

Scheme of Studies for PhD (Pathology)
Department of Pathobiology, Faculty of Veterinary Sciences, BZU Multan

Mission Statement

Courses have been designed to enable Ph.D students to gain expertise in the discipline of Pathology. These course will be helpful to work as practical pathologist in livestock/poultry industry and also as research worker in the discipline of Pathology.

Course No.	Courses	Credit hours
PATH-701	Molecular Pathogenesis of Avian Diseases	3(2-2)
PATH-702	Biochemical Pathology	3(1-4)
PATH-703	Diagnostic Techniques in Pathology	3(1-2)
PATH-704	Pathology of Intoxications	3(2-2)
PATH-705	Food Animal Pathology	3(2-2)
PATH-706	Immunopathology	3(2-2)
PATH-707	Wildlife and Zoo Animal's Pathology	3(2-2)
PATH-708	Oncology	3(2-2)
PATH-709	Special Problem-II	1(0-2)
PATH-710	Seminar-II	1(1-0)
PATH-711	Fish Pathology	2(1-2)
PATH-712	Pathology of Zoonotic Diseases	3(2-2)
PATH-713	Current Topics in Pathology	1(1-0)

PATH-701

Molecular Pathogenesis of Avian Diseases

3(2-2)

Learning Objectives:

Upon completion of this course students will be able to:

- have a knowledge of gross and microscopic pathology of different Viral, bacterial and parasitic diseases of poultry
- conduct post mortem examination of poultry and identify different gross lesions peculiar to different bacterial and parasitic diseases
- make a tentative and differential diagnosis of different poultry diseases

THEORY:

Bacterial, viral, parasitic and fungal diseases. Mycotoxicosis. Hatchery-borne diseases, Yolk sac infection, Vertically transmitted diseases. Genetic basis of disease resistance. Biosecurity, Strategies for disease control. Immunity, immunosuppression. Vaccines and vaccination. Zoonotic problems.

PRACTICAL:

Organization, management and control of poultry diagnostic laboratory. Gross and histopathological features of various infectious diseases of poultry. Differential diagnosis of various infectious diseases. Laboratory aids in diagnosis of viral, bacterial and parasitic diseases. Serological diagnosis of viral diseases with the help of ELISA, HA-HI. Identification of different types of tumors of poultry birds. Health monitoring programmes. Hatchery visit(s), Farm visit(s), Visit(s) to Research Institute(s).

RECOMMENDED BOOKS:

1. Charlton BR, Burmudez AJ, Boulianne M, Halvorson DA, Shrader JS, Newmann LJ, Sander Wakenell PS, 2006. Avian Disease Manual, 6th Ed, American Association of Avian Pathologists, Athens, Georgia, USA.
2. Electronic sources – digital libraries, books, journals, etc.
3. Jordan FTW, Pattison M, Alexander D, Faragher T, Alexander DJ, 2002. Poultry Diseases, 5th Ed. W.B Saunders Company, London, UK.
4. Saif YM, Nolan LK, Fadly AM, Glisson JR, McDouald LR, 2008. Diseases of Poultry, 12th Ed. Blackwell Pub Professional, Ames, Iowa, USA.
5. Swayne DE, Glisson JR, Jackwood MW, Pearson JE, Reed WM, 1998. A Laboratory Manual for the Isolation and Identification of Avian Pathogens, 4th Ed., American Association of Avian Pathologist inc. Kennett square, Pennsylvania, USA.
6. Tegetmeier WB, 2010. Profitable Poultry: Their Management in Health and Disease. 1st Ed. General Books.
7. Electronic sources – digital libraries, books, journals, etc

PATH-702

Biochemical Pathology

3(1-4)

Learning Objectives:

Upon completion of this course students will be able to:

- Know sampling strategies for serum/tissue for animal diseases
- Processing and interpretation of results for animal diseases
- Discuss various diseases of interest through case presentations.
- Understand and perform various biochemical tests/ techniques used in Veterinary diagnostic laboratory.

