

UNIVERSITY OF THE POONCH RAWALAKOT

PROPOSED CURRICULUM
FOR
M. Phil. 2 YEARS PROGRAM
IN
ZOOLOGY



DEPARTMENT OF ZOOLOGY
UNIVERSITY OF THE POONCH RAWALAKOT
AZAD KASHMIR

Website: www.upr.edu.pk

UNIVERSITY OF THE POONCH RAWALAKOT, AJK
SCHEME OF STUDIES FOR M. Phil. ZOOLOGY
DEGREE PROGRAMME

Duration	4-6 Semesters
Courses	24 Credits
Seminar I and II	02 Credits
Special Problem	01 Credit
Research and Thesis	10 Credits
Total Credits	37 Credits

COURSES FOR M. Phil. 1st SEMESTER **(Credit hours 13)**

Course Code	Course Title	Credit Hrs.
ZOO-701	Applied and Experimental Statistics	3(2+1)
ZOO-729	Seminar-I	1(1+0)
	Elective-I	3(3+0)
	Elective-II	3(3+0)
	Elective-III	3(3+0)
Total		13

COURSES FOR M. Phil. 2nd SEMESTER **(Credit hours 13)**

Course Code	Course Title	Credit Hrs.
ZOO-702	Research Methodology and Scientific Writing	3(2+1)
ZOO-730	Seminar-II	1(1+0)
	Elective-I	3(3+0)
	Elective-II	3(3+0)
	Elective-III	3(3+0)
Total		13

COURSES FOR M. Phil. 3rd SEMESTER **(Credit hours 01)**

Course Code	Course Title	Credit Hrs.
ZOO-731	Special Problem	1(1+0)
ZOO-732	Research and Thesis	10 (0+10)

COURSES FOR M. Phil. 4th SEMESTER

Course Code	Course Title	Credit Hrs.
ZOO-732	Research and Thesis	10 (0+10)

LIST OF ELECTIVE COURSES FOR M. Phil. ZOOLOGY
SEMESTER 1st and 2nd

Course code	Course Title	Credit Hrs.
ZOO-703	Clinical Bacteriology	3(2+1)
ZOO-704	Environmental Issues in Pakistan	3(3+0)
ZOO-705	Fish Physiology and Breeding	3(2+1)
ZOO-706	Basic Pharmacology and Animal Trials	3(3+0)
ZOO-707	Wildlife of Pakistan and Azad Jammu and Kashmir	3(2+1)
ZOO-708	Biological Molecules	3(2+1)
ZOO-709	Molecular Physiology	3(3+0)
ZOO-710	Cancer Genetics	3(3+0)
ZOO-711	Systemic Toxicology	3(3+0)
ZOO-712	Advances in Medical Parasitology	3(2+1)
ZOO-713	Advances in Developmental Biology	3(2+1)
ZOO-714	Genomics	3(3+0)
ZOO-715	Advances in Molecular Biology and Biotechnology	3(3+0)
ZOO-716	Medical Entomology	3(2+1)
ZOO-717	Medical Virology	3(2+1)
ZOO-718	Immunology: Introduction and Applications	3(2+1)
ZOO-719	Advances in Aquaculture	3(2+1)
ZOO-720	Molecular Biology Technique	3(0+3)
ZOO-721	Advanced Molecular Genetics	3(3+0)
ZOO-722	Bacterial Genetics	3(2+1)
ZOO-723	Biology of Birds and Mammals in Pakistan and AJK	3(2+1)
ZOO-724	Microbial Genomics	3(2+1)
ZOO-725	Cancer Biology	3(3+0)
ZOO-726	Applied Reproductive Physiology	3(2+1)
ZOO-727	Helminthology and Protozoology	3(2+1)
ZOO-728	Behaviorial Zoology	3(2+1)

COURSE CONTENTS OF COMPULSORY/ELECTIVE COURSES FOR M. Phil. ZOOLOGY 1st and 2nd SEMESTERS

ZOO-701	APPLIED AND EXPERIMENTAL STATISTICS	3(2+1)
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Course contents

Theory

Importance of statistics in variety of fields including medicine, biological, physical and social sciences, Basic concepts of statistics, frequencies, mean, mode, standard deviation, standard error, range etc. Probability and Normality, Sampling methods, Hypothesis testing, T test (Paired T test, one sample t test), Chi Square test, F test, One way analysis of variance, two way analysis of variance, LSD and DMRT tests, Correlation analysis, simple linear regression analysis, Logistic regression analysis, Odds Ratio

Practicals

Analysis of given data by T test, Chi square test, Correlation, regression and one way ANOVA applying any of the available statistical software preferably SPSS or Statistic

Recommended Books

1. Montgomery D. C. 2014. Design and Analysis of Experiments 8th Edition, Wiley Publishers, New Dehli.
2. Mariappan P. 2013. Biostatistics: An Introduction (LPE). Pearson, New York, New Dehli.
3. Forthofer R. N. 2011. Biostatistics: A guide to design, analysis and discovery. Elsevier Publishers.
4. Blair R. C. and Taylor R. A. 2009. Biostatistics for Health Sciences. Pearson Education Publishers.
5. Muhammad F. 2005. Statistical methods and Data analysis. Kitab Markaz, Faisalabad.

