite Relationship**	**3-1**
	BSZ-483	**Applied Fisheries**	**3-1**
	BSZ-484	**Research, Thesis and Presentation / Special Paper**	**3-0**
			15
		Total credit hours	**133**

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Detail of Courses
BS 4 year Programme (ZOOLOGY)

SEMESTER-1		
BSZ-111	**Pakistan Studies**	**3-0**
BSZ-112	**English for Academic Purposes**	**3-0**
BSZ-113	**Basic Mathematics**	**3-0**
BSZ-114	**Organic Chemistry**	**2-1**
BSZ-115	**Cell Biology**	**3-1**
		16

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) POLITAICAL 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; definition and dimensions, management and natural resources environmental pollutions: industrial; agricultural; land; water; air and space 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

1. Shahid Javed Burki, State and Society in Pakistan, The Macmillan Press Ltd. 1980 (Reprint, 1997)
2. Wayne Wilcox The Emergencies of Bangladesh, Washington American Enterprise Institute of Public Policy Research 1972
3. Safdar Mehmood Pakistan Kayyum Tooda Idara-Saqafat-e-Islamia, Club Road Lahore

4. Tahir Amin National Movement of Pakistan Institute of Policy studies Islamabad.
5. Lawrence Ziring, Enigma of Political Development, WmDawson and son Ltd. Cannon House Falkstone. Kent England 1980
6. Waseem Ahmad Pakistan under Marshal Law, Lahore 2002
7. Ansar Zahid, History and culture of Sindh, Karachi Royal Book Company 1980
8. G.A Allana culture of Pakistan
9. Enamery Shamil The Pearls of Sindh
10. M Rafique Afzal Political Parties in Pakistan Vol I, II, and III Islamabad National of Historical and culture Research 1998
11. Inyatullah Bureaucracy, Development in Pakistan Peshawar 1996
12. M Ikram Rabbani Pakistan Affairs Lahore Carwan Book House 1997
13. M Ikran Rabbani and Munawar Ali Sayyid An introduction to Pakistan studies Karwan Book House 1999
14. Crompton.S.W. Pakistan (Modern World Nations) (2nd Edition).2006. Chelsea House Publications
15. Kagan.R. The Return of History and the End of Dreams.2008. Knopf
16. Fatah.T. Chasing a Mirage: The Tragic lllusion of an Islamic State.2008. Wiley
17. **Farzana Perveen** (2012) Women and Higher Education-Gender Discrimination; ISBN: 978-81-925-4197-6; In: "Issues and Challenges on Higher Education"; General Editors: Doris P. Singh and Naveen S. Singh; Published in: Lucknow Christian College, Lucknow India.

BSZ-112	English for Academic Purposes	3-0

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 wriing
Presentation Skills

Books Recommended

1. English for Academic Purposes (Students Manual) British Council.

BSZ-113	Basic Mathematics	3-0

Number system: Natural numbers, integers, rational and irrational numbers
Sets: Introduction and operation sets
Functions: Concept of function, domain and range of function, 1-1, onto, linear and quadratic functions
Equation: Quadratic Equation**,** quadratic formula, solution of quadratic equation

Books Recommended

1. Algebra and Trigonometry (Mathematics XI), Punjab Text Book board
2. Veena. G.R. Comprehensive Basic Mathematics Vol 2 . 2008. New Age International. India

BSZ-114	Organic Chemistry	2-1

Introduction to organic chemistry
Importance of organic chemistry
Sources of organic compounds
Functional groups etc
Nomenclature, preparation and reactivity of aldehyde, ketones, alkyl halides, carboxylic acids, alcohols and phenols
Practical

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

Books Recommended

1. Organic chemistry for B. Sc by M. Younas
2. Organic chemistry by B. S. Bhal
3. Clayden.J, Greeves N, Warren.S and Wothers.P.Organic Chemistry.2008. Oxford University Press
4. Klein.D.R.Organic Chemistry as a Second Language.2009. Wiley

BSZ-115	Cell Biology	3-1

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.

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
3. Cyto-histochemical staining of proteins, carbohydrates, lipids and nucleic acids.
4. Mitosis: smear preparation of onion roots
5. Meiosis: smear preparation from anthers of plants such as onion, Wheat, maize et

Books Recommended

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson.1991
2. Lodish, H. D. Baltimor, A. Berk, S.L. Zipursky, P. Matsudaira, J. Darnell,
3. Molecular Biology of the Cell, Garland Publishing Inc. New York. 1994
4. Molecular Biology of the Cell. Scientific American Books, W.H. Freeman and Company, New York. 2001
5. Pollard T .D, Earnshaw W. C. Cell Biology. 2007. Saunders

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SEMESTER-2		
BSZ-121	**Islamic Studies**	**3-0**
BSZ-122	**Communication Skills**	**3-0**
BSZ-123	**Morphology of Vascular Plants**	**2-1**
BSZ-124	**Inorganic Chemistry**	**2-1**
BSZ-125	**Invertebrate Zoology**	**3-1**
		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 (vebval, 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
3. Suson M. Ervin Tripp. 1973: Stonford University press
4. Scott 1974: Experience and Communication Forqan and Company
5. Simon and Schuster Communication Essentials University of Phoenix.
6. Managerial Communication A finger on the Pulse (3rd ed), Prentice Hall.
7. Murphy et. Al., Effective Business Communication

8. Hargie.O. Handbook of Communication Skills.2006. Routledge
9. Barker.A. Improve Your Communication Skills.2008. Kogan Page

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

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, USA
3. Raven, P.H., Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants. W.H. Freeman and Company Worth Publishers

Stuessy, T.F. 1990. Plant Taxonomy. Columbia University Press, USA.

