

**University of Lakki Marwat Khyber Pakhtunkhwa 28420,
Pakistan**



**Course outline
Department of Zoology Program
MSc 1st Semester**

S. No	Course code	Course Title	Cr. Hrs.
1	ZOO-310	Biostatistics	3 (3+0)
2	ZOO-312	General Biochemistry	4 (3+1)
3	ZOO-313	Cell and Molecular Biology	4 (3+1)
4	ZOO-314	Zoogeography and Palaeontology	3 (2+1)
5	ZOO-311	Animal Behaviour	3 (3+0)
		Total credits	17 (14+3)

Course code: ZOO-310

Biostatistics 3 (3+0)

Aims and Objectives:

The course will provide knowledge about the importance and use of statistics in life sciences. It will help the students to understand the methods to analyze data pertaining to their research work and to assess the significance of their experimental designs. After this course students will be able to apply basic statistical procedures for analysis of data for practical and research.

Course Contents

Introduction and scope, use of statistics in biology. Population and sample. Stages of research, types of data and methods of data collection. Data arrangement and presentation, formation tables and charts. Measures of central tendency computation of mean, median and mode from grouped and ungrouped data. Measures of dispersion, computation of variance, standard deviation, standard error and their coefficients. Probability rules. Binomial, Poisson and normal distributions. Hypothesis testing, Student 't' test, Chi square test, Analysis of variance and LSD. Correlation and regression. Experimental designing, planning of an experiment, replication and randomization.

Books Recommended

1. Geffery, R. Norman, David L. Streiner **BIOSTATISTICS: THE BARE ESSENTIALS**. 2000. B.C. Decker Inc.
2. Gerry, P. Quinn, Michael J. Keough, **EXPERIMENTAL DESIGN AND DATA ANALYSIS FOR BIOLOGISTS**. 2002. Cambridge University Press.
3. Campbell, R. C. **STATISTICS FOR BIOLOGISTS**. 1989. Cambridge University Press.

4. Zar, J. H. 2013. Biostatistical analysis 4th Ed. Dorling Kindersley Publ. Inc.
5. Forthofer, R. N., Lee E. S., Hernandez, M. 2011. Biostatistics: A Guide to Design, Analysis and Discovery 2nd Ed. Elsevier Inc.
6. Rao, K. V. 2009. Biostatistics: A Manual of Statistical Methods for Use in Health, Nutrition and Anthropology. Jaypee Brothers Publishers.
7. Quinn, G., P., Keough M. J. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.

ZOO-312

General Biochemistry 4 (3+1)

Course Objectives

The course aims to

- Provide in-depth knowledge about the polymerized organic compounds of life.
- Develop an understanding about the dynamism life as it proceeds with inter-conversion of the chemicals from feeding to the liberation of energy for work.
- Understand that inter-conversion is performed by various tools called as enzymes.
- Enable students to know how organisms harvest of energy for growth, duplication etc.

Course Contents

Amino acids, peptides and proteins: standard amino acids, their structure and classification; acid/base properties of amino acids and their titration curves; peptides, their ionic behaviour and amino acid composition, cytochrome c; Proteins: level of structural organization, example of structural and functional proteins.

Enzymes: Introduction; important characteristics of enzymes; immobilized enzymes; how enzymes work; example of enzymatic reaction; enzyme kinetics, enzyme rate of reaction and substrate concentration, how pH and temperature effect on enzyme activity.

Carbohydrates: Classification, types, important characteristics and structure of carbohydrates; cyclic structure of monosaccharides; cyanohydrins formation; disaccharides their types structure and function; polysaccharides, storage and structural types; structure and major functions of polysaccharides.

Lipids: fatty acids, their types and major characteristics; storage lipids, acylglycerols; waxes; structural lipids in membranes; major functions of lipids; lipoproteins, their types and major functions.

Vitamins and cofactors: occurrence, structure and biochemical function of vitamins B complex group.

Metabolism: detailed description of glycolysis and catabolism of other hexoses; regulation and bioenergetics of glycolysis. Anabolic role of glycolysis; fate of pyruvate under aerobic and anaerobic conditions, lactate, acetyl CoA and ethanol formation; alcoholic fermentation; gluconeogenesis, its regulation and significance in the tissues; feeder pathways in glycolysis; utilization of other carbohydrates in glycolysis phosphorolysis and starch; regulation of glycogen metabolism.

Citric acid (TCA) cycle: conversion of pyruvate to acetyl CoA, pyruvate dehydrogenase, a multi-enzyme complex; detailed description of citric acid cycle; bioenergetics and conservation of energy produced in the cycle. Anabolic or biosynthetic role of citric acid cycle intermediates; replenishing or anaplerotic reactions and their role; regulation of citric acid cycle; Electron transport and its components, oxidative phosphorylation, chemiosmotic theory, ATP synthesis, uncouple electron transport and heat generation.