ZOO-702	RESEARCH METHODOLOGY AND SCIENTIFIC WRITING	3(2+1)
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Course Contents

Theory

Meaning of research, objectives and significance of research, research processes, criteria for good research, problems encountered by researchers in Pakistan. Defining research problem: Selecting research problem, techniques involved in defining a problem. Developing hypothesis. Review of literature: Different forms and sources of acceptable data and techniques of acquiring required literature. Research and sampling design: Need for research design, characteristics of a good research design, basic principles of experimental designs, Steps in sampling designs, different types of sampling designs. Data collection: types of data, methods of data collection,

4. Willey J, Sherwood L. and Woolverton C (2007). Prescott/Harley/Klein's Microbiology, McGraw Hill.
5. Nester E.W, Anderson DG and Nester MT (2006). Microbiology. A Human Perspective, McGraw Hill

ZOO-704	ENVIRONMENTAL ISSUES IN PAKISTAN	3(3+0)
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Course Contents

Theory

Human population: Human population explosion, environmental and social impacts of growing population and affluence, addressing population problems. Food production and its distribution, hunger, malnutrition and famine. Pest and pest control need and approach to pest control, integrated pest management. Water Pollution: Human impact on water resources, Eutrophication, Combating eutrophication. Sewage Pollution: Sewage hazards and sewage managements. Hazardous Chemical pollution: Nature of chemical risks, pollution sources and control. Major atmospheric Changes; Acid deposition, global warming/ cooling, greenhouse effect, Ozone depletion. Solid Waste: Landfills, incineration, management and solutions. Energy resources: Energy sources and uses; issues related to fossil fuel and nuclear power, alternate energy resources. Environmental Issues in Pakistan: Ecological issues: Soil erosion, deforestation, issues related to irrigation system, natural hazards. Issues related to conservation of habitat and biodiversity: Major threats to biodiversity in Pakistan, Conservation strategies. Industrial pollution: Sources and remediation. Population issues: Socio-economic issues in Pakistan.

Recommended Books

1. McKinney, M.L., Schoch, R.M. and Yonavjak, L. Environmental Science: systems and solutions. 2007. 4th Ed. Jones and Bartlett Publishers.
2. Wright, R.T. and Nebel, B. J. Environmental Science. 2007. Toward a Sustainable Future. 10th Ed. Pearson Educational.
3. Botkin, D. B. and Keller, E. A. Environmental Science: Earth as a Living Planet. 2007. 6th Ed. John Wiley and Sons.
4. Botkin, D. B. and Keller, E. A. Environmental Science (Earth as a living planet). 2000. 3rd ed. John Wiley and Sons Inc. New York, USA
5. Pakistan-A Descriptive Atlas (A comprehensive geo-politics course). 2000. 1st ed. Ahmad, R. Z. Ferozsons Pvt. Ltd. Lahore Pakistan.
6. A Geography of Pakistan Environment (Environment, people and economy). 1993. 1st Ed. Khan, F. K. Oxford University Press. New York USA.

WEB SITES

1. <http://wu.w.panasia.org.sg/tcdc/pakistan>
2. <http://urww.wwfpak.org/biodiversity>
3. <http://www.populationconnection.org>
4. <http://www.epa.org.pk>
5. <http://www.unep.org>

ZOO-705	FISH PHYSIOLOGY AND BREEDING	3(2+1)
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Course Contents

Fish nutrition: Digestive system; Stomach less fishes; Stomached fishes; Digestion and absorption; Food; Plant origin; Animal origin; Feeding; Fresh food; Dry concentrates; Pelleted food. Transportation: Blood; Blood cells (Erythrocytes, leukocytes, Platelets and plasma); Circulation; Arterial system; Venous system; Capillaries; Transport of food material. Respiration: Gills; Lungs; Skin; Swim bladder; Homeostasis. Excretion: Kidneys; Hypo-osmotic urine; Hyper-osmotic urine; Osmoregulation. Reproduction: Gonads; Testes and ovaries; Maturation; Reproductive cells (egg and sperm); Artificial fertilization of sex cells. Breeding: Natural (seasonal); Artificial; Hormonal induced breeding; Temperature and photoperiod; control induced breeding. Growth: Extensive culture (due to the consumption of natural food); Semi-intensive culture (due to natural and artificial food); Intensive culture (due to only dry concentrates). Fish health: Water quality; Hygiene of fish culture facilities; Hygiene of equipments used in fish culture. Diseases and their control: Viral; Bacterial; Fungal; Parasitic; Protozoan; Helminths (trematodes, cestodes, nematodes, acanthocephalons); Crustaceans (cladocera); Annelids (leeches); Arthropods (water ticks, water flea, water mites). Fish migration: To nursery ground; to maturation grounds; Freshwater to marine water; Marine water to freshwater. Fish behaviour: Learning and memory; Light response for maturation; Courtship behaviour; Aquarium fish behaviour.

Practical

Study of morphological characters of a typical fish. Dissection of a bony fish to expose its various systems. Species identification based on fin formula, scale counting etc. Practical demonstration of induced breeding. Artificial feeds and their constituents. Aquatic plants. Aquatic insect. Visit to hatchery and fish farm.

Recommended Books

1. Shulka, A. N. Hormones of Fishes. 1st Edition 2009. Discovery Publishing House Private LTD, New Dehli.
2. Peter, B. Moyle, Joseph, J. Cech, J. R. An introduction to Ichthyology. Fifth Edition. 2014. PHI Learning Private Limited. Dehli.
3. Frank, C. Adminster. Fish Pond for the Form. 2010. AGROBIOS.
4. Kestin, S. C. and Warris, P.D. (Editors). Kestin Farmed Fish Quality, 2002, Blackwell Science, Oxford, UK.

ZOO-706	BASIC PHARMACOLOGY AND ANIMAL TRIALS	3(3+0)
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Course contents

Introduction to pharmacology? What are drugs? drug development stages, isolation of active ingredients from sources, in vitro testing. animal trials, studying dose

determination, LD₅₀, LC₅₀, drug toxicity, side effects, pharmacokinetics, pharmacodynamics, drug delivery, absorption, distribution, bioavailability, half life and elimination using animals. Phase I, II, III and IV clinical trials, Ethics of animal trials and other animal studies, Ethics committees. patenting of drugs, commercialization and benefit sharing. Important study animals.