Theory

Advances in animal diagnostic pathology. Diagnosis of viral and bacterial diseases. Diagnosis of Fungal, parasitic and nutritional diseases- Diagnosis of intoxications.

Practical

Sampling strategies for animal diseases surveys. Choosing an appropriate test; liver and kidney function tests in various animal diseases; urinalysis and interpretation; diagnosis of animal diseases based on serum biochemical tests; acute phase proteins in veterinary diagnosis. Immunological tests. Histochemistry; Immunocytochemistry. Enzymology in disease diagnosis. Serum micro and macro-mineral profile in diseases; Fluid, electrolyte and acid-base balance. Variations in proteins, carbohydrates and lipid profiles in various animal diseases.

Suggested readings:

1. Latimer KS, (Ed), 2011. Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology, 5th Ed. Blackwell Pub Professional, Ames, Iowa, USA.
2. Coles EH, 1986. Veterinary Clinical Pathology, 4th Ed. W.B. Saunders and Co, Philadelphia, USA.
3. Kaneko JJ, Harvey J W, Bruss ML (Eds), 1997. Clinical Biochemistry of Domestic Animals, 5th Ed. Academic Press, New York, USA.
4. Rosenfeld AJ, and Dial SM, 2010. Clinical Pathology for the Veterinary Team. 1st Ed. Blackwell Pub Professional, Ames, Iowa, USA.
5. Stockham SL, Scott MA, 2009. Fundamentals of Veterinary Clinical Pathology. 2nd Ed. Blackwell Pub Professional, Ames, Iowa, USA.
6. Electronic sources – digital libraries, books, journals, etc.

Learning Objectives:

Upon completion of this course students will be able to:

- Understand the requirements to work in Pathology lab.
- Understand the concepts of various techniques used in routine Pathology lab and their uses in different diseases.
- Understand the concepts about PCR/ELISA etc. and their uses in disease diagnosis.
- Handle the disease and molecular data and its analysis/interpretation.

Theory:

Pathology Laboratory Safety guidelines/protocols. Introduction to biosafety. Introduction to different molecular diagnostic techniques; benefits of molecular testing in disease diagnosis; considerations for selection of a molecular test; Gene amplification technologies.

Introduction to PCR and its variations; RT PCR, Real Time PCR, Multiplex PCR, Genomic PCR, Nested PCR; Post Infection initial detection limit of Molecular Tests for common Veterinary diseases. Use of novel molecular techniques for determining the course of a disease. *In-situ* nucleic acid hybridization assays. Principles and uses of Electrophoresis, histochemistry, Immuno-histochemistry, ELISA, High Pressure Liquid Chromatography. Handling and analysis of data; The future of diagnostic pathology.

Practical:

Ultra Centrifugation. Microscopy. Gross and microscopic digital photography and image analysis. Micrometry. Measuring oxidant status. Spectrophotometry. Histopathology and immunohistochemistry. Electrophoresis. Cell membrane permeability. ELISA. Apoptotic cell staining. RBC membrane rigidity/ viscoelasticity testing. Hypo-osmotic swelling (HOS) test. Somatic cell count. PCR, RT PCR, Real Time PCR, Multiplex PCR, Genomic PCR, Nested PCR; Isothermal PCR and Interpretations. Extraction of DNA from tissues and blood cells. Computer assisted DNA sequence data interpretation. Blotting Techniques; DNA identification using restriction fragment-length polymorphism (RFLP) Analysis; Computer assisted Single nucleotide polymorphism (SNP). Computer aids in data processing and handling.