Lawrence, G.H.M. 1951 Taxonomy of Vascular Plants. MacMillan and Co. New York

Panday, B.P. 2004. A textbook of Botany (Angiosperms), S. Chand and Co. New Delhi

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

1. Inorganic chemistry, principles of structure and Reactivity 4th Ed. By J.E Huheey, E.A. Keiter and R.L Keiter, Harper international.

2. Basic inorganic chemistry by F.A Cotton and G.Willinson, Advanced chemistry 5th Ed. F.A cotton john wiley and sonsn New York.
3. Housecroft.C. Sharpe. A.G. Inorganic Chemistry (2nd Edition).2004. Prentice Hall
4. House.J.E. Inorganic Chemistry.2008. Academic Press

BSZ-125	Invertebrate Zoology	3-1

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

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.
6. Moore, J, An Introduction to the Invertebrates, 2nd edition.2008. Cambridge University Press
7. Smith .C. Biology of Sensory Systems, 2nd edition.2009. Wiley
8. **Farzana Perveen** and Anzela Khan **(2012)** Pearl Culturing Industry. 1-123; ISSBN: 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.
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 histolitica, 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. 5th Edition (International), 2002. Singapore: McGraw Hill.

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SEMESTER-3		
Course No.	**Title**	**Credit Hours**
BSZ-231	**Introduction to Sociology**	**3-0**
BSZ-232	**Computer Applications**	**2-1**
BSZ-233	**Plant Systematics and Anatomy**	**2-1**
BSZ-234	**Microbiology**	**2-1**
BSZ-235	**Biology of Chordates**	**3-1**
		16

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

1. Introduction
    a. Definition, Scope, and Subject Matter
    b. Sociology as a Science
    c. Historical back ground of Sociology
2. Basic Concepts
    a. Group, Community, Society
    b. Associations
        i. Non-Voluntary
        ii. Voluntary
    c. Organization
        i. Informal
        ii. Formal
    d. Social Interaction
        i. Levels of Social Interaction
        ii. Process of Social Interaction
            a) Cooperation
            b) Competition
            c) Conflict
            d) Accommodation
            e) Acculturation and diffusion
            f) Assimilation
            g) Amalgamation
3. Social Groups
    a. Definition 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:

1. Anderson, Margaret and Howard F. Taylor. 2001. *Sociology the Essentials*. Australia: Wadsworth.
2. Brown, Ken 2004. *Sociology*. UK: Polity Press
3. Gidden, Anthony 2002. *Introduction to Sociology*. UK: Polity Press.
4. Macionis, John J. 2006. 10th Edition *Sociology* New Jersey: Prentice-Hall
5. Tischler, Henry L. 2002. *Introduction to Sociology* 7th ed. New York: The Harcourt Press.
6. Frank N Magill. 2003. *International Encyclopedia of Sociology*. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. 2005. *Sociology* 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. 1989. *Sociology: Social Structure and Social Conflict.* New York: Macmillan Publishing Company.
9. Koening Samuel. 1957. *Sociology: An Introduction to the Science of Society*. New York: Barnes and Nobel..
10. Lee, Alfred Mclung and Lee, Elizabeth Briant 1961. *Marriage and The family.* New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. 1973. *Order and Change: Introductory Sociology* Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jeam. 1982. *Human Societies*. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. 2004. *Sociology: A Down to Earth Approach*. Toronto: Allen and Bacon.

14. **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

BSZ-232	Computer Applications	2-1

Brief history of computers and their applications: Major components of computer, computer and society, the social impact of computer age, computersin 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

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
4. Dandamudi. S P. Fundamentals of Computer Organization and Design.2008. Springer

BSZ-233	Plant Systematics and Anatomy	2-1

Plant Systematics; Introduction, aims, objectives and importance

Classification brief history of various systems of classification with emphasis on Takhtajan

Nomenclature: Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature.

Morphology: a detailed account of various, morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types

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)

Anatomy: Cell wall: structure and chemical composition **Concept, structure and function of various tissues like:** Parenchyma, Collenchyma, Sclerenchyma, Epidermis Xylem, Phloem

Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm

Characteristics of wood: diffuse porous and ring –porous, sap and heart wood, soft and hard wood, annual rings

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

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 and Co. New York
6. Panday, B.P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi
7. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd ed. John Wiley and 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. Dickison. W. C. Integrative Plant Anatomy.2007. Academic Press
12. Rudall. P.J. Anatomy of Flowering Plants: An Introduction to Structure and Development, 3rd edition .2007. Cambridge University Press

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:

1. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. Mcgraw Hill. Publisher.
2. Black, J. G., 2005. Microbiology: principles and explorations, *by* 6th Edition, J. Wiley and Sons, USA.