Recommended Books

1. Pharmacology: An Introduction (Paper back) by Henry Hitner Published January 12th 2011 by McGraw-Hill.
2. Advances in Experimental Medicine and Biology, Volume 595: The Molecular Targets and Therapeutic Uses of Curcumin in Health and Disease (ebook) by Bharat B. Aggarwal, Published January 1st 2007 by Springer.
3. Principles of Pharmacology: The Path physiologic Basis of Drug Therapy (Paperback) by David E. Golan (Editor) published April 27th 2007 by LWW
4. Pharmacology for Anaesthesia and Intensive Care (Paperback) by Tom E. Peck, Published April 1st 2008 by Cambridge University Press
5. Pharmacology: Prep Manual for Undergraduates (Kindle Edition) by Tara Shanbhag, Published January 23rd 2016 by Elsevier India

ZOO-707	WILDLIFE OF PAKISTAN AND AZAD JAMMU AND KASHMIR	3(2+1)
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Course Contents

Definitions, concepts and importance of wildlife. Classification of the amphibians, reptiles, birds and mammals of Pakistan/AJK up to Orders with identifying characteristics and examples. Status and distribution of the wildlife of Pakistan/AJK. Species status assessment system of IUCN-global and national. Extinct/extirpated wildlife of Pakistan/AJK, with their causes of extinction. Threatened wildlife of Pakistan/AJK and their threats. Different types of wildlife habitats in Pakistan/AJK (Alpine, sub alpine, forests, wetlands, village groves, cultivations, grasslands, deserts, etc.). Wildlife conservation: Ethics of conservation, priorities in conservation effort, *ex situ* and *in situ* conservation, conservation and rural development, role of culture and religion in conservation, National Conservation Strategy of Pakistan/AJK. Protected areas of Pakistan/AJK: History, status, categories and management. Participatory management of protected areas. Captive breeding and re-introduction of wildlife. Cage/fencing, habitat preparation and maintenance of wildlife for captive breeding. Zoos and Safari Park in Pakistan/AJK. Human-wildlife conflict in Pakistan/AJK and its mitigation (snake bite, crop damage by bears and macaques, poultry damage by wild cats and jackals, human and cattle deaths by leopards, etc.). Laws and conventions related to wildlife: Pakistan/AJK Wildlife Act, Convention on Biological Diversity (1992), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973), Ramsar Convention (1971). National and international organizations involved in wildlife conservation.

Practicals

- Procedure of studying species richness.
- Population estimates of some local subterranean animals, butterflies, birds, rodents
- Demonstration of distribution of animal species of Pakistan (blank maps will be provided)
- Critical account (phylogenetic controversies) of some important museum specimens with the help of literature.

Recommended Books

1. Jordan, E. L. and Verma, P. S. 2011. Invertebrate Zoology, S. Chand and Company.
2. Grimmett, R. Roberts, T. J and Inskipp, T. 2008. Birds of Pakistan. Helm Field Guide.
3. Gaston, G. and J. Spicer. 2007. Biodiversity. Blackwell Publishing and Co. London, UK.
4. Mitsch, W. J. and Gosselink, J. G. 2007. Wetlands 4th ed. John Wiley and Sons, Inc
5. Hickman, Roberts, and Larsen, 2003. Animal Diversity (3rd Edition). McGraw Hill, New York.
6. Hickman, Roberts, and Larsen, 2004. Integrated principles of Zoology (12th Edition). McGraw Hill, New York.
7. M. S. Khan. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Florida USA.
8. M. M. Shafique, 2005. Wildlife Acts and Rules of Pakistan. PFI, Peshawar.
9. Mirza, Z. B. 1998. Illustrated handbook of Animal Biodiversity of Pakistan. Print Pak.
10. Roberts, T. J. 1997. Mammals of Pakistan. Oxford University Press, Karachi.

ZOO-708	BIOLOGICAL MOLECULES	3(2+1)
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Course Contents

Carbohydrates: classification, types, important characteristics and structure of carbohydrates; monosaccharides; disaccharides, their types structure and function; polysaccharides, storage and structural types; structure and major functions of polysaccharides. 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 behavior and amino acid composition. 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. 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 enzyme activity. Vitamins and cofactors: occurrence, structure and biochemical function of vitamins of B-complex group. Nucleic Acids; DNA and RNA structures and types.

Practicals

- Separation and identification of various types of sugars, fatty acid and amino acid Thin Layer Chromatography (TLC).
- Determination of pKa values of an amino acid by preparation of titration curves.
- Biochemical tests for detection of different amino acids.
- Separation of various protein fractions by precipitation method.
- Demonstration of differential solubility of lipids in various solvents.
- Quantitative analysis of phospholipids by estimation of inorganic phosphorous.
- Quantitative analysis of Amylase activity from blood serum or liver.
- Study on the effect of temperature on the enzymatic rate of reaction

Recommended Books

1. Denise R. Ferrier. Biochemistry. 6th edition. 2015 Lippincott's.
2. Aroor A. R. Medical Biochemistry. 2011. Jaypee Brothers Medical publishers, UK London.
3. Nelson, D. L. and Cox, M.M. Lehninger Principles of Biochemistry, 3rd Edition, 2000. McMillan Worth Publishers, New York.
4. Murray, R.K., Granner, D.K., Mayer, P.A. and Rodwells, V.W. Harper's Biochemistry, 25th Edition, 2000. McGraw Hill, New York.

ZOO-709	MOLECULAR PHYSIOLOGY	3(3+0)
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Course Contents

Overview of resting membrane, action potential and synaptic transmission; structure and mechanisms in ion channels; Biosynthesis of neurotransmitters; Neurotransmitters action at synaptic receptors. Neurosecretions and neurotransmitters in higher nervous system actively. Molecular mechanisms in transduction of sensory stimuli into impulse; photochemistry and transduction of photoreceptor; Colour vision. Overview of endocrine glands, their hormones and roles; chemistry and biosynthesis of hormones of adenohipophysis, thyroid, parathyroid, endocrine pancreas, adrenal medulla and steriodogenic tissues; Metabolism of thyroid and steriodogenic tissues; Structure of hormone receptors; Mechanisms of action of a protein/peptide, a steroid and thyroid hormone; Hormonal regulation of metabolism; Molecular basis of muscular contraction; Molecular interaction at neuromuscular level; Molecular structure of cilia and flagella and mechanisms in movements.