Suggested readings:

1. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A and Scott MP 2013. Molecular Cell Biology. 7th Ed. W.H.Freeman and Company, New York.
2. Clark DP and Pazdernik NJ, 2013. Molecular Biology. 2nd Ed. Academic Press, Elsevier, USA.
3. Rosenfeld AJ and Dial SM, 2010. Clinical Pathology for the Veterinary Team, 1st Ed, Blackwell Pub Professional, Ames, Iowa, USA.
4. Ozcan, E., 2005. A new automated colorimetric method for measuring total oxidant status. Clinical Biochemistry, 38: 1103–1111.
5. Coles EH, 1998. Veterinary Clinical Pathology, 5th Ed., W.B. Saunders Co, Philadelphia, USA.
6. Kaneko JJ, Harvey JW and Bruss ML (Eds), 1997. Clinical Biochemistry of Domestic Animals, 5th Ed. Academic Press, New York, USA.
7. Stockham SL and Scott MA, 2009. Fundamentals of Veterinary Clinical Pathology, 2nd Ed, Blackwell Pub Professional, Ames, Iowa, USA

PATH-704

Pathology of Intoxications

3(2-2)

Learning Objectives

Upon completion of this course students will be able to:

- Learn the clinical signs, gross and microscopic lesions produced by different toxicant in farm animals.
- Identify the pathological alteration in the tissues caused by different intoxicants
- Make a tentative and differential diagnosis of different cases of toxicity in farm animals.

Theory

Chemical toxicities, phytotoxins, heavy metals and nanoparticles induced lesions. Mycotoxicosis. Effects of bacterial toxins on body tissues. Drugs toxicity. Chemical induced teratogenesis. Changes induced by radioactive materials, gases and vapours. Pathological effects of insecticides and pesticides. Snake/insect venom toxicity. Waste water toxicities.

Practical

Recognition of lesions induced by toxins and their differential diagnosis from non-toxic lesions. Laboratory methods for detection of toxins. Estimation of drug residues, pesticides and other chemicals in animal tissues and fluids/milk. Diagnosis of acute toxicities

Suggested readings:

1. Chapman M, Campbell A, 2011. Veterinary Toxicology. Blackwell Pub Professional.
2. Amdur MO, Doull J, Klaassen CD, 1991. Toxicology. 4th Ed. McGraw Hill, Inc. New York, USA.
3. Bartik M, 1981. Veterinary Toxicology. Elsevier Scientific Publishing Co. London, UK.
4. HMSO, 1984. Manual of Veterinary Investigation Laboratory Techniques, 3rd Ed. Vol 2. Her Majesty's Stationery Office, London, UK.
5. Louis, J, Casarett, Amdur MO, Klaassen CD, Doull J, 1996. Casarett and Doull's Toxicology: The Basic Science of Poisons. 5th Ed. McGraw-Hill (Tx). USA.
6. Watkins JB, III and Klaassen C, 2010. Casarett & Doull's Essentials of Toxicology. 2nd Ed. McGraw-Hill Professional, USA.
7. Electronic sources – digital libraries, books, journals, etc.

PATH-705

FOOD ANIMAL PATHOLOGY

3(2-2)

Learning Objectives

Upon completion of this course students will be able to:

- Conduct meat inspection and can give judgment about wholesomeness
- conduct anti-mortem and post mortem examination of Food Animals
- have a knowledge of gross and microscopic pathology of different disease of Food animals
- differentiate the meat of different species

Theory

Introduction of Food animals. Important diseases of food animals effecting meat production. Pathology of diseases leading to condemnation of meat. Introduction of meat industry in Pakistan. Characteristics of good quality meat. Differentiation of meat of different animals. Meat inspection and its objectives. Ante mortem and Postmortem examination of animals. Non-specific and specific lesions in different organs of body. Conditions rendering meat unwholesome for human consumption. Judgment of meat. Disposal of condemned meat. Laws governing meat inspection in Pakistan.

Practical

Recognition of various pathological conditions of meat and edible organs and judgment about wholesomeness of carcass, Techniques for differentiation of meat of different species of animals, Laboratory tests for evaluation of meat quality. Visits to slaughter houses.