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

BSZ-235	Biology of Chordates	3-1

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

1. Hickman, C.P., Roberts, L.S. and Larson, 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
6. Roots.C. Flightless Birds (Greenwood Guides to the Animal World).2006. Greenwood Press
7. Newton. I. The Migration Ecology of Birds. 2007. Academic Press
8. Attenborough. D. The Life of Mammals [BBC Series].2008. BBC Warner
9. Farzana Perveen and Anzela Khan **(2012)** Turtle and its Realistic Entropy. 1-95; ISSBN: 978-3-659-19211-1; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com/catalog/details//store/gb/book/978-3-659-19211-1/turtle-and-its-realistic-entropy
10. Anzela Khan and **Farzana Perveen (2012)** Felinology: The Cat, *Felis species*. 1-99; ISSBN: 978-3-659-18782-7; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com.
11. Anzela Khan and **Farzana Perveen (2012)** Cat a Loving Pet. 1-137; ISSBN: 978-3-659-18268-6; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com.

Books Recommended for practical

1. Hickman, C.P. and Kats, H.L. laboratory studies in integrated principle of zoology. 2000. Singapore: McGraw Hill
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill

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SEMESTER-4		
BSZ-341	**Fundamentals of Biophysics**	**2-1**
BSZ-242	**Histology**	**3-1**
BSZ-243	**Plants Physiology**	**2-1**
BSZ-244	**Biochemistry**	**2-1**
BSZ-245	**Genetics**	**3-1**
		17

BSZ-341	Fundamentals of Biophysics	2-1

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

I. 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
6. Jue. T. Fundamental Concepts in Biophysics: Volume1.2009. Humana Press

BSZ-242	Histology	3-1

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
2. COMPARATIVE ANIMAL PHYSIOLOGY. 1992. Saunders College Publishing, Philadelphia.
3. Cormack. D. H. Essential Histology. 2009. Lippincott Williams and Wilkins.
4. Johnson. K. E. Histology and Cell Biology. 2009. Harwal Pub Co

BSZ-243	Plant Physiology	2-1

Plant Physiology

Water relations: Properties of water, water potential, Absorption of water

Diffusion, Osmosis, osmotic potential, Stomata regulation

Mineral nutrition: Soil as a source of minerals. Essential mineral elements and their role plants metabolism. Deficiency symptoms of macronutrient

Photosynthesis: Introduction, Mechanism of photosynthesis; Differences between C_3 and C_4 plants, Factors affecting the process of photosynthesis

Respiration: Mechanism; Glycolysis, Krebs cycle and Electron transport. Anaerobic respiration. Respiratory quotients

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

Photoperiodism: Definition, Classification of plants based on photoperiod

Dormancy**:** Definition and causes of seed and bud dormancy

Plant Movements: Classification of plant movements

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
9. Measurement of light and temperature. Effect of light and temperature on seed

germination

Books Recommended

1. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
2. Ihsan Illahi (1995). Plant Physiology, Biochemical Processes in Plants, UGC Press
3. Salisbury F.B. and Ross C.B. 1992. Plant physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA
4. Lambers. H, Chapin.F.S, Pons.T.L. Plant Physiological Ecology.2008.

BSZ-244	Biochemistry	2-1

A general introduction to the science of biochemistry: overview of biological molecules and their stricture 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

1. Principles of Biochemistry, A. L. Lehniger, D.L .Nelson and M.M. Cox.3 rd editions (2000),Worth Publisher ,New York
2. Text Book of Medical Physiology, Arthur C. Guyton, John E . Hall 10th Edition (2000) W.B. Saunders company
3. Fundamental of Biochemistry, D. Voet , J. G. Voet, C. W. Prrat, (1999) John Willey and sons ,New York
4. Harper 'Biochemistry, R. K. Murray, D. K. Grammer, P. A. Mayes, V. W. Rodwell, 25th edition (2000),Appleton and Lange
5. Outline of Biochemistry. Eric E. Conn: Paul K. Stumpf; Georage Bruening and Roy H. Doi. (1995) 5th Edition. John Wiley and sons
6. Modern Experiment Biochemistry, R.F. Boyer ,second edition (1993),Benjamin – Cummings Publishing

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. SimoPrinciples of Genetics by Eldon John Gardner, Michael J. Simons, and D. Peter Snustad
2) 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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SEMESTER-5		
Course No.	**Title**	**Credit Hours**
BSZ-351	**Animal Morphology and Physiology**	**3-1**
BSZ-352	**Zoogeography and Paleontology**	**2-1**
BSZ-353	**Developmental Biology**	**3-1**
BSZ-354	**Animal Behaviour and Evolution**	**3**
BSZ-355	**Molecular Genetics**	**2-1**
		17

BSZ-351	**Animal Morphology and Physiology**	**3-1**

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 O_2 and CO_2 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

1. Randall, D., Burggren, W., French, K. and Fernald, R. ECKERT ANIMAL PHYSIOLOGY: MECHANISMS AND ADAPTATIONS, 5th Edition. 2002. W.H. Freeman and Company, New York

2. Bullock, J., Boyle, J. and Wang, M.B. PHYSIOLOGY, 4th Edition.2001. Lippincott, Williams and Wilkins, Philadelphia

3. Berne, R.M. and Levy, M.N. PRINCIPLES OF PHYSIOLOGY, 3rd Edition. 2000. St. Lious, Mosby

4. Guyton, A.C. and Hall, J.E. TEXTBOOK OF MEDICAL PHYSIOLOGY, 10th Edition. 2000. W.B. Saunders Company, Philadelphia

5. Withers, P.C. COMPARATIVE ANIMAL PHYSIOLOGY. 1992. Saunders College Publishing, Philadelphia

6. Schmidt-Nelsen, K. ANIMAL PHYSIOLOGY, ADAPTATION AND ENVIRONMENT, 5th Edition. 1997. Cambridge University Press, Cambridge.
8. Bullock, J., Boyle, J. and Wang, M.B. PHYSIOLOGY, 4th Edition. 2001. Lippincott, Williams and Wilkins, Philadelphia
8. David R, Warren B, Eckert Animal Physiology: Mechanisms and Adaptations 4ed. 2009. W.H. Freeman and Company
9. Tharp, G. and Woodman, D. Experiments In Physiology, 8th Edition. 2002. Prentice Hall, London

