

RECOMMENDATION OF TITLE OF PhD PROGRAM THAT WILL APPEAR IN DEGREE and MARKS BREAKDOWN OF PhD PROGRAM

The board unanimously decided the title of the PhD Degree and mark break down as follow

Title that will appear in Degree

DOCTOR OF PHILOSOPHY IN ZOOLOGY (PhD in Zoology)

Marks Breakdown for PhD Courses (As per University approved Format)

Item	Maximum Marks for Courses (3 - 0)
Mid-Term Examination	20%
Internal Marks (Assignments, Quizzes, Presentations)	20%
Final-Term Examination	60%
Total	100

APPROVAL OF COURSES FOR PhD PROGRAM IN THE DEPARTMENT OF ZOOLOGY Following courses were unanimously approved by the board.

Courses for PhD Program

Course Category	Course Code	Course Title	Cr. Hrs.	Semester
Uni. Option	ZOO-811	Advanced Avian Physiology	3(3+0)	I/II
Uni. Option	ZOO-812	Advances in Biological Techniques	3(3+0)	I/II
Uni. Option	ZOO-813	Advanced Reproductive Physiology	3(3+0)	I/II
Uni. Option	ZOO-814	Advanced Helminthology	3(3+0)	I/II
Uni. Option	ZOO-815	Advances in Medical Parasitology	3(3+0)	I/II
Uni. Option	ZOO-816	Advances in Research Methodology	3(3+0)	I/II
Uni. Option	ZOO-817	Animal Growth & Adaptation	3(3+0)	I/II
Uni. Option	ZOO-818	Advanced Biostatistics	3(3+0)	I/II
Uni. Option	ZOO-819	Advanced Applied Entomology	3(3+0)	I/II
Uni. Option	ZOO-820	Advanced Applied Parasitology	3(3+0)	I/II
Uni. Option	ZOO-821	Advanced Fish Nutrition and Health	3(3+0)	I/II
Uni. Option	ZOO-822	Advanced Fish Parasitology	3(3+0)	I/II
Uni. Option	ZOO-823	Advanced Fish Requirements	3(3+0)	I/II
Uni. Option	ZOO-824	Advanced Medical Entomology	3(3+0)	I/II
Uni. Option	ZOO-825	Range Livestock Production	3(3+0)	I/II
Uni. Option	ZOO-826	Advanced Wildlife Conservation & Management	3(3+0)	I/II
Uni. Option	ZOO-827	Advanced Wildlife of Pakistan	2(2+0)	III / IV
Compulsory		Seminar	12	III & IV
Compulsory		Research and Thesis		
Total Credits=32 (Flexible from 30 to 36)				

DETAIL COURSE CONTENT OF PHD PROGRAM

ZOO-811	ADVANCED AVIAN PHYSIOLOGY	3(3+0)
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Course Outlines:

Physiology of the digestive tract; feed intake and its control; digestion, absorption and metabolism of carbohydrates, fats and proteins; basal metabolic rate; metabolic role vitamins and minerals; cardiovascular system; the blood; haemodynamics; main groups of blood cells and their functions; urinary, respiratory and nervous systems; endocrines, hormones and their role in body thermoregulatory mechanism. Blood collection and hematological studies, dissection for study of ova and counting of ova in mature ovary.

BOOKS RECOMMENDED

1. Jadhav, N.V. and M.F. Siddiqi. Latest Edi. Handbook of Poultry Production and Management. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi, India.
2. Sturkle, P.D. (Latest edition). Avian Physiology. Springer-verlag. New York, U.S.A.
3. Swenson, M.J. and W.O. reece. Latest Edi. Dukes Physiology of Domestic Animals. 11th ed. Panima Publishers, India.
4. Freeman, B.M. Latest Edi. Physiology and Biochemistry of Domestic Fow. Vol. 1.5 Academic Press Inc. Ltd., London, U.K.