Lipid metabolism: oxidation of fatty acids; digestion, mobilization and transport of fats; biosynthesis of triacylglycerol; utilization of triacylglycerol; activation of fatty acids and their transportation to mitochondria; beta oxidation; bioenergetics of beta-oxidation; oxidation of unsaturated and odd chain fatty acids; omega oxidation pathway; biosynthesis of saturated fatty acid, supply of raw material for palmitic acid synthesis; fatty acid synthetase (FAS) multi enzyme complex; Ketone bodies their biosynthesis, utilization and role in the tissues; cholesterol metabolism: Steroid hormones.

Nitrogen metabolism: metabolic fate of amino acids; catabolism of amino acids; deamination and transamination; nitrogen excretion and urea cycle; regulation of urea cycle.

Practicals

1. Preparation of standard curve for glucose by *ortho*-Toluidine method.
2. Tests for detection of carbohydrates in alkaline and acidic medium.
3. Tests for detection of Disaccharides.
4. Detection of Non-Reducing sugars in the presence of reducing sugars.
5. Demonstration of Acid Hydrolysis of Polysaccharide.
6. Separation and identification of various types of sugars, fatty acid and amino acid Thin Layer Chromatography (TLC).
7. Determination of pKa values of an amino acid by preparation of titration curves.
8. Biochemical tests for detection of different amino acids.
9. Separation of various protein fractions by precipitation method.
10. Demonstration of differential solubility of lipids in various solvents.
11. Quantitative analysis of phospholipids by estimation of inorganic phosphorous.
12. Quantitative analysis of Amylase activity from blood serum or liver.
13. Study on the effect of temperature on the enzymatic rate of reaction

Books Recommended

1. Nelson, D. L., Cox, M. M. 2012. Lehninger Principles of Biochemistry. McMillan worth Publishers, New York.
2. Berg, J. M., Tymoczko, J. L., Lubert Stryer. 2010. Biochemistry. 7TH Ed.
3. Lodish, H., Berk, A., Zipursky, S. L., Paul. M., Baltimore D., Darnell, J. 2012. Molecular Cell Biology.
4. McKee, T., McKee, J.R. 2003. Biochemistry: The Molecular Basis of Life. 3rd Edition, McGraw Hill.

Course code: ZOO-313 **Cell and Molecular Biology** 4 (3+1)

Course Contents

Objectives

The course aims to:

- Impart knowledge about the animal cell and its complex organization of architecture
- Provide understanding about the unified role of a cell for the ultimate sustainability of the organisms.
- Enable students to understand various ultra-structural, molecular and functional aspects of the cells will be communicated in this course.

Course Contents

Introduction to prokaryotic and eukaryotic cells: Plasma membrane, its chemical composition structure and functions of plasma membranes, cell permeability, active transport, endocytosis, phagocytosis.

Cytoskeleton: Microfilaments, Microtubules, Intermediate filaments.

Cytoplasmic Organelles: Membrane system, structural and functional commonalities. Ultrastructure, chemical composition and functions of Endoplasmic Reticulum and their role in protein synthesis and drug metabolism, Golgi apparatus its role in synthesis of glycoprotein, Mitochondrial respiration and its significance as semi-autonomous organelle; Lysosome, its diverse roles due to hydrolytic activity of enzymes, Peroxisome, its role in metabolism of hydrogen peroxide, Glyoxysome with reference to glyoxylic acid cycle. **Nucleus:** chromatin, heterochromatin, euchromatin,

chromosome structure, coiling and nucleosome during different phases of cell cycle.

Replication: mechanism, DNA replication in prokaryotes specially with reference to variety of DNA polymerases and other proteins involved, DNA replication in Eukaryotes with emphasis on DNA polymerases, concept of replicons etc.,

Transcription: variety of RNA and their characteristics, synthesis of mRNA, rRNA and tRNA with special reference to enzymes involved, RNA splicing, split genes, concept of ribozymes and posttranscriptional processing, RNA transduction, Genetic code, point mutations.

Translation: Specific role of Ribosomes, various factors, and posttranslational processing, control of gene expression in Prokaryotes.

Practicals

1. Identification of cell organelles
2. Preparation of temporary whole mount.
3. Preparation of permanent whole mount (demonstration)
4. Preparation of human blood smear and identification of Leucocytes.
5. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone).
6. Squash preparation of onion root tip for mitotic stages.
7. Mounting of polytene chromosome (Drosophila/Chironomous.)

Demonstration.

8. Detection and quantitative determination of chromosomal DNA and

RNA.

9. Cultural and staining of bacteria and yeast.

10. Separation of different sized DNA fragments on agarose gel.

11. Isolation and characterization of proteins on polyacrylamide gel electrophoresis (native and sub-unit molecular weights).

Books Recommended

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. 2013. Molecular Biology of the Cell. Garland Publishing Inc., New York.
2. Damell Jr. J., Lodisch, H., Baltimore, D. 2013. Molecular Cell Biology, Scientific American Inc. N.Y.
3. Friefelder, D. 2010. Molecular Biology.
3. Geoffrey M.C., Robert E.H. 2007. The cell: A Molecular Approach, Sinauer Associates, INC.
4. Karp, J. 2005. Cell and Molecular Biology, Concepts and Experiments, Jhon Wiley and Sons, INC.
5. De Robertis, E. D. P., De Robertis Jr. E. N. F. 1987. Cell and Molecular Biology, Lea & Febiger, New York.