BSZ-352	Zoogeography and Paleontology	2-1

Animal distribution

Cosmopolition , 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; Ethopian region; Australian region; Oriental region; Theories of continental drift

Principals of Paleontology

Structure of Earth, Rocks, (igneous, metamorphic, sedimentary rocks),Fossils, types of fossils, uses of fossils, nature of fossils, Process of Fossilization, Geological time Scale Precambrian life, Cambrian life, Paleozoic life, Mesozoic life, coenozoic life, Radiocarbon dating method, Evolution of horse, Evolution of man, Evolution of elephant

Practical

1. Study of fauna of various zoo geographical 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

1. Darlington, P. J. Jr. ZOOGEOGRAPHY, 1963. John Wiley and Sons
2. DeBeaufort, L. F. ZOOGEOGRAPHY OF THE LAND AND INLAND WATERS. 1951. Sidgwick and Jackson
3. Ali, S.S. PALAEONTOLOGY, ZOOGEOGRAPHY AND WILDLIFE MANAGEMENT. 1999. Nasim Book Depot, Hyderabad, India
4. Perveen, F. 2009. A beauty of Indus River: the Indus River dolphin, Platanista minor Owen, its threats and protection in N-WFP, Pakistan Edited by A.G. Müller. 1st edition. VDM-Verlag Publisher, Berlin, Germany. p. 102.

Paleontology

1. Dunbar C.O. Historical geology, 1969. John wiley and sons inc. New York
2. Brouwer, A. General palaeontology, 1977. Oliver and boyed, london.
3. Gilbert, L. I. and Colbert, E.H. Evolution of vertebrates, 1980. John Wiley and sons inc. New York
4. Ali, S.S. Palaeontology, Zoogeography and management wildlife. 1999. Nasim Book Depot, Hyderabad, India
5. Farzana Perveen (2010). Ixodid tick infestation in livestock and traditional control in Northern Pakistan. A.G. Müller (Ed.); Publisher: VDM Verlag House Ltd.,

Germany, 115 pages. ISSBN: 978-3-639-19281-0. Online: http://www.amazon.com/Infestation-Livestock-Traditional-Control-Pakistan/dp/3639192818/ref=sr_1_1? s=gatewayandie = UTF8andqid=1284782047andsr=8-1

BSZ-353	Developmental Biology	3-1

Historical review of embryology. Uses of modern molecular techniques in developmental biology. Origin of germ cells (gametogenesis). Spermatogenesis and Oogenesis, Structure and organization of male and female gametes. Fertilization: Chemistry of fertilization, Molecular biology of fertilization, surface changes in the egg and sperm surface, In vitro Fertilization (test tube technology). Mono- and Di-zygotic Twinning , Parthenogenesis, Uses of Transgenic animals in Developmental biology, Cleavage, Blastulation, Fate maps and their preparation, Morphogenetic movements and Gastrulation in Amphioxus, mammals, chick and frog. Stem cells technology and its uses in developmental biology: with special reference to the uses of totipotent, multipotent and pluripotent stem cells. Embryonic adaptations (fetal extra-embryonic membranes) and Placentation, Umbilical cord, Parturition (birth) and its stages. Regeneration and regenerative powers of vertebrates. Aging

Books Recommended

1. Balinskey, B.I. (1984). An introduction to Embryology 6th Ed. Saunders College Publishing Co., New York.
2. Patten, B.N. (2004). Foundation of Embryology. McGraw Hill Books Company, Inc, New York, London.
3. Rao, K.V. (2003). Developmental biology: A modern synthesis. Oxford is publishing Co. Ltd., Delhi.
4. Oppenheiner, S.B and Lefevre, G. (1984). Introduction to Embryonic Development.. Allen and Bacon Publishers, New York.
5. Saddler, T. W. (1995). Langmans Medical embryology. Library of congress Cataloguing-in-Publication Data. Williams and Wilkins Publishers, USA.
6. Carlson, B.M. (2001). Patten's Foundations of Embryology (6th Edition). McGraw-Hill, Inc. New York, London, Tokyo, Sydney.

Latest Publications

1. Cell signaling in ovarian follicle: intra-follicular survival of ova. Johnson. (2003). Animal reproduction science. 78:185-201
2. Morphological Changes in mouse egg at fertilization. Grey et al. (2004). Current biology.14: 397-405
3. Transgenic animals in Developmental biology: Outlook for the future. Wheelers et al. (2003). Animal reproduction science. 79: 265-279
4. Mono- and Di-zygotic Twinning. Hall. (2003). The Lancet. 362(1). 735-43
5. Reproductive biotechnology and Aging. Seidel Jr. (2000). Theriogeneiology.53: 187-194
6. Yashimora (2004). Oogenesis in Hen. Anim.Scie.J. 75:183-193
7. Embryonic stem cells in cell therapy. Garcia *et al.* (2005). Advanced Drug Delivery Reviews 57:1935– 1943
8. Embryonic stem cells: Understanding their history, cell biology and signalling. Frieal *et al.* (2005). Advanced Drug Delivery Reviews 57:1894– 1903