Automaticity and rhythmicity of myogenic heart; Regulation of cardiac activity; humeral regulation of circulation: Vasoconstriction and vasodilatation. Exchange of respiratory gases; Chemical regulation of respiration. Nature formation of various nitrogenous waste products; Glomerular filtration, reabsorption, and secretion mechanisms; Concentration of urine. Regulation of digestive secretions; Digestion and absorption of nutrients, Molecular mechanisms in adaptation to temperature extremes

Recommended Books

1. Randall, D., Burggren, W., French, K. and Fernald, R., 2002. Eckert Animal physiology; Mechanisms and Adaptations, 5th ed. W. H. Freeman and Company,
2. Bullock, J., Boole, J. and Wang, M.B., 2001. Physiology, 4th edition. Lippincott, Williams and Wilkins, Philadelphia.
3. Berne, R.M. and Levy, M.N., 2000. Principles of Physiology, 3rd edition. St., Lious, Mosby.
4. Guyton, A.C. and Hall, J.E., 2000. Textbook of Medical Physiology, 10th Edition. W.B. Saunders Company, Philadelphia.
5. Tharp, G. and Woodman, D., 2002 Experiments in Physiology, 8th Edition, Prentice Hall, London.

ZOO-710	CANCER GENETICS	3(3+0)
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Course Contents

Cancer definition. Genetic basis of cancer. Oncogenes and Tumor Suppressor Genes. Cell Cycle Control Genes. Growth Regulatory Genes. Genes involved in Repair pathways. Cancer and Genetic Susceptibility. SNP and Cancer. Genetic Screening for Cancer. Case Studies: P53. Rb. BRCA1, RRCA2.

Recommended Books

1. Jorde, carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in india by Rajkamal Electrical press, kundli, Haryana.
2. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
3. Waseem Ahmad (Faridi) 2013. Genetics and Genomics. Pearson publication incorporation.
4. Articles Published in Nature Review Cell and Molecular Biology.
5. Articles Published in Nature Review Immunology.
6. Essentials of Cell Biology by Bruce Alberts.
7. Biochemistry by Stryer.
8. Genes VIII by Lewin.

ZOO-711	SYSTEMIC TOXICOLOGY	3(3+0)
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Course Contents

Brief introduction to the principals of distribution. Excretion and absorption of toxicants. Biotransformation of toxicants and chemical carcinogens. A detailed study of the Toxic responses of various systems of the body like Toxic responses of blood, Immune system, Liver, Kidney, Respiratory system, Central Nervous system and Cardiovascular system. Role of free radicals in Toxicity. Modes of Cell death Necrosis and Apoptosis; Cytokines and Signal Transduction.

Recommended Books

1. Hayes, A. Wallace, 2014. Principles and Methods of Toxicology, Sixth Edition, Raven Press, New York.
2. Klaassen, C. D., (2010). Casarell and Doull's Toxicology; The Basic science of Poisons; 6th Edition (International). McGraw-Hill, Health Professions Division, New York.
3. Timbrel, J. A., 2001. Introduction to Toxicology, 3rd edition. Taylor and Francis Ltd. London.

ZOO-712	ADVANCES IN MEDICAL PARASITOLOGY	3(2+1)
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Course Contents

Symbiosis to parasitism: parasite, host, community; Malaria; biological aspects; immunological and patho-physiological aspects in malaria; Leishmaniasis: disease spectra and immunopathology; Chagas' disease; Opportunistic pathogens: Toxoplasmosis; Intestinal protozoa: Amebiasis and Giardiasis; Hepatosplenic, intestinal and urinary schistosomiasis; Fascioliasis; Echinococcosis; Cerebral and generalized cysticercosis; Ascariasis and visceral larva migrans; Intestinal nematodiasis: immunological mechanisms of worm expulsion; Cytokines: their roles in parasitic diseases; Lymphatic filariasis; Trichinosis; Significance of eosinophilia in helminthiasis. Parasite-host cell molecular interaction

Practical

Collection, preservation/culture and preparation of slides of local biological and mechanical vectors of medical and veterinary importance and their identification.

Recommended Books

1. D. R. Arora. Medical Parasitology. 2015. 4th edition. Amazon publishers
2. Hunter's Tropical Medicine (6th edition) by G. T. Strickland. 2001.
3. Foundations of Parasitology by L.S. Roberts and J. Janovy Jr., 8th Edition, 2009. McGraw Hill, Boston.
4. Animal Agents and Vectors of Human Diseases by P.C. Beaver and R.C. Jung 2007.
5. Topley and Wilson's Principle of Bacteriology, Virology, Mycology, Parasitology and Immunity (Vols. I-6). 9th edition. 2007. Edward Arnold Publishers, UK

ZOO-713	ADVANCES IN DEVELOPMENTAL BIOLOGY	3(2+1)
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Course Contents

General Principles: Differential Gene Expression, Cell-Cell Communication, Principles of Development - Differentiation, Specification, and Cell Lineage. Reproduction and Early Development: Meiosis – Gametogenesis, Fertilization, Early Development and Axis Formation – Drosophila, Vertebrates. Apoptosis- mechanism and significance, Ageing- mechanism, concepts and models. Applied Developmental Biology: Assisted Reproduction and Hormonal Regulation, Multiple ovulation and embryo transfer technology (MOET), Pluripotent Stem Cells: ES Cells and iPS Cells Application of embryonic stem cells, clinical and economic significance, Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.), Cloning of animals by nuclear transfer. Mammalian development and medical embryology: Early Development of the Mammalian Central Nervous System, Early Musculoskeletal Development, Limb Patterning and Development, Development and Birth Defects of the Eye and Ear, Development of the Heart, Development of Lungs and Aortic Arches, Development of the GI and Renal Systems, Sex Determination, Gonadal Development, Neural Crest and Craniofacial Development.