ZOO-812	ADVANCES IN BIOLOGICAL TECHNIQUES	3(3+0)
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Course Outlines:

Advances in UV Spectroscopy/Separations and Flame Atomic Absorption Spectroscopy, Advances in Spectrofluorimetry, Advances in Thin Layer Chromatography (TLC), Gas Chromatography and High Performance Liquid Chromatography (HPLC), Advances in Amino acid sequencing, Blotting techniques, Centrifugation techniques, PCR and DNA Sequencing, Advances in Electrophoresis, Isoelectric Focusing Apparatus, Lyophilizer, Microarray Technology, Microscopy and Microtomy, Advances in Nuclear Magnetic Resonance Instrument, principles and application, Geographic Information Systems and Remote sensing and ELISA, Advances in Cell culture.

Books Recommended:

1. Chemical Analysis: Modern instrumentation, methods and techniques, Francis Rouessac and Annick Rouessac, John Wiley & Sons, Latest Edi, ISBN 0-471-97261-4.
2. Principles of Instrumental Analysis Latest Edi, Douglas A. Skoog, F. James Holler and Timothy A. Nieman, Brooks Cole, Latest Edi, ISBN 0-03-002078-6.
3. Spectrometrische analysetechnieken, M.T.C. de Loos - Vollebregt, Heron reeks - Bohn Stafleu Van Loghum, Latest Edi, ISBN 90-313-4142-8.

ZOO-813	ADVANCED REPRODUCTIVE PHYSIOLOGY	3(3+0)
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Course Outline:

1. Assisted Reproductive techniques: an overview
2. Semen Collection & Evaluation: a. Semen collection methods, b. Initial assessment: Appearance, volume & concentration, c. Sperm motility: Computer Aided Sperm Analysis, d. Sperm Morphology, e. Acrosome status, f. Chromatin integrity.
3. Semen cryopreservation: a. Properties of Semen Extenders, b. The cryopreservation technique
- c. Application in farm animals & endangered species and humans.
4. Artificial insemination: a. Introduction and history of Artificial insemination, b. Artificial insemination procedures
5. Estrus synchronization
6. In vitro fertilization (IVF) and in vitro embryo production (IVEP): a. IVEP & Transfer for genetic improvement of farm animals, b. IVF and ICSI for treatment of infertility in human
7. Superovulation and Embryos transfer

8. Assisted Reproductive techniques for conservation of endangered species: a. Sperm cryobanking
b. Embryo freezing
9. Causes of sterility in domestic animals: Infertility in Male, Infertility in female, Sperm sexing for sex pre-selection. Contraception
14. Student's presentation: recent research paper/ review article in the field
15. Morphological & morphometric studies of sperm & ova in buffalo/cattle.
16. Collection and cryopreservation of sperm in farm animals.
17. Artificial insemination in buffalo/cattle.
18. Motility assessment of sperm.
19. Staining of live and dead sperm.
20. Acrosomal analysis of sperm.
21. Aspiration and in vitro maturation of oocytes

Text and Reference Books:

1. Andrology by E. Nieschlag, H. M. Behre and S. Nieschlag. Latest Edi. Published by Springer, USA.
2. Knobil & Neill's Physiology of Reproduction by T. M. Plant and A. J. Zeleznik. Latest Edi. Published by Springer, USA.
3. Reproduction in Farm Animals by E. S. E. Hafez and B. Hafez. Latest Edi. Published by Wiley-Blackwell, NY, USA.
4. Applied Animal Reproduction by H. J. Bearden, J. W. Fuquay and S. T. Willard. Latest Edi. Published by Pearson Prentice Hall, USA.

ZOO-814	ADVANCED HELMINTHOLOGY	3+0
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Course Contents

Recent advances in evolutionary perspectives of host parasite relationship, helminths adaptation, host specify in helminthes and epidemiology of some helminth infection of human origin (Ascariasis, Trichuriasis, Enterobiasis, Dracunculiasis, Taeniasis, Hymenolepiasis, Echinococcosis, Fascioliasis). Recent advances in genetic variation in helminth and their epidemiological importance. Recent advances in Ultra-structure, chemical composition and pathogenesis of helminth parasites. Recent advances in response to helminth infection, antigen of pathogenic helminth, diagnosis of helminth infection. Recent advances in Immunodiagnosis and radiation in the control of helminth infection, chemotherapy and genetic control of immunity to helminth parasites. Recent advances in examination of stool specimens for different helminth eggs/segments. Recent advances in helminth eggs recovery through different techniques, (Kato-Katz, Direct smear methods and concentration procedures, Recovery of Enterobius vermicularis and Taenia spp eggs through cellophane tape Swab, Methods for estimation of worm burden (stoll-egg counting technique, Kato-Katz techniques), Recent advances in methods for investigation of intestinal helminthes (Knott concentration technique and membrane filtration technique for micro-filaria)