BOOKS RECOMMENDED

1. Gracey JF, 1999. Meat Hygiene. 10th Edition. The English Language Book Society, Bailliere Tindal, London U.K.
2. Herenda DC, Franco DA. 1991. Food Animal Pathology and Meat Hygiene. Mosby year Book. London, UK.
3. FAO, 2000. Manual on meat inspection for developing countries, 2nd Ed. Vol. 119, Food and Agriculture Organization of United Nations, Rome, Italy.
4. Wilson WG, 1998. Wilson's Practical Meat Inspection. 6th Ed. Blackwell Publishing, Ltd.
5. Herenda DC, Franco DA. 1996. Poultry Diseases and Meat Hygiene. The Iowa State University Press, Ames, Iowa, USA.
6. Bremner AS, Johnston M. 1996. Poultry Meat Hygiene and Inspection. W.B. Saunders Company, Ltd. UK.
7. Grist A, 2004. Poultry Inspection: Anatomy, Physiology and Disease condition, Nottingham University Press, UK.
8. Electronic sources – digital libraries, books, journals, etc

PATH-706

Immunopathology

3(1-4)

Learning Objectives:

Upon completion of this course students will be able to:

- Understand the basic mechanism of immunity and diseases related with immune system.
- Understand the concepts of auto-immunity and auto-immune diseases.
- Understand the diagnostic procedures involved in diagnosing the immune diseases.
- Understand the basic techniques of isolation and purification of antibodies used for diagnosis.

Theory

Cells of the immune system, Pathology induced by immune complex reactions and hypersensitivity reactions, Frontal and stealth attack strategies in microbial pathogenesis, Toll-like receptor in induction of the innate immune response, autoimmunity (cellular and genetic mechanism of self-tolerance and autoimmunity, regulation of immunity by self reactive T- cells, CD1-restricted- T-cell responses and microbial infection, immunopathogenesis of sepsis, Role of mast cells in autoimmune diseases. Autophagy and immunity. Role of mitochondria in various immunological disorders and oxidative stress.

Immunopathological consequenceing of bacterial, viral, parasitic and fungal infections.

Practical

Techniques in isolation, purification and differentiation of antibodies from serum against Common infectious disease. Methods of conjugation of antibodies with fluorescent dyes. Practical use of fluorescent microscope. Cryosectioning and immuno-staining techniques. Clinical Immunology Tests.

Suggested readings:

1. Boehncke, W.H., 2004. Lymphocyte Homing to the Skin: Immunology, Immunopathology, and Therapeutic Perspectives, 1st Ed., Informa Healthcare, UK
2. Chauhan, R.S. and B.N. Tripathi, 2002. Veterinary Immunopathology: Theory and Practice. International Book Distributing Co. USA
3. Colvin, R.B., A.K. Bhan, A.K. Bhan and R.T. McCluskey (Eds), 1995. Diagnostic Immunopathology, 2nd Ed., Lippincott Williams & Wilkins, USA
4. Electronic sources – digital libraries, books, journals, etc.
5. Gershwin, L.J., S. Krakowka and R.G. Oslen, 1995. Immunology and immunopathology of domestic animals, 2nd Ed., Elsevier Science Health Science div., New York, USA
6. Sell, S. and E.E. Max, 2001. Immunology, Immunopathology and Immunity, 6th Ed., American Society for Microbiology, USA
7. Zola, H., R. McEvoy and P.R. Thomson, 1995. Diagnostic Immunopathology: Laboratory Practice and Clinical Application. Cambridge Univ Pr., UK

Learning Objectives:

Upon completion of this course students will be able to:

- Understand the important diseases involving different wild and zoo animals.
- Differentiate various diseases closely resembling to each other.
- Understand the gross and histological lesions produced in different diseases.
- Understand the sample collection procedures from different wild and zoo animals.

Theory

Introduction to wildlife. Capturing myopathy. Lesions caused by nutritional diseases and intoxications. Emergencies. Gross and histopathological lesions of infectious and non-infectious diseases, parasitic and metabolic diseases. Behavioural problems. Zoonotic diseases of wild and zoo animals.

Practical

Capturing and restraining methods. Collection and examination of blood, urine, skin scrapings and faecal samples. Collection and examination of biopsy and other morbid materials. Recognition and interpretation of lesions.