Practical

Study of structure of gametes in some representative cases, i.e. frog, fish fowl, etc. Study of cleavages and subsequent development from prepared slides and / or whole mounts in various animals i.e. chick, fish frog, etc. Preparation of serial section of frog of chick embryos. Application of microsurgical techniques on chick embryos in vitro.

Recommended Books

1. Developmental Biology, S. F. Gilbert. 10th Edi. 2013. Sinauer Associates Inc. Publishers.
2. Jonathan, M., W. Slack. Essential developmental biology.2012 3rd edition. Wiley-Blackwell.
3. Klaus, K. 2001. Biological Development. 2nd Edition. McGraw Hill.
4. Principles of developmental: Lewis Wolpert. 2011. 4th edition. OUP. Oxford.

ZOO-714	GENOMICS	3(3+0)
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Course Contents

Strategies for the systematic sequencing of complex genomes, Genomic features of model organisms, Orthologs, paralogs and evolutionary genomics, Gene duplication and co-option 2R or not 2R: extensive genomic duplications in early chordates, Primate segmental duplications, Comparative genomics and decoding the regulatory

genome, “Evodevo” (Evolutionary Developmental Biology) and genomics, Classification of vertebrate gene deserts, Expansion of introns in animal genomes

Recommended Books

1. Introduction to Genomics by BY Arthur Lesk Oxford University Press, USA; 1 edition (March 30, 2007).
2. Human Molecular Genetics by Tom Strachan and Andrew Read, Garland Science/Taylor and Francis Group; 3 edition (November 21, 2003).
3. Endless Forms Most Beautiful: The New Science of EvoDevo and the Making of the Animal Kingdom Sean B. Carroll W. W. Norton and Company; 1 edition (April 11, 2005).
4. The Regulatory Genome: Gene Regulatory Networks in Development and Evolution Eric H. Davidson Academic Press; 1 edition (June 13, 2006)

ZOO-715	ADVANCES IN MOLECULAR BIOLOGY AND BIOTECHNOLOGY	3(3+0)
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Course contents

Recombinant DNA technology, PCR techniques, RFLP technique, Gel electrophoresis, Cell culture techniques, some important cell lines and their culture techniques, Stem cell research and techniques, Hematopoietic stem cells and their culture techniques, Stem cell therapy, Antibody research and techniques of antibody production, antibody engineering, hybridoma technique for generation of monoclonal antibodies, Cloning techniques, Gene therapy. Indigenous knowledge and patenting, commercialization and benefit sharing. National bioethic committees.

Recommended Books

1. William J. Thieman (2014) Introduction to Biotechnology 3rd edition. Pearson publication incorporation
2. Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Robert, Keith; Walter, New York and London: Garland Science; 2002, Molecular Biology of the Cell.
3. Cooper, Geoffrey M. The Cell – A Molecular Approach Sunderland (MA): Sinauer Associates, Inc.; 2002
4. Lodish, Harvey; Berk, Arnold; Zipursky, S. Lawrence; Matsudaira, Paul; Baltimore, David; Darnell, James E. New York: W.H. Freeman and Co.; 1999. Molecular Cell Biology.
5. Karp, J. Cell and Molecular Biology, Concepts and Experiments, 2005. Jhon Wiley and Sons, INC.
6. Malacinski. G. M. 2003. Essentials of Molecular Biology. 4th Edition. Jones and Bartlett Publishers, Massachusetts

ZOO-716	MEDICAL ENTOMOLOGY	3(2+1)
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Course contents

Arthropod borne diseases, Biology, disease relationships and control of insects and other arthropods parasitic on or in humans, clinical and preventive medicine. Direct impacts that parasitic insects have on human health. Taxonomy of medically important arthropods and molecular biology applications, epidemiology, transmission, disease control, vector control and disease surveillance. Arthropod groups involved in the causation and/or transmission of diseases affecting human health with key morphological characteristics, habits and habitat needs of the various life stages of arthropod being emphasized. Use of molecular biology applications to medical entomology.

Practical

Collection of arthropods vectors, preservation/culture and preparation of slides of local biological and mechanical vectors of medical importance and their identification.

Recommended Books

1. Mullen, Gary and Lance Durden. 2009. Medical and Veterinary Entomology, Academic Press: New York.
2. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods 2nd Edition by B.F. Eldridge, J.D. Edman, Kluwer Academic Publisher
3. Mike Service. 2011. Medical Entomology for Students. 5th Edition, Cambridge Press.
4. Jerome Goddard. 2004. Public Health Entomology 1st Edition CRC Press

ZOO-717	MEDICAL VIROLOGY	3(2+1)
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Course contents

Introduction, structure and classification of viruses, Detection and diagnosis of medically important viruses. Mechanism of virus entry in the cell. Acute, Chronic, Persistent and Latent infection, sources, mode of transmission, life cycle, epidemiology, disease course and control of some human viral infections including HIV, Hepatitis A, B, C and D viruses; polyoma viruses, rabies virus, Epstein barr virus, Varicella zoster virus, Prevention and control of Viral Diseases. Vaccine, its types and mode of action. Antiviral Drugs and their mode of action. Safety measures and rules for working in an infectious disease laboratory

Practical

Laboratory techniques, rules and regulations; ELISA, RIA, techniques; HCV. HBsAg testing kits, HIV kits testing of blood sera; visitation to hospitals, pharmaceuticals to further enhance knowledge of virology techniques.