Books recommended

1. Smyth, J.D. Latest Edi. The Physiology and Biochemistry of Cestodes. Cambridge University Press.
2. Cheng, T.C. Latest Edi. General Parasitology 2nd ed. Elsevier
3. Chiodini, P.L and Moody, A.H. Latest Edi. Atlas of Medical Helminthology and Protozoology. Churchill Livingstone
4. Geoffrey. Latest Edi. Monnigs Veterinary Helminthology and Entomology. Lapage
5. Hyde, J.E. Latest Edi. Molecular Parasitology. Oxford University Press.
6. Maggenti, A. Latest Edi. General Nematology. Springer Verlag, Heidelberg.
7. Smyth, J.D and Halton, D.W. Latest Edi. The physiology of trematodes 2nd Ed. Cambridge University Press.

ZOO-815	ADVANCES IN MEDICAL PARASITOLOGY	3+0
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Course Contents

Recent advances in symbiosis to parasitism (parasite, host, community; Malaria; biological aspects); Recent advances in immunological and patho-physiological aspects in malaria; Recent advances in Leishmaniasis(disease spectra and immunopathology). Recent advances in Chagas' disease; Recent advances in 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), Recent advances in Parasite-host cell molecular interaction.

Books Recommended

1. L.S. Roberts and J. Janovy Jr. Latest Edi. Foundations of Parasitology. 8th edition. McGraw Hill, Boston.
2. Animal Agents and Vectors of Human Diseases by P.C. Beaver and R.C. Jung. Latest Edi
3. Hunter's Tropical Medicine. Latest Edi. By G. T. Strickland.
4. Immunobiology by Janeway, C.A. and Travers,. Latest Edi

ZOO-816	ADVANCES IN RESEARCH METHODOLOGY	3(3+0)
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Course Contents:

Recent advances in various aspects research, (Research methods vs. research methodology, scientific method, b. Types of research, general steps involved in research, c. Problems of research in Pakistan, d. Problem identification for research, criteria and evaluation)

Recent advances in Literature review process (a. Importance and sources, b. Referencing and citation and bibliography, c. Plagiarism), Recent advances in Research Design, objectives (Parts, important features, important concepts in research design), Material and Methods(Bioethics, sampling, sampling designs, data collection and data analysis, sampling requirements, scales of measurement, error of measurement and its sources) and Data Analysis (Processing, statistics in research, hypothesis testing, t-tests and ANOVA), Recent advances in applications of SPSS, SAS, SATA, Python and R etc. Recent advances in Data Presentation (a. Tabulation, graphical presentation, b. Presentation software), Scientific Writing: a. Difference between thesis/report/synopsis/research proposal, b. Parts of synopsis/project proposal, parts of thesis/report).

Text and Reference Books:

1. Paul Leedy, Latest Edi, Practical Research: Planning and Design (8th Edition), Jeanne Ellis Ormrod
2. Creswell, J. W. Latest Edi. Research Design Quantitative Qualitative and Mixed Methods Approaches. Sage.
3. Hess-Biber, S. N. and P. Leavy. Latest Edi. Approaches to Qualitative Research, A Reader on Theory and Practice. New York, Oxford University Press.
4. Khan, J.A. Latest Edi. Research Methodology. New Delhi: APH Publishing.
5. Kothari, C.R., & Gaurav, G. Latest Edi. Research Methodology: Methods and Techniques. New Delhi: New Age International.
6. Kumar, R. Latest Edi. Research Methodology: A Step By Step Guide for Beginners. Cornwall: SAGE Publications, Inc.
7. Laurel, B. Latest Edi. Design Research, Methods and Perspectives. London England, The MIT Press.