Suggested readings:

1. Fairbrother A, Locke LN, Hoff GL, 1996. Non-infectious Diseases of Wildlife, 2nd Ed. Iowa State University Press, Ames, Iowa, USA.
2. Fowler ME, Muller RS, 1999. Zoo and Wildlife Animal Medicine, 3rd Ed. W.B. Saunders Company, Philadelphia, USA.
3. Childs JE, Mackenzie JS, Richt JA (Eds), 2007. Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and Consequences of Cross-species Transmission. Sports Media Challenge.
4. Majumdar SK, 2005. Wildlife Diseases. Landscape Epidemiology, Spatial Distribution And Utilization of Remote. Pennsylvania Academy of Science, Pennsylvania, USA.
5. Electronic sources – digital libraries, books, journals, etc.

PATH-708

Oncology

4(3-2)

Learning Objectives:

Upon completion of this course students will be able to:

1. Know Various theories of oncogenesis and molecular processes involved in animal tumor
2. Etiopathology, gross and histopathology of animal tumors,
3. Differentiate between various types of tumors.
4. Various tests used for the diagnosis of tumors.

Theory

Introduction to oncology. Theories of oncogenesis; the cell and molecular processes associated with the biology of cancer progression; tumor cell growth control with Ras, PI(3)K and m-ToR signaling, role and functions of oncogenes and tumor suppressor genes. Growth factor receptor interactions, cell cycle control and regulation of cell death. Tumor angiogenesis and the role of the extra cellular matrix. Viruses and cancer. Tumor immunobiology and tumor metastases. Aneuploidy and cancer, Role of inflammation in neoplastic progression. Hypoxia and cancer; intrinsic tumor suppression. Stromal fibroblast in cancer initiation and progression. Role of TAM, Apoptosis and cancer. Microecology of tumours.

Practical

Tumors; skin, soft tissues, muscles, bone and cartilage, respiratory system, urogenital organs, alimentary tract, mammary, endocrine glands, eye. Tests; comet Assay, micronucleus assay.

Suggested readings:

1. Demetriou J, Foale R, 2010. Small Animal Oncology. W.B. Saunders Ltd, USA.
2. McGavin DM., Zachary JF, 2007. Pathologic Basis of Veterinary Disease. 4th Ed. Mosby, St. Louis, MO, USA.
3. Meuten DJ (Ed.), 2002. Tumors in Domestic Animals. Blackwell Pub Professional, Ames, Iowa, USA.
4. Moulton JE, 1978. Tumors of Domestic Animals. 2nd Ed. University of California Press, USA.
5. Slauson DO, Cooper BJ, 2002. Mechanisms of Disease. 3rd Ed. Williams & Wilkins, London, UK.
6. Withrow SJ, MacEwan EG, 2011. Small Animal Clinical Oncology, 3rd Ed., W.B. Saunders Ltd, USA.
7. Electronic sources – digital libraries, books, journals, etc.

PATH-709

Special Problem-II

1(1-0)

Learning objectives;

Upon completion of this course students will be able to:

- Identify, review and plan to address the specific issues pertaining to Pathology diseases

The respective supervisor of the student will assign a topic of interest to make him understand the ways and means of addressing an issue pertaining to Pathology

PATH-710

Seminar-II

1(1-0)

Learning objectives

Upon completion of this course students will be able to:

- Identify, review, plan and orally present the specific issues pertaining to Pathology

The respective supervisor of the student will assign a topic of interest to make him understand the ways and means of addressing an issue pertaining to pathology and present as a seminar

PATH-711

Fish Pathology

2(1-2)

Learning Objectives:

Upon completion of this course students will be able to:

- Understand the important diseases involving different systems of fish.
- Differentiate various diseases closely resembling to each other.
- Understand the gross and histological lesions produced in different diseases.
- Understand the sample collection procedure from fish and its environment.
- Discuss various disease problems of interest through case presentations.

Theory

Warm water fish diseases caused by viruses, bacteria, parasites and fungi. Drug induced lesions and intoxications. Nutritional diseases of fish. Neoplastic diseases. Effect of environmental factors on health. Diseases due to low and high oxygen contents in water and due to other gasses.