ZOO-314

Zoogeography and Palaeontology

3 (2+1)

Objectives:

The course aims to

- Provide information on the distribution of animals and their associations in the past and to rationalize their relationship in the present time.
- Impart knowledge and concepts of evolution mainly on the basis of fossil record.
- Give understanding that fossil record also provide information about the distribution of animals in the past eras.

Course Contents

(i). Zoogeography Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography.

Animal distribution: cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution, barriers and dispersal.

Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Palaearctic, Nearctic regions, Oriental, Ethiopian, Australian, and Neotropical Regions, insular fauna Palaeogeography: Theories of continental drift and plate tectonics; Pangea.

Zoogeography of Pakistan:

(ii). Paleontology

The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.

Rocks: types; Igneous rocks, sedimentary rocks and metamorphic rocks.

Fossil types and uses of fossils, nature of fossils.

Fossilization: Geological time scale. Pre-Cambrian life. Post Cambrian life,

Palaeozoic life, Mesozoic life, Cenozoic life. Geochronometry: Uranium/Lead dating, radiocarbon dating, methods, index

fossils; evolutionary history of man, elephant, horse and camel, Paleocology, Paleomagnetism.

Practicals

1. Study of fauna of various zoogeographical regions.
2. Study of mould, cast, pseudomorph, coprolite, petrified fossils of plants and animals.
3. Study of invertebrate fossils of coelenterates, trilobites, ammonite, brachiopods, molluscs and echinoderms.
4. Study of vertebrate fossils e.g. horse/elephant/camel/bovids.
5. Study and identification of Igneous, Sedimentary and Metamorphic rocks.
6. Map work for identification of various zoogeographical regions of the World.

Books Recommended

Zoogeography:

1. Beddard, F. E. 2008. A text book of zoogeography. Bibliobazar, LLC.
2. Tiwari, S.K. 2006. Fundamentals of world zoogeography. Wedams eBooks Ltd (India) Sarup & Sons. Delhi.
3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.
4. Darlington, P. J. Jr. 1963. Zoogeography, John Wiley and Sons.

Paleontology:

1. Michael, J. B. David, A and Haper, T. 2009. Paleobiology and the fossil record. 3rd Ed. Wiley Black, UK.
2. Foote, M and Millar, A. I. 2007. Principles of paleontology. 3rd Ed. W. H. Freeman & Co. USA.
3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.
4. Brouwer, A. 1977. General Palaeontology, Oliver and Boyed, London.

Course code: ZOO-311 Animal Behavior 3 (3+0)

Course Objectives:

The objectives of the course are:

- To impart knowledge about animal responses to external stimuli.
- To emphasize on different behavioural mechanisms (classical and recent concepts).
- To explain development of behavior with suitable examples of animals
- To understand role of genetic and neuro-physiology in behavioural development.

Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. **OUTLINE** the baseline information and knowledge for animal behavior.
2. **ASSOCIATE** the likely role of external and internal stimuli on various animals during the day, season and year.
3. **RELATE** daily behavioural rhythms in diurnal and nocturnal periodicities.
4. **PREDICT** and anticipate variety of animal actions (costs and benefits) as assessed by innate and learned behaviours; displays.
5. **INTEGRATE** the animal behavior as balanced mechanism to develop animal personality.

Course Outline

1. Introduction

- Behaviour and its types.
- Proximate and ultimate causes of behavior.
- Development of behavior and impact of neural and physiological mechanisms; role of external and internal stimuli and animal responses. Physiology of behavior in changed environments.
- Hormones and behavior in animals.

- Innate behavior and innate releasing mechanisms; built in programmed performance by offspring to that of parents. Innate behavior of three spined stickle back fish.
- Learned behavior and its mechanisms; quick learners' vs slow learners. Concept of animal cognition; key to understand and develop multiple behavioural choices. Ecological and genetics to maintain animal behavior. Concept of territoriality and defense in animals.
- Circadian rhythms and concept of bio-rhythmicity in animals. Maintenance of internal biological clock to perform various diurnal and nocturnal periodicities. Costs and benefit ratios in behavior; successful foragers and winners of predator-prey relationships. Altruism and parental sacrifice to nurture the young.
- Competition for resources; survival of the most suitable individuals; evolutionary arms races in behavior.
- Social organization in animals and concept of group living; benefits and losses. Aggression, appeasement and selfish individuals. Social organization in insects and mammals.
- Communication in animals: Visual, Bioacoustic, electrical, chemical and tactile.
- Various types of chemical signals in animals' behavior and their importance in ecosystems.

Books Recommended:

1. Dngatkin, L. A. 2012. Principles of Animal Behavior.W.W. Nortan and Co.New York.
2. Alcock, J. 2010. Animal behavior, an evolutionary approach. 9th Edition. Sinauer Publishers.
3. Scott, G. 2009. Essential Animal Behavior. Wiley publishers.
4. Scott, G. 2005.Essential Animal Behavior. Blackwell Pub. New York.