Recommended Books

1. NJ. Dimmock, AJ. Easton and KN. Leppard. 2007. Introduction to Modern Virology, 6th Edition. Blackwell Publishing Ltd.
2. EK. Wagner, MJ. Hewlett, DC. Bloom and D Camirini. 2008. Basic Virology, 3rd Edition. Blackwell Publishing Ltd.
3. CA. Mims, A. Nash and J. Stephen. 2000. Mims' Pathogenesis of Infectious Diseases, 5th Edition. Academic Press, London.
4. RA. Goldsby, TJ. Kindt and B. Osbourne. 2000. Kuby Immunology, 4th Edition. W.H. Freeman, New York.

ZOO-718	IMMUNOLOGY: INTRODUCTION AND APPLICATIONS	3(2+1)
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Course contents

Introduction to immune system, First, second and third line of immune system, Innate and acquired immunity, cell mediated and humoral immunity, components of immune system, classification and function of immune cells with process of hematopoiesis, Antibodies, monoclonal and polyclonal antibodies, complement system, Interleukins and interferon, Allergy and Anaphylaxis, Inflammation, Applications of immunology in diagnosis and therapeutics, ELISA, RIA etc. Monoclonal antibodies, antibody engineering and production for diagnostic and therapeutic purposes using animals and animal models

Practicals

Antigens and elicitation of immune response. Experiments on methodology that employs immunological procedure such as radioimmuno assay.

Recommended Books

1. F. H. Khan, The Elements of Immunology, Pearson Publishers India, 2012
2. Thao Doan, Roger Melvold, Susan Viselli, Carl Waltenbaugh, Immunology, Published by Wolters Kluwer, India, Pvt. Ltd. New Dehli, 2014
3. Subash Chandra Parija, Text Book of Microbiology and Immunology, Elsevier, 2016
4. Richard A Goldsby, Thomas J. Kindt. Kuby Immunology. 2006.
5. Alfred I. Tauber. Metchnikoff and the origins of immunology. 2010.

ZOO-719	ADVANCES IN AQUACULTURE	3(2+1)
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Course Contents

Aquaculture: the concept, mariculture; the substrate system, seawater ponds, cages, enclosure, tanks. Aquaculture in fresh and brackish water. Water quality parameters in fish culture. Culture systems (open, semi-closed, closed). Polyculture vs. monoculture. Significance of aeration, culture of molluscs, Crustaceans; Fish (Carp,

Trout, Cat fish, Tilapia, Salmon). Aquaculture management (lakes, reservoirs etc.) economics and marketing; feeding for Carp, Salmonids and Cat Fishes. Intensive and semi-intensive culture of major carps. Aquaculture Engineering, Applied economics of Fisheries and Aquaculture, Pond Management, Advanced site selection and pond management, Breeding and rearing techniques of local and ornamental fishes, Carp and lobster aquaculture, Environmental conditions feeding and fertilization factors, biological filtration in aquaculture, Sterilization and disinfection, Design of Production system

Practical

Study of chromosomes and DNA. Quantitative analyses of sex hormones. Artificial fecundity and induced breeding of cultivable fish. E.M. Techniques.

Recommended Books

1. Bhardwaj, K. D. A-Z of Fisheries and Aquaculture Technology. 1st Edition. 2011. Cyber. Tech Publication, New Dehli
2. Shulka, A. N. Hormones of Fishes. 1st Edition 2009. Discovery Publishing House Private LTD, New Dehli.
3. Peter, B. Moyle, Joseph, J. Cech, J. R. An introduction to Ichthyology. Fifth Edition. 2014. PHI Learning Private Limited. Dehli.
4. DianabandhuSahoo. Sustainable Aquaculture. 2009. A.P.H. Publishing Corportion, New Dehli
5. Frank, C. Adminster. Fish Pond for the Form. 2010. AGROBIOS.

ZOO-720	MOLECULAR BIOLOGY TECHNIQUES	3(0+3)
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Course contents (Practical)

Extraction and purification of DNA and RNA from body fluids, tissues, skin, hair and nails etc. quantitative PCR RT-PCR, gel filtration, Agarose gel electrophoresis, polyacrylamide gel electrophoresis (PAGE), Ultrafiltration, Dialysis, Lyophilisation, Southern, Northern and Western blotting, Western blotting, ELISA, RIA, RAPD, SSR, DAF, AFLP, FISH, Principles and applications of visible, UV, IR, NMR spectroscopy; Atomic absorption, Fluorescence spectroscopy, electron microscopy Principle and applications of X-ray diffraction, Principles and applications of gas chromatography and HPLC, Fast performance Liquid Chromatography (FPLC). Biosensors, protein chips

Recommended Books

1. Carson and Susan (2012) Elsevier Inc. ISBN: 978-0-12-385544-2
2. Keith Wilson, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press
3. Carson and Susan (2012) Elsevier Inc. ISBN: 978-0-12-385544-2
4. Keith Wilson, John Walker (2010). Principles and Techniques of Biochemistry

ZOO-721	ADVANCED MOLECULAR GENETICS	3(3+0)
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Course Contents

Genome structure, nuclear and mitochondrial genome, Types of DNA, Prokaryote and Eukaryote gene, molecular definition of a gene, Solitary genes and gene families , Simple sequence repeats and finger printing, Eukaryotic Gene Clusters and their Transcription, Transposable genetic elements, DNA methylation and Cancer, Repeat instability, repeat instability and genetic diseases, Imprinting, Differential methylation and cancer, Epigenetics and its implications in the genome, Replication and Transcription shaping the genome, Telomere and Telomerase and their role in cancer and aging, applications, RNA interference, RNAi mediated pathways in nucleus, therapeutic potential for human diseases, molecular regulation of gene expression.

Recommended Books

1. Harvey Lodish(2016), Cell and Molecular Biology, W. H. Freeman publishers, USA.
2. Jorde, carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in India by Rajkamal Electrical press, kundli, Haryana.
3. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
4. Waseem Ahmad (Faridi) 2013. Genetics and Genomics. Pearson publication incorporation.
5. Lewin, Benjamin (2003), Genes VIII, Oxford University Press.