9. Stem cells. Vats *et al*. (2005). The lancet.366:2-11

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 Hemocytmeter, 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

Mimicary 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

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. 2000. New York: McGraw Hill
5. Campbell, N.A. Biology, 6th Edition. Menlo Park, California: 2002.Benjamin/Cummings Publishing Company, Inc
6. Peter J.B, Advances in the Study of Behavior, Volume 23. 2009. Academic Press
7. Coyne.J. A. Why Evolution Is True .2009. Oxford University Press
8. Tomecek.S.M. Animal Communication (Animal Behavior).2009. Chelsea House Publications

BSZ-355	Molecular Genetics	2-1

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 switiching, Introduction to dendritic cells), Oncogenes and Cancer.

Books Recommended (latest editions):

1. De Robertis, E.D.P. and De Robertis, Jr. E.M.F. (1995) Cell and Molecular Biology, 8th edition, Lea and Febiger.
2. DeRobertis, Nowinski and Saez. (1970) Cell Biology, 5th Ed.W.B. Saunders Co. Philadelphia, London
3. Avers , Cell Biology (1976), D Von Nostrand Co.
4. Karp, G. (2001), Cell Biology. Mc Graw Hill Book Company New York.
5. Strickberger, M.W. (1998). Genetics: an introduction. Macmillan publications Ltd., New York.
6. Gardener, E. J. (1972) Principles of Genetics. John Wiley and Sons. New York.
7. Sinnot, E. W., Dunn, L. C. and Dobzhansky, T. Principles of Genetics. International Student Edition. McGraw-Hill. Tokyo.
8. Burns, G.E. (1983) The Science of Genetics: An introduction to Heredity. 5th edition. Macmillan. New York.
9. Nicholl, D. S. T. (1994), An introduction to genetic engineering. Cambridge University Press, UK.
10. Brown T.A. (1989). Gene Cloning: an introduction. Van-Nostrand Reinhold International, UK

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

1) Nicholl, D. S. T. (1994), An introduction to genetic engineering. Cambridge University Press, UK.
2) Vaillancourt P. E. E. Coli Gene Expression Protocols (Methods in Molecular Biology, Vol 205, Humana Press, 2002.

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SEMESTER-6		
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**
		18

BSZ-361	Bioinformatics	1-1

Introduction to computer hardware and software, computer applications for zoologists, Spreadsheet work, Word processing; Graphical and Statistical analysis packages.

Biocomputing (Introduction to String Matching Algorithms, Database Search Techniques, Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Introduction to Graph Matching Algorithms, Genome Comparison, Prediction and its Implication).

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

1. Gibas, C. and Jambeck, P. Developing bioinformatics computer skills. 2001. O'Reilly publishers
2. Westhead, D.R., Parish, J.H. and Twyman, R.M. Instantnotes on Bioinformatics. 2003. Viva Books PrivateLimited
3. Lest, A.M. Introduction to bioinformatics. 2002. Oxford University Press
4. Baxevanic, A.D. and Ouellette, B.F.F. BIOINFORMATICS: 2004. A practical guide to the analysis of genes and proteins, 3rd Edition. O'Reilly publishers
5. Krane, D.E. and Raymer, M.L. Fundamental concepts of bioinformatics. 2002. Benjamin Cummings
6. Moody, G. Digital code of life: how bioinformatics is revolutionizing science, medicine and business. 2004. John Wiley and Sons
7. Orengo, C. A., Jones, D.T. and Thornton, J.M. Bioinformatics: genes, proteins and computer (Advanced Text) 2003. Roultledge
8. S. C. Rastogi, N. Mendirata and P. Rastogi. 2004. Bioinformatics: Methods and applications. ISBN 81-203-2582-6 Prentice Hall of India
9. Fulekar.M.H. Bioinformatics: Applications in Life and Environmental Sciences. Springer
10. Ramsden.J. Bioinformatics: An Introduction (Computational Biology).2009.Springer

BSZ-362	Taxonomy and Biosystematics	3-1

Taxanomy: 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; Multidimenstional species concept; Cohesion species concept; Difficulties in the application of biologicalspecies 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; interpretationand 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

1. Ridley, M. EVOLUTION. 1993. Blackwell Scientific Publications
2 Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. EVOLUTION. 1973. W.H. Freeman and Company
3. Dobzhansky, T. GENETICS AND THE ORIGIN OF SPECIES, 1951. Columbia University Press, New York
4. Mayr, E. POPULATIONS, SPECIES AND EVOLUTION, 1965.Harvard University Press
5. Moody, P.A. INTRODUCTION TO EVOLUTION, 1989. Harper and Row Publishers, New York
6. Strickberger. M.W. EVOLUTION. 2000. Jones and Barrett Publishers
7. Mayer, E. PRINCIPLES OF SYSTEMATIC ZOOLOGY. 1994. McGraw Hill, New York
8. Mayer, E. and Asblock, P.D. PRINCIPLES OF SYSTEMATIC ZOOLOGY. 1991 McGraw Hill, New York
9. Mayr, E. ANIMAL SPECIES AND EVOLUTION, 1985. Harvard University Press.
10. Heywood, V.H. TAXONOMY AND ECOLOGY. 1975. Academic Press, London
11. Whili, M.J.D. Modes of Speciation, 1978. W.H. Freeman and Co., San Francisco
12. Winston. J. Describing Species. 1999. Columbia University Press
13. Fastovsky.D.E, Weishampel.D.B. The Evolution and Extinction of the Dinosaurs. 2005. Cambridge University Press