Practical

Applied anatomy and physiology of fish. Dissection/postmortem of fish. Skeletal anomalies. Sampling and dispatch of sick fish for laboratory investigation, Determination of freshness of dead fish. Hematological changes associated with diseases. Recognition and differential diagnosis of gross and histopathological lesions in various organs.

Suggested readings:

1. Cunningham CO, 2002. Molecular Diagnosis of Salmonid Diseases. Kluwer Academic Pub, New York, USA.
2. Noga EJ, 2010. Fish Disease: Diagnosis and Treatment. Blackwell Pub, USA.
3. Woo PTK, Leatherland JF (Ed), 1999. Fish Diseases and Disorders: Non-Infectious Disorders. Oxford University Press, New York, USA.
4. Woo PTK, 2006. Fish Diseases and Disorders: Protozoan and Metazoan, 2nd Ed., Infections. Oxford University Press, New York, USA.
5. Roberts RJ, 2001. Fish Pathology. W.B. Saunders Co, USA.
6. Electronic sources – digital libraries, books, journals, etc

Learning objects

Upon completion of this course students will be able to:

- Conduct the postmortem examination of different animals suspected for zoonotic diseases.
- Identify different gross & microscopic lesions associated with different zoonotic diseases.
- Aetiopathology of zoonotic diseases involving various systems of the body.
- Develop Public Health Safety guidelines for zoonotic diseases.

Theory

Aetiopathology of various zoonotic diseases including Anthrax, Bovine Spongiform (B.S.E), Brucellosis (*B. melitensis*), Crimean Congo Hemorrhagic Fever, Ebola Virus, Highly Pathogenic avian Influenza (HPAI), Japanese Equine Encephalomyelitis, Marburg Hemorrhagic Fever, New World Screwworm, Nipah Virus, Old World Screwworm, Q Fever, Rabies, Rift Valley Fever (R.V.F), Sheep Pox/Goat Pox, Tularemia, Venezuelan Equine Encephalomyelitis, West Nile Virus, Hydatidosis, Salmonellosis, Tuberculosis, Strangles, Glanders, Leptospirosis, Compylobacteriosis, Ringworm, Toxocariasis, Leshmaniasis, Toxoplasmosis, Pasteurellosis, Cat Scratch Fever, Chlamydiosis, Yersiniosis. Amebiasis, giardiasis.

Practical

Postmortem examination procedures for different zoonotic diseases. Selection of specimen for Laboratory examination. Handling of morbid material. Writing of Pathology reports. Postmortem room safety codes. Disposal of carcass. Recognition & differential diagnosis of gross, histopathological lesions in zoonotic diseases.

Suggested readings:

- 1) World Organization for Animal Health, 2015. Manual of Diagnostics Tests and Vaccines for Terrestrial Animals.
- 2) Dvorak G, Spickler AR, Roth JA, 2008. Hand Book for Zoonotic Diseases of Companion Animals. Center for Food Security and Public Health. Iowa State University, College of Veterinary Medicine.
- 3) Ronich JA, 2007. Understanding Zoonotic Diseases. Delmar College Learning.
- 4) Childs JE, Macckenzie JE, Richt JA, 2007. Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and consequences of cross species transmission. Springer Berlin Heidelberg, New York, USA
- 5) Burroughs T, Knobler S, Lederberg J, 2002. The Emergency of Zoonotic Diseases. Understanding the Impact on Animal Health and Human health. Workshop Summary. Institute of Medicine (U.S) Form on Emergency Infections.
- 6) Electronic sources – digital libraries, books, journals, etc

PATH-713

Current Topics in Pathology

1(1-0)

Learning objectives

Upon completion of the course, students will be able to:

- Attain knowledge and review the selected topics on recent developments in Pathology

Detailed overview of top ten journals in the field of veterinary pathology. Selection of emerging research topics. Comprehensive review of selected topic of interest and demonstration of latest techniques used in current research. The course is presented in lectures/discussions format.

Suggested readings:

1. Electronic sources – digital libraries, books, journals, etc.
2. Personal communications
3. Field visits