ZOO-722	BACTERIAL GENETICS	3(2+1)
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Course Contents

Nucleic acids structure and functions. DNA replication: replicon origins, events that occur at the replication fork, the structure and functions of DNA polymerases, and replication strategies. Control of DNA replication: dichotomous replication in prokaryotes. Control of gene expression in prokaryote: polycistrons, transcriptional initiation and termination, the operon, catabolite repression and attenuation control. Protein synthesis - mRNA translation: Genetic code - non universality, codon usage. Events on ribosomes (c.f. prokaryotes), ribosome structure-function relationships, organelle and archaeobacterial systems. Plasmids, episomes and transposons. DNA mutagenesis and mutagenic agents, repair and mutation suppression. Genetic recombination: generalized recombination, site specific recombination and illegitimate recombination. Gene transfer mechanisms and their role in evolution. Transformation, transduction, conjugation and crossphylogenetic transfer. Gene mapping by conjugation and transduction. Circular chromosomal maps of bacteria. Introduction to genetic rearrangements.

Practical

Estimation of gene frequencies in natural population. Artificial selection of quantitative characters; protective coloration and frequency dependent selection (a) artificial prey (b) natural prey. Visits to NARC at Islamabad and NIAB, NIBGE at Faisalabad.

Recommended Books

1. Udis, N., Streips, U. N., Ronald, E., Yasbin, R. E., 2002. Modern Microbial genetics. Wiley, John and Sons, Inc.
2. Pierca, B. A., 2005. Genetics. A conceptual approach, W. H. Freeman and Company, NY.
3. Synder, L. and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D.C.
4. Ringo, J., 2004. Fundamental Genetics, Cambridge University Press.
5. Griffiths, A. J. F., Wessler, S. R., Lewontin, R. C., Gelbart, W. M., Suzuki, D.T., and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company

ZOO-723	BIOLOGY OF BIRDS AND MAMMALS IN PAKISTAN AND AZAD JAMMU KASHMIR	3(2+1)
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Course Contents

Structure, origin, evolution, reproduction and life history of birds, behaviour, population regulation, general ecology, geography migration and orientation in birds. Introduction to classification, classification of avifauna of Pakistan. Characteristics, distribution, classification, reproduction and development, behaviour, population and economic relationship of mammal. The mammal fauna of Pakistan and its scientific and economic importance

Practicals

Techniques of collection and studying mammals, preparation of study skins and identification of local mammalian species, field trips. Taxonomy of Birds, Bird Identification, Bird census techniques, Ecological notes on endemic and threatened birds of Pakistan, Mist-netting, Methods of bird migration, Important bird areas of Pakistan and AJK.

Recommended Books

1. Jordan, E. L. and Verma, P. S. 2011. Invertebrate Zoology, S. Chand and Company.
2. Grimmett, R. Roberts, T. J and Inskipp, T. 2008. Birds of Pakistan. Helm Field Guide.
3. Gaston, G. and J. Spicer. 2007. Biodiversity. Blackwell Publishing and Co. London, UK.
4. Mitsch, W. J. and Gosselink, J. G. 2007. Wetlands 4th ed. John Wiley and Sons, Inc.
5. Hickman, Roberts, and Larsen, 2003. Animal Diversity (3rd Edition). McGraw Hill, New York.
6. Hickman, Roberts, and Larsen, 2004. Integrated principles of Zoology (12th Edition). McGraw Hill, New York.
7. M.S. Khan. 2006. Amphibians and Reptiles of Pakistan. Krieger Publishing Company, Florida USA.
8. M. M. Shafique, 2005. Wildlife Acts and Rules of Pakistan. PFI, Peshawar.
9. Mirza, Z. B. 1998. Illustrated handbook of Animal Biodiversity of Pakistan. Printopak.
10. Roberts, T.J. (1997). Mammals of Pakistan. Oxford University Press, Karachi.

ZOO-724	MICROBIAL GENOMICS	3(2+1)
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Course Contents

Genome Mapping: Genome size-complexity, structure and function of prokaryotic and eukaryotic genome. Physical mapping of genome-Sequencing whole genome, Restriction mapping – FISH, STS mapping, Hybridization assays , Physical mapping without cloning Mapping by genetic techniques, DNA markers: RFLPs, SSLPs, SNPs. Sequencing methods and Strategies: Basic DNA sequencing , Modifications of chain terminator sequences, Automated DNA sequencing, DNA sequencing by capillary array electrophoresis, shotgun sequencing Overlapping clone contigs, High throughput sequencing strategies, Alternative DNA sequencing, EST sequencing and sequence skimming. Genome Analysis: Overview of sequence analysis, Gene prediction, Tools for genome analysis. Detecting open-reading frames-using homology to find genes, software programs for finding genes Identifying the function of a new gene, Analyses not based on homology, Genome annotation, Molecular phylogenetics. Comparative Genomics : Comparative genomics of prokaryotes, organelles, eukaryotes and other aspects. Representational difference Analysis of cDNA and Genome Comparisons, Gene Expression during Host-pathogen interactions, genomics of Mycobacterium tuberculosis, Helicobacter pylori. Approaches to bacterial mRNA extraction and labeling for microarray Analysis. Functional Genomics: DNA micro array, Construction and Design, Application of DNA micro array for comparative and Evolutionary Genomics. Gene silencing, RNAi, SiRNA, SHRNA-Proteome analysis, Protein-protein Interactions. Application of Microbial Genomics, Reverse Vaccinology: from genome to vaccine, Microbial genomics for Antibiotic Target Discovery.

Practical

Estimation of gene frequencies in natural population. Artificial selection of quantitative characters; protective coloration and frequency dependent selection (a) artificial prey (b) natural prey. Visits to NARC at Islamabad and NIAB, NIBGE at Faisalabad.