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

1. Jim Fowler, Lou Cohen and Phil Jarvis, Practical Statistics for Field Biology (2nd ed.)
John Wiley and Sons, 1998
2. Jerrold H. Zar, Bio-Statistical Analysis, 1998
3. Harvey Motulsky, Intuitive Bio-statistics, 1995
4. Sokal, R.R. and Rohlf, F.J., An Introduction to Bio-statistics, W.H. Freeman Co. 1987
5. Mather, K., Statistical Analysis in Biology, Chapman and Hall, U.K. 1960

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

1. Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press
2. Bailey, N.T.J. 1994. Statistical Methods in Biology, Cambridge University Press
3. Berry D.A, Stangl. D. Bayesian Biostatistics .2008. CRC

BSZ-364	Ecology	3-1

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.

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

Measurement of environmental factors on land, water and air. Ecosystems: pond, agricultural or grassland, forest. Community analysis through different sampling techniques (quadrat, Transect). Population dynamics of grasshoppers. Adaptive features of animals in relation to food and environment. Food chain studies through analysis of gut contents. Analysis of polluted and fresh water for biotic and abiotic variations. Field visits for study of selected terrestrial habitat and writingnotes. Development of an ecological management plan of some selected area

Books Recommended

1. Odum, E. P. 1994. FUNDAMENTALS OF ECOLOGY. 3rd EditionW.B.Saunders. Philadelphia
2. Molles, M.C. 2005 Ecology: CONCEPTS AND APPLICATIONS. 6th Edition, McGraw Hill, New York, USA
3. Dondson, S.I., Allen, T.F.N., Carpenter, S.R., Ives, A., Jeanne, R.L., Kitchell, J.F., Langston, N.E. and Turner, M.G., 1998. ECOLOGY. Oxford Univ. Press, UK
4. Slingsby, D. And Cook, C., 1986. Practical Ecology.Mcmillan Education Ltd. UK
5. Chapman, J.L. And Reiss, M.J.1997. Ecology: Principles AndApplications.Cambridge Univ. Press, Uk
6. Smith, R.L. 1980. Ecology and Field Biology, Harper and Row
7. Newman, I. 1993. Applied ecology. Black well scientific publications oxford. UK
8. Coxes, C.B and Morre, D. 2000. Biogeography: An Ecological and Evolutionary Approach, 6th Edition. Life Sciences King's College, London, UK
9. Molles .M. C. Ecology: Concepts and Applications, 4th Edition.2006. McGraw-Hill
10. Lambers. H, Chapin.F.S, Pons.T.L. Plant Physiological Ecology.2008. Springer
11. Valk.A.V. Herbaceous Plant Ecology: Recent Advances in Plant Ecology.2009. Springer
12. Farzana Perveen and Anzela Khan (2012) Ecological data sampling and collection. 1-69; ISSBN: 978-3-659-24745-3; Lambert Academic Publisher (LAP), Germany; Online: https://www.lap-publishing.com/catalog/details//store/gb/book/978-3-659-24745-3/ecological-data-sampling-and-collection

BSZ-365	Wild Life Biology	3-1

1. Wildlife: Definition and values, ecosystem concept, characteristics and management requirements for different eco-systems in Pakistan.
2. Population Dynamics of Wildlife
3. Wildlife Health: Wildlife handling, diseases, parasites and preventative management actions.
4. Principles of Wildlife Management.
5. The Wildlife of Pakistan, its distribution, status and importance.
6. Wildlife Laws and Regulations.
7. Protected areas: Wildlife Sanctuaries, National Parks. Game Reserves and Community Controlled Hunting Areas.

8. Study of endangered species as listed in CITES, IUCN Red Data Book and species listed as threatened under provincial legislation.
9. Preparation of wildlife Management plans: Purpose, structure, contents and reviews/approval procedures.
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.
2. To prepare and submit Model Wildlife Management Plan.
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

1. Sinclair, Anthony R. E.; Fryxell, John M.; Caughley, Graeme, 2009. Wildlife Ecology, Conservation and Management. Wiley Blackwell.
2. Fulbright, Timothy E. 2007. Wildlife Science. CRC Press.UK
3. Bailey, J.A. 1984. Principles of Wildlife Management. John Wiley and Sons. Inc. USA.
4. Giles, R.H. Jr. 1987. Wildlife Management. W.H. Freeman and Co. San Francisco.
5. Robinson, W. L and Eric, G. Bolen. 1984. Wildlife Ecology and Management. McMillan Publishing Co. New York.
6. Quraishi, M.A.A., R.A. Khan and Sh. M.A.Q. Hussain. 2002. Practical Manual of Wildlife Management. University of Agriculture, Faisalabad.
7. IUCN, Pakistan (1996). Management Conflicts in Protected Areas. IUCN.
8. McNeely, J. (1997). Conservation and the future Trends and options towards the year 2025. IUCN H.Q. pp. 119.
9. Provincial Wildlife Acts and Ordinances. (Provincial Wildlife Departments).
10. Quraishi, M.A.A. Rashid A. Khan. 2002. Manual for wildlife management. UAF, Faisalabad.
11. Sale J.B (1988). Manual of Wildlife Techniques for India. Special publication of the Wildlife Institute of India.
12. Rao, A.L. (1984). The Wildlife Legislation of Pakistan MSc Thesis. University of Edinburgh. National Council for Conservation of Wildlife, Islamabad.
13. Roberts. T.J. (1991). The Birds of Pakistan (Vol. Iand II). Oxford University Press.
14. Roberts. T.J. (1977). Mammals of Pakistan. Oxford University Press.
15. Scott et al. (1995). Conservation of Biological Diversity; Perspectives and the future for the Wildlife Profession. Wildlife Society Bulletin 23(4): 645-657.