8. Walliman, N. Latest Edi. Your Research Project, 2nd Edition, A step by step guide for the first-time researcher. New Delhi, Vistaar Publications

ZOO-817	ANIMAL GROWTH AND ADAPTATION	3(3+0)
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Course Outlines:

Theory Mechanism of animal growth; Factors governing the growth and development in dairy and meat animals; Introduction to adaptation and mechanism; Stress and adaptation; anatomical and morphological changes during adaptation; Adaptation in different agro ecological zones; Growth regulators and promoters; Energetics; Stress; Hormonal and physiological changes due to stress; Homeostasis; Animal adaptation in climatic changes; Behavioral adaptation; Species specific adaptations; Environmental effects on productive and reproductive performance.

Reference Books:

1. Curry, B.W. Latest Edi. Structure and Function of Domestic Animals. CRC Press, Inc., Boca Raton, FL, USA.
2. Frandson, R.D., W.L. Wilke and A.D. Fails. Latest Edi. Anatomy and Physiology of Farm Animals. Wiley-Blackwell, USA.
3. Hafez, E.S.E. Latest Edi. Adaptation of Farm Animals. Baillier Tindal and Cassell, London, UK.
4. Lawrence, T.L.J. and V.R. Fowler. Latest Edi. Growth of Farm Animals. CABI, UK.
5. Schmidt, N.K. Latest Edi. Animal Physiology: Adaptation and Environment . Cambridge, UK.

ZOO-818	ADVANCED BIOSTATISTICS	3(3+0)
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Course Outline:

Advanced descriptive statistics (Measure of central tendency and dispersion, frequency distribution, data representation using tables, graphs and charts). Advanced Probability (Concept, definition and types of probability, Bayes theorem), Distribution and confidence interval: The Binomial distribution, the Poisson distribution, the normal distribution and 95% confidence interval for mean. Sampling Technique: Population, sample, different sampling techniques Hypothesis testing: Introduction to hypothesis, one and two samples testing, interpretation of P-value, ANOVA and multiple comparisons, non-parametric testing, chi-square test of independence. Correlation and regression: Concept and type of correlations and association, simple and multiple linear regressions).

Reference Books

1. Zar, J.H. Latest Edi. Biostatistical Analysis, Fourth Edition, Pearson Education (Singapore) Prentice Hall International (UK) Limited. London, UK.
2. Muhammad F., Latest Edi. Statistical Methods and Data Analysis, Kitab Markaz, Bhawana Bazar Faisalabad, Pakistan. Choudhry, M. R. Latest Edi. Modern Statistics. Polymer Publications, Urdu Bazaar, Lahore. Steel, R. G. D, J. H.
3. Dickey, D.A (Latest Edi) Principles and Procedures of Statistics A Biometrical Approach Third Edition. WCB Mc. Graw Hill, New York, USA.

ZOO-819	ADVANCED APPLIED ENTOMOLOGY	3(3+0)
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Course Outline:

Advanced causes of success and economic importance of insects; Advanced principles and methods of insect control (cultural, biological, physical, mechanical, reproductive, legislative, chemical and biotechnological control), Advanced introduction to IPM (insecticides, their classification, formulations and application equipment; Advanced identification, life histories, mode of damage and control of important insect pests of crops, fruits, vegetables, stored grains, household, termites and locust; Advanced entomological industries (apiculture, sericulture and lac-culture). Advances in Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household, Insecticide formulations, their dilutions and safe handling and Use of application equipments, instructions for apiculture, sericulture and lac-culture.