Recommended Books

1. Pina Faramico, Yanhong Liu, Sophia Kathariou (2011). Genomes of food borne and water borne pathogens ASM Press Washington DC
2. Fraser, C. M., T. D. Read and K. E. Nelson (2004). Microbial Genomes, Humana Press, USA
3. Thomas J. Dougherty, Steven J. and Projan (2003). Microbial Genomics and Drug Discovery CRC Press. 4. Brendan Wren, Nick Dorrell (2002). Functional Microbial Genomics, Methods in Microbiology, Academic Press, UK.
4. Sandy B. Primrose Richard M. Twyman (2005). Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.

ZOO-725	CANCER BIOLOGY	3(3+0)
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Course Contents

Cancer Introduction, General features and types of cancer. Carcinogenesis;

Mechanisms of Carcinogenesis, Factors involved in Carcinogenesis. Role of cell cycle in carcinogenesis. Cell Cycle regulation. Metastasis or spread of cancers. Role of Proteinases in the spread of cancer. Matrix Metalloproteinases (MMPs), MMP1-13 Tissue Inhibitors of Matrix Proteinases (TIMMPs), Urokinase type plasminogen activator. Angiostatin, Endostatin, FGF, VEGF Kinases, Receptor and their ligands, EGF, TGF. Viral Proteins; FOS, JUN, Myc, Ras. Surrogate cancer Markers; AML, APC, BRCA, Estrogen Receptors Adhesion Molecules and Integrins. Cathepsins. Role of Apoptosis in cancer. Role of Cytokines in regulating carcinogenesis

Recommended Books

1. Harvey Lodish (2016), Cell and Molecular Biology, W. H. Freeman publishers, USA.
2. Jorde, Carey, Bamshad. (2012) Medical Genetics. Elsevier, printed in India by Rajkamal Electrical press, Kundli, Haryana.
3. Watson, Baker and Bell (2008) Molecular Biology of the Gene (6th edition) Pearson publication incorporation.
4. Zhang, Wei, (2004). Genomic and molecular neuro-oncology, Jones and Bartlett Publishers, Boston.

ZOO-726	APPLIED REPRODUCTIVE PHYSIOLOGY	3(2+1)
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Theory

Introduction, reproductive health. Infertility in male: classification, diagnosis, disorders at various levels. Infertility in female: classification, diagnosis, distinct disorders. Contraception, male and female, approaches rationale, modalities, side effects. Menopause: physiology, replacement therapy. Senescence in male reproduction: aging, sexuality, treatment. Field trials of artificial insemination to determine fertility rates. Causes of sterility in domestic animals. Anti-fertility mechanisms in humans. Synthesis of milk and lactation. Gender selection based on human genome project.

Practical

Demonstration of male and female reproductive system in vertebrates. Histological studies of ovaries, testes and different endocrine glands. Radioimmunoassays of different hormones. Morphological studies of sperm and ova in the buffalo. Morphometrical studies of sperm and ova. Collection and cryopreservation of sperm and ova in buffalo. Artificial insemination in buffalo. Motility assessment of male gametes. Staining of live and dead male gametes. Acrosomal analysis of sperm in buffalo.

Books Recommended

1. Bruce White Susan Porterfield. 2012. Endocrine and Reproductive Physiology. 4th Edition. Mosby Physiology Monograph Series.
2. Nischlag, E. and Behre, H.M. 2010. Andrology. 3rd Eds. Springer. NY. USA.

3. Knobil, E and Neill, J.D. 2013. The Physiology of Reproduction. 3rd Edition. Ravan Press. NY. USA.
4. DeGroot, L.J. 2010. Endocrinology. 6th Edition. Saunders Publishers. NY. USA.

ZOO-727	HELMINTHOLOGY AND PROTOZOOLOGY	3(2+1)
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Theory

Systematics, biology, pathology, Host-parasite relationship and control of parasitic helminthes, with special reference to helminthes of medical and veterinary importance. Systematics, biology, pathology, Host-parasite relationship and control of parasitic protozoa of medical and veterinary importance.

Practical

Collection, preservation/culture and preparation of slides of local helminthes and protozoa of medical and veterinary importance and their identification.

Books Recommended

1. Topley and Wilson's Principle of Bacteriology, Virology, Mycology, Parasitology and Immunity (Vols. I-6). 9th edition. 2007. Edward Arnold Publishers, UK
2. Foundations of Parasitology by L.S. Roberts and J. Janovy Jr., 8th Edition, 2009. McGraw Hill, Boston.
3. D. R. Arrora. Medical Parasitology. 2015. 4th edition. Amazon publishers
4. Hunter's Tropical Medicine (6th edition) by G. T. Strickland. 2001.
5. Animal Agents and Vectors of Human Diseases by P.C. Beaver and R.C. Jung 2007.

ZOO-728	BEHAVIORIAL ZOOLOGY	3(2+1)
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Theory

Instincts and learning, physiology of learning. Physiological basis behavior. Ultimate analysis of behavior, role of nature in shaping a behavior, Migratory behavior, predatory and anti-predatory behavior, group defense and mimicry, aggression and flight behavior, game theory models, prisoner's dilemma, behavioral strategies, sexual behavior. Natural and sexual selection, Swimming, burrowing and attachment behavior. Social and community behavior. Communication behavior and chemical signals.

Practical

Short films on the behavior of animals with at least one trip per semester to a facility to study animals' behavior kept in captivity. Short field trips to record behaviors in natural conditions. These will be followed by interactive exercises and quizzes.

Books Recommended

1. Nithya M Devi. 2011. Elements of Animal Behaviour. Anmol Publishers.

India.

1. Lee Alan Dugatkin. 2013. Principles of Animal Behavior. 3rd Edition. Norton, W. W. & Company, Inc.
2. Sherman, PW. And Alcock, J. 2013. Exploring Animal Behavior. 6th edition. Sinauer Associates, NY USA
3. Alcock, J. 2005. Animal Behavior 8th Edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA
4. Dugatkin, L. A. 2004. Principles of Animal Behavior. W.W. Norton & Company Inc., 500 avenues, New York, N.Y.