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SEMESTER-7		
BSZ-471	**Entomology**	**3-1**
BSZ-472	**Protozoology, Pathology and Immunology**	**3-1**
BSZ-473	**Ichthyology**	**3-1**
BSZ-474	**Research Methodology**	**3-0**
BSZ-475	**Research / Special Paper**	**3-0**
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BSZ-471	Entomology	3-1

Morphology and Physiology:

An introduction of Entomology with a brief description of different classes of Arthropods. Complete morphology of an insect. Anatomy and Physiology of various systems with special reference to digestive, nervous, circulatory, respiratory, excretory and reproductive system. Development and metamorphosis. Hibernation and diapause.

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.
6. Classification and identification of insects.

Books Recommended:

1. Imms, A.D. (1957) A General Textbook of Entomology. 9th ed. Revised by O. W. Richards and R. G. Davies, (1957) Reprinted with minor corrections, 1960. Methuen and Co. London. 886 pp.
2. Richards, O. W. and Davies, R. G. (1977) Imms' General Textbook of Entomology. Vol. 1. 10th ed. Chapman and Hall. Reprinted in India in 1993. 418 pp.
3. Borror, D. J. and Delong, D. M. (1971) An Introduction to the Study of Insects. 2nd ed. Hold, Rinehart and Winston, N. York. 812 pp.
4. Ross, H. H. (1965) A textbook of Entomology. John Wiley and sons, New York.

Snodgrass, R. E. (1935) Principles of Insect Morphology. Mc Graw Hill New York.

5. Wigglesworth, V. B. (1972) The Principles of Insect Physiology. 7th ed. (Low-priced). English Language Book Society and Chapman and Hall, London. Reprinted 1979.
6. Patton, R. L. (1963) Introduction to Insect Physiology. Saunders, London.

BSZ-472	Protozoology, Pathology and Immunology	3-1

Protozoology

Systematic, geographical distribution, habitats, biology, pathogenesis, important symptoms, mode of transmission laboratory methods of diagnosis, and control of

protozoa of medical and veterinary importance.

Pathology and Immunity

The cell and cell injury and its relationship to disease. Acute and chronic inflammations, wound healing, disorders of growth, benign and malignant tumors in case of infections immunity, and hypersensitivity in case of parasitic diseases.

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:

1. Barriga, O.O., (1981). The Immunology of Parasitic infection . University of Park Press, Baltimore.
2. Chandler, A.C. and Read, C.P., (1961). Introduction to Parasitology. Int.Ed. Wiley Poppan, New York.
3. Chandrasoma , P. and Taylor, C.R.(1997). Concise Pathology. Prentice Hali International Inc. New Jercy USA.
4. Dixon, M. E. Aid to Pathology. Churchill Livingstone, Edinburgh London and New York.
5. Facust, E. C. and Russell, P. F. (2001). Craig and Faust's clinical Parasitology. Lea and Febiger, 8th edition London
6. Levine, N. D. Protozoan Parasites of domestic animals and of man. Durgers publishing Burgers publishing Co: Minnesota.
7. Markell, E.K. Mo. Vogo. (1999). Medical Parasitology. W. B. Sundress Co: Philadelphia.
8. Noble, E.R and Noble, G.A. (1982). Parasitology: the biology of animal parasites. Lea and Febiger, Philadelphia.
9. Olsen, O. W. (1974). Animal Parasites: their life cycle and ecology. University Park Press Baltimore
10. Peters, W and Gills, H.M. (1989). A color atlas of Tropical medicine and Parasitology. Wolfe Medical Publications Ltd., Netherlands.
11. Robbins, S. L. Basic Pathology. W. B. Saunders Co: London, Toronto.
12. Roberts,L.S. and Jonovy ,J.Jr., (2005). Foundation of Parasitology. W. Brown Publishers, Chicasgo, USA.
13. Soulsby: E. J. L. (1981). Textbook of veterinary clinical Parasitology Vol: 1 Blackwell Scientific Publication, London.
14. Schmidt, G. D. and Robbert, T. S. (2001). Foundation of Parasitology. The C.V. Mosby Company, Saint Louise
15. Smyth, J. D. (1994). Introduction to Animal Parasitology, 3rd edition. Cambridge University Press, Cambridge.
16. Thomson, A.D. and Cotton, R.E. (1980). Lecture Notes on Pathology. Blackwell Publication, Oxford London.
17. Wakelin, D., (1984). Immunity to Parasite . Edward Amold, London.
18. Walter, J.B. and Israel, MS (1979). General Pathology . Charchill Living Stone Edinburgh , London and New York.