Text and Reference Books:

1. Atwal, A.S. Latest Edi. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
2. Awastheir, V.B. Latest Edi. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India.
3. Duncton, P.A. Latest Edi. The Insect: Beneficial and Harmful Aspects. Kalyani Publishers Ludhiana.
4. Gullan, P. J. and Cranstan, P. S. Latest Edi. The Insects: An Outline of Entomology. 4th edition. Wiley-Blackwell. A John Wiley & Sons, Ltd., Publication, UK.
5. Lohar, M. K. Latest Edi. Applied Entomology, Latest Edi. Department of Entomology, Sindh Agriculture University Tandojam Sindh, Pakistan.
6. Mathews, G.A. Latest Edi. Pesticide Application Methods, 3 rd. Ed. John Wiley & Sons, Inc. N.Y. 7. Pedigo, L.P. and Marlin, E. R. Latest Edi. Entomology and Pest Management, 6 th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
7. Pfadt, E.R. Latest Edi. Fundamentals of Applied Entomology, Latest Edi. The McMillan Co., N. Y.
8. Robinson, D.H. Latest Edi. Entomology Principles and Practices. Agro-bios.
9. Shah, H.A. and Saleem, M.A. Latest Edi. Applied Entomology, Latest Edi. Izhar Sons Printers, Lahore.

ZOO-820	ADVANCED APPLIED PARASITOLOGY	3(3+0)
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Course Outline:

Advances in chemicals and reagents used in preservation of parasitic materials (Collection, processing and identification of parasites, b. Recovery of parasite eggs, oocysts and larvae from faecal specimens, c. Determination of parasite resistance to pesticidal chemicals and chemotherapeutic drugs).

Advances in Control and Vaccine Development Against Parasitic Infections:

Advances in Chemotherapeutic agents used against parasitic infections: a. eg. anthelmintics, insecticides etc. b. The mode of action of chemotherapeutic agents, c. The mechanisms of parasite resistance to drugs.

Advances in Methods of Vaccine Development: a. Various approaches will be discussed for example: Helminths use of 3 types of antigens viz: Irradiation-attenuated live helminths, b. Somatic extracts of helminths, c. Metabolic or excretory/secretory (E/S) antigens produced by the in vitro culture of helminths. d. Genetic engineering. the application of genetically engineered vaccines will be discussed. Cultivation of Parasites tissue culture techniques, cryopreservation

Text and Reference Books:

1. William Charles Marquardt, Richard S. Demaree, Jr., Robert Burton Grieve., Latest Edi. Parasitology & Vector Biology. Latest Edition.
2. Chandler, A.C. and Read, C.P. Latest Edi. Introduction to Parasitology. Latest Edi. Wiley Toppan, New York, USA
3. Handler, A. M. James, A.A. Latest Edi. Insect Transgenesis: Methods and Applications, Comprehensive review of insect gene transfer, its methodologies, applications and risk assessment and regulatory issues. CRC Press.
4. Erlich, H. Latest Edi. PCR Technology: Principles and Applications for Amplification. W.H. Freeman & Company, New York.

ZOO-821	ADVANCED FISH NUTRITION AND HEALTH	3(3+0)
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Course Outlines:

1. Advances in macronutrients and micronutrients and their importance; Advances in carbohydrates, lipids, protein, amino acids, vitamins, minerals, carotenoids. Nutritional energetic: digestion process in fish, energy partitioning, bioenergetics model, methods of digestibility determination, factors affecting digestibility, nutrient digestibility.
2. Advances in fish feed and feeding (natural and artificial; production of live feed; classification of fish feed on the basis of nutrient composition and texture. feed additives; other dietary components (water, fiber, hormones, antibiotics, pigments, pellet binders, stimulants). Anti-nutritional factors, types of anti-nutrients and their sources.
3. Advances in toxic agents and anti-oxidants in fish nutrition: (Toxic agents, non-nutrient diet components; antioxidants in compounded feeds),
4. Advances in fish nutritional disorders (Nutritional fish diseases; nutrients and immune response; feed rancidity).
5. Recent novel diets for aquaculture and aqua feed industry: (Encapsulated diets, medicinal diets and experimental diets. Introduction, economics of feed production and feeding; quality control in fish feed manufacturing; feed regulations).