BSZ-473	Ichthyology	3-1

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:

1. Lagler, K.F.et.al.1977. Ichthyology, John Wiely and Sons, New York.
2. Pillay, T.V.R. 1993 Aquaculture, Principles and Practices. Fishing News Books, Oxford
3. Jobling, M. 1995 Environmental Biology of Fishes. Chapman and Hall, London.
4. Evans, D.H. 1997 The Physiology of Fishes, 2nd ed. CRC Press, N.Y.
5. Wootton, R.J. 1990 Ecology of Teleost Fishes. Chapman and Hall, London

BSZ-474	Research Methodology	3-0

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

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

BSZ-475	Research / Special Paper	3-0

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.

SEMESTER-8		
BSZ-481	**Applied Entomology and Pest Management**	**3-1**
BSZ-482	**Helminthology and Host-Parasite Relationship**	**3-1**
BSZ-483	**Applied Fisheries**	**3-1**
BSZ-484	**Research, Thesis and Presentation / Special Paper**	**3-0**
		15

BSZ-481	Applied Entomology and Pest Management	3-1

Applied Entomology

Principles of apiculture, sericulture and lac culture. Study and identification of pests of agriculture, stored grain and households. General characteristics, life cycles and habits of insects of medical and veterinary importance. Study of various insect-borne diseases.

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:

1. Atwal, A. S. (1984) Agricultural pests of India and South East Asia. Kalyani Publishers Delhi
2. Imms, A.D. (1957) A General Textbook of Entomology. 9th ed. Revised by O. W.

Metcalf, G. L. and Flint, W.P. (1962) Destructive and useful insects. Mc Graw Hill New York.

3. Ross, H. H., Herms, W. E. and Janes, M. T. (1982) A text book of Entomology.John Wiley and sons, New York
4. Herms, W. E. and Janes, M. T. Medical Entomology. The Macmillan Co. New York
5. Pfadt, R. E. Fundamental of applied Entomology. The Macmillan Co. New York
6. Green, M. B. Hartley, G.S. and West, T.P. Chemicals for crop protection and pest control, Pergamon Press, New York
7. De Bach, P. Biological control of insect pests and weeds. Chapman and Hall, London.
8. Matheson, R. (1950). Medical Entomology. Comstock Publishing Associates, N.Y.

BSZ-482	Helminthology and Host-Parasite Relationship	3-1

Helminthology

Basic principles and concepts in Parasitology, Taxonomy, etiology, biology,

epedemiology, pathology and pathogenesis, diagnosis, control and treatment of Digenetic Trematodes, Monogenetic trematodes, Cestodes and Creeping eruption.

Host Parasite Relationship

Host parasite relationship as associative organization between two organisms. Structural aspects of the association interface. Nutrient exchanges in associations. Physiological and regulatory interactions between associates. Behavioral aspects of organism associations. Ecology and evolution of intimate associations. Anthelmintic resistance detection methods. Detection and characterisation of parasites causing emerging zoonoses. Vaccination against Schistosomaisis; DNA micro arrays in Parasitology

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:

1. Robberts, L. Sand Janovy John Jr. (2005). Foundation of Parasitology. 7th edition. The C.V. Mosby Company, Saint Louise
2. Smyth, J. D. (1994). Introduction to Animal Parasitology, 3rd edition. Cambridge University Press, Cambridge.
3. Peters, W and Gills, H.M. (1989). A color atlas of Tropical medicine and Parasitology. Wolfe Medical Publications Ltd., Netherlands.
4. Noble, E.R and Noble, G.A. (1982). Parasitology: the biology of animal parasites. Lea and Febiger, Philadelphia.
5. Olsen, O. W. (1974). Animal Parasites: their life cycle and ecology. University Park Press Baltimore
6. Markell, E.K. Mo. Vogo. (1999). Medical Parasitology. W. B. Sundress Co: Philadelphia.
7. Facust, E. C. and Russell, P. F. (2001). Craig and Faust's clinical Parasitology. Lea and Febiger, 8th edition London
8. Soulsby: E. J. L. (1981). Textbook of veterinary clinical Parasitology Vol: 1 Blackwell Scientific Publication, London.
9. CONDER, G. A. and CAMPBELL, W. C. (1995). Chemotherapy of nematode infections of veterinary importance, with special reference to drug resistance. Advances in Parasitology 35, 1-84.
10. WHO publications WORLD HEALTH ORGANIZATION. (1995). Onchocerciasis and its Control. WHO Technical Report Series No. 852. WHO, Geneva.
11. Anthelmintic resistance detection methods. An excellent Review By
12. Taylor et al. (2002). Veterinary Parasitology 103: 183–194
13. Detection and characterisation of parasites causing emerging zoonoses. Morgan. (2002). International Journal for Parasitology.30: 1407-1421
14. Vaccination against Schistosomaisis and Malaria.
15. McManus and Bartley. (2004). Parasitology International .53:163-173

BSZ-483	Applied Fisheries	3-1

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 andfin 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;
9. Study of larvae, fry and fingerlings of a common fish, regulation of fishing, enactment of fishery legislation.

Books Recommended:

1. Ali S.S.1999 Freshwater Fishery Biology, Naseem Book Depo, Hyderabad, Pakistan.
2. Rath, R.H.1993 Freshwater Aquaculture, Scientific Publishers, Delhi,India.
3. Rounsefell, G.A.and Everhart, W.H. 1953 Fisheries Science, John Wiely and Sons, New York
4. Mirza, M.R.and Bhatti, M.N.1993 Pakistan ki Machlian aur Mahi Parwari Ferozsons, Lahore

BSZ-484	Research, Thesis and Presentation / Special Paper	3-0

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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