Recommended Books:

1. John Halver. Latest Edi. Fish Nutrition, ELSEVIER.
2. Lovell, T., Latest Edi. Nutrition and Feeding of Fish. Latest Edi. Springer Science, USA
3. Stickney, R. R. Latest Edi. Aquaculture: An Introductory Text. CABI Publishing, London, UK.
4. Pandey, B. N., S. Deshpande and P. N. Pandey. Latest Edi. Aquaculture. APH Publishing Corporation, New Delhi, India.
5. Ojha, J.S. Latest Edi. Aquaculture Nutrition and Biochemistry. GeetaSomaniAgrotech Publishing Academy, Udaipur, India.
6. Parker R. O., Latest Edi. Aquaculture Science Latest Edi. Delmar Learning, London.
7. Halver, J.E. and Hardy, R.W. Latest Edi. Fish Nutrition. Academic Press. Boston, London,
8. Hertrampf, J.W., Pascual, F.P. and Ong, S.L. Latest Edi. Handbook on Ingredients for Aquaculture Feeds. Kluwer Academic Publishers
9. Rajagopalsamy, C.B.T. and. Ramadhas. V. Latest Edi. Nutrient Dynamics in Freshwater Fish culture system. Daya Publishing house, Delhi.
10. Rajagopalsamy, C.B.T. and. Ramadhas. V. Latest Edi. Nutrient Dynamics in Freshwater Fish culture system. Daya Publishing house, Delhi.

ZOO-822	ADVANCED FISH PARASITOLOGY	3(3+0)
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Course Outlines:

Recent advances in fish parasitology (a. Host and parasite, b. Types of host and parasite, c. Ectoparasite and endoparasite concepts, d. Overview and Adaptation, e. association of parasites: f. symbiosis, g. commensalism, h. mutualism, i. parasitism). **Fish parasite s**(a. Classes of fish parasites: b. Ecto-parasites, c. Endo-parasites, d. Identification of parasitic problems, e. Methods of diagnosis, physical examination, f. Pathogenesis, g. Life cycles and treatment methods of following parasites: h. Protozoa, i. Monogenean trematodes, j. Degenean trematodes, k. Nematodes, l. Cestodes, m. Crustaceans, n. Leeches.), **Medically important parasites** (a. The medically important parasites, b. Protection and the treatment of fish parasites), **Identification of parasites** (Life cycles of parasites, Isolation of fish parasites from host Treatment methods, Prevention and control measures).

Recommended Books/Readings:

1. Patrick T. K. W and K. Buchmann. Latest Edi. Fish parasites: pathobiology and protection. 2012. CABI Publishers
2. Bremner, HA. Latest Edi. Safety and Quality Issues in Fish Processing. Woodhead Publishing Limited, Cambridge, England
3. Buchmann, K. Latest Edi. An introduction to practical methods in fish parasitology. CABI Publishers
4. Bresciani, J., E. Ariel, K. Pedersen, I. H. Dalsgaard. Latest Edi. Fish Disease: an introduction. CABI Publishers.

ZOO-823	ADVANCED FISH REQUIREMENTS	3(3+0)
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Course Outlines:

Recent advances in fish nutrition, Digestion and absorption of nutrients, Feeding types and anatomy. Recent advances in Energy, protein, lipids, carbohydrate, mineral and vitamin requirements of fish. Recent advances in factors affecting nutrient requirements of fish, Energy losses and partitioning in fish. Advances in the role of other dietary components (water, fiber, hormones, antibiotics, antioxidants, pigments, pellet binders and feeding stimulants), Anti-nutrients and toxins, Forms and size of feed, feeding rates and feeding practices for different fish species.

Recommended Books:

1. Fitzsimmons, K., R.S.N. Janjua and M. Ashraf, Latest Edi. Aquaculture Handbook—Fish Farming and Nutrition in Pakistan.
2. John Halver. Latest Edi. Fish Nutrition, ELSEVIER.
3. Lovell, T., Latest Edi. Nutrition and Feeding of Fish. Latest Edi. Springer Science, USA
4. Hephher, B., Latest Edi. Nutrition of Pond Fishes. Cambridge University Press, UK.
5. Halver, J.E., Ronald, W.H. and Daniel, M.H. Latest Edi. Fish Nutrition (4thed.). Academic Press, N. York.
6. Pillay, T.V.R. Latest Edi. Aquaculture: Principles and Practices. Fishing News Books, London.
7. N.C.R., Latest Edi. Nutrient Requirements of Fish. National Academy Press, Washington D.C.

ZOO-824	ADVANCED MEDICAL ENTOMOLOGY	3(3+0)
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Course Outline:

Advances in arthropods of Medical Importance, Problems caused, Arthropods borne diseases, Food Contaminants, Toxins and Venoms, Defense secretions and allergens. Recent advances in Introduction, lifecycle, medical importance and management strategies of (a. Mosquitoes, b. Sandflies, c. Horse flies, d. Tsetse fly, e. Fleas, f. Lice g. Bed bugs, h. Cockroaches, i. Houseflies, j. Black flies, k. Beetles, l. Butterflies and Moths, m. Bees and Wasps, n. Scorpions, o. Spiders, p. Ticks, q. Mites).

Text and Reference Books:

1. Mike Service, Latest Edi. Medical Entomology for Students, Cambridge University Press.
2. Mullen, G. and Durden, L., Latest Edi. Medical and Veterinary Entomology.. Academic Press. San Diego, CA.
3. Ralph E William. Latest Edi, Veterinary Entomology: livestock & Companion Animals CRC press, 343 pp.
4. Marquardt, W.C., Latest Edi. Biology of Disease Vectors, 2nd Ed., Elsevier Academic Press.
5. Aldridge, B., Latest Edi. Medical Entomology: Text Book of Public Health and Veterinary. Chapman and Hall, London.
6. Service, M., Latest Edi. Medical Entomology for Students. Cambridge University Press.
7. Tyagi, Latest Edi, Medical Entomology: A Hand book of medically Important Insects & other arthropods Scientific Publisher.
8. Eldridge F. Bruce & Edman, J.D. Latest Edi. Medical Entomology: A text book on Public Health and Veterinary problems caused by Arthropods. Kluwer Academic Publishers.
9. Kettle, D.S., Latest Edi. Medical and Veterinary Entomology., CAB International, UK.
10. Busvine, J.R., Latest Edi. Insects and Hygiene. Chapman and Hall, London.

ZOO-825	RANGE LIVESTOCK PRODUCTION	3(3+0)
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Theory:

Range livestock industry; ecological problems and concepts; mechanisms of controlling animal population; native range forage plants; protection of land resources and range livestock; selection and handling of livestock on ranges; supplementary feeding on ranges; range inventories and grazing plans; range resources improvement and pasture development; conservation of water resources on ranges; ailments of range animals; carrying capacity and stocking rates. Effect of supplementary feeding on the performance of grazing animals; seasonal variation in body condition; measurement of nutritional status through blood metabolites; observations on grazing habits of buffaloes, cattle, sheep, goats and camels; visits to range areas for observation on range inventory, fencing, rotational grazing, calculating carrying capacity and stocking rate of grazing animals;

Books Recommended

1. Qureshi, M.A.A., G.S. Khan and M.S. Yaqoob. Latest Edi. Range Management in Pakistan. Kazi. Publications, 121-Zulqurnain Chambers, Ganpat Road, Lahore
2. Drickamer, L.C. and H.V. Vessey. Latest Edi. Animal Behaviour: Concepts, Processes and Methods. Wadsworth Pub. Co., California, USA.
3. Morley, F.M. W. Latest Edi. Grazing Animals. Elsevier Scientific Pub. Co., Amsterdam, The Netherlands.
4. Bell, H.M. Latest Edi. Rangeland Management for Livestock Production. University of Oklahoma Press, USA.
5. Vallentine, J. F. Latest Edi. Range Development and Improvement. (3rd Ed.) Academic Press, Inc. San Diego, CA.

ZOO-826	ADVANCED WILDLIFE CONSERVATION AND MANAGEMENT	3(3+0)
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Course Outline:

Recent advances in wildlife of Pakistan (a. Introduction, b. Important Definitions, c. Identification, d. Distribution e. Status f. Wildlife values g. Conservation and Management (population estimate technology) of fishes, amphibians, reptiles, birds and mammals of major importance in Pakistan), **Problems in wildlife conservation, Wildlife rules and regulations in Pakistan** (a. Principles of Reintroduction b. IUCN categories of Wildlife, c. Zoo rules), **National and International agencies involved in conservation and management of wildlife** (National Organizations, b. International Organizations) **Threatened species of Pakistan** (Vulnerable b. Endangered c. Critically Endangered) and **Modern Techniques for Control of Environmental Pollution in Wildlife Areas.**

Recommended Books:

1. Mills, S. Latest Edi. Conservation of Wild population. Blackwell Publishing & Co. London, UK.
2. Sinclair, A. R. E., Fryxell, J. M. and Caughley, G. Latest Edi. Wildlife Ecology, Conservation and Management. Blackwell Publishing & Co., London, UK.
3. Sutherlands, W. J. Latest Edi. The Conservation handbook, Blackwell Science.
4. Sexena, M.M., Latest Edi. Applied Environmental Biology, Agro Botanical Publ. India.
5. Rigger, P.G. Latest Edi. Long Term Ecological Research, an International Perspective. John Wiley.
6. Sheehun et. al. P. J. Latest Edi. Effects of Pollution on the Ecosystem. John Wiley.

ZOO-827	ADVANCED WILDLIFE OF PAKISTAN	3(3+0)
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Course Outline:

1. Advances in Wildlife of Pakistan vs existing Wildlife in Pakistan (Overall and Provincewise), Wildlife biology, Wildlife Population Ecology, **Wildlife Management** (Wildlife Management at Wetlands, b. Terrestrial Wildlife Management, c. Wildlife Damage Management, d. Captive Wildlife Management), **Wildlife Conservation:** (a. Philosophy and significance of wildlife conservation. b. Essentials of Wildlife Conservation and National Perspectives, c. Conservation of Amphibians and Reptiles, d. In-situ conservation and Ex-situ conservation), **Biodiversity of Pakistan** (a. Biodiversity and sustainability of wildlife, b. Identification, distribution, status and endangered species, c. Mammals, Birds, Reptiles and Amphibians, d. Fresh water and Marine fish fauna of Pakistan, Insects and plants), **Wildlife Conservation** (a. Philosophy and significance of wildlife conservation. b. Essentials of Wildlife Conservation and National Perspectives, c. Conservation of Amphibians and Reptiles, d. In-situ conservation and Ex-situ conservation).

Text and Reference Books:

1. Wildlife of Pakistan, Latest Edi. Published by Punjab Wildlife Department, Lahore.
 2. Miller, G.T. Latest Edi. Living in the Environment: Principles, Connections and Solution. Thomson Learning Inc., Australia.
 3. Roberts, T.J., Latest Edi. The Birds of Pakistan, Oxford.
 4. Roberts, T.J., Latest Edi. Mammals of Pakistan, Ernest Benon Ltd. London.
- Robinson, W.L. and Bolen, E.G., Latest Edi. Wildlife Ecology and Management, McMillan, Cambridge.

WORKING PAPER (PhD)
8th BOARD OF STUDIES MEETING
DEPARTMENT OF ZOOLOGY
SHAHEED BENAZIR BHUTTO UNIVERSITY-SHERINGAL

RECOMMENDATION OF SCHEME OF STUDIES (OVERALL AND SEMESTER WISE BREAKUP) FOR P. HD IN ZOOLOGY PROGRAM

Below detailed draft of scheme of studies (as per approved PhD rules of the university), for launching of PhD program in the department of Zoology was approved

Degree Awarded: Doctor of Philosophy in Zoology (PhD in Zoology)

SCHEME OF STUDIES (Semester-wise Breakdown)

1st Semester

S. No.	Course Code	Course Title	Marks	Credit Hours
1	ZOO-	Course-I	100	3(3-0)
2	ZOO-	Course-II	100	3(3-0)
3	ZOO-	Course-III	100	3(3-0)
Total			300	09

2nd Semester

S. No.	Course Code	Course Title	Marks	Credit Hours
5	ZOO-	Course-I	100	3(3-0)
6	ZOO-	Course-II	100	3(3-0)
7	ZOO-	Course-III	100	3(3-0)
Total			300	09

3rd and onward Semesters

S. No.	Course Title	Credit Hours
8	Seminar	2
9	Thesis and Research	12
Total		32