

**Scheme of Studies for PhD (Parasitology), Department of Pathobiology
Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan**

Mission

Development of human resource capable of

- 1) Providing education and training in all aspects of parasitic diseases and their vectors
- 2) Conducting basic and applied researches in parasitic diseases and vector control
- 3) Providing laboratory services in the diagnosis of parasitic diseases
- 4) Provide extension services in the planning, implementation and evaluation of parasitic diseases control programs

PROPOSED COURSES		
Course No.	Course Title	Credit hours
PARA-701	Techniques in Molecular Parasitology	3(2-2)
PARA-702	Immunoparasitology	3(2-2)
PARA-703	Chemotherapy of Parasitic Diseases	3(2-2)
PARA-704	Medical Protozoology and Helminthology	3(2-2)
PARA-705	Medical Entomology	3(2-2)
PARA-706	Epidemiology of Parasitic Diseases	3(2-2)
PARA-707	Invertebrate Cell Culture	3(2-2)
PARA-708	Vector Borne Zoonoses	3(2-2)
PARA-709	Special Problem	1(1-0)
PARA-710	Seminar	1(1-0)
PARA-711	Research Planning and Scientific Writing	3(3-0)
PARA-712	Current Topics in Parasitology	1(1-0)
	Total Credit hours	30

PARA-701 Techniques in Molecular Parasitology

3(2-2)

Learning Objectives:

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

- practice application of molecular techniques in the diagnosis and control of parasitic diseases
- have hands on training on the protocols of DNA based or Protein based techniques in molecular parasitology

Theory

Introduction; Principles, basis and importance of molecular Parasitology; Conventional versus modern diagnostic tools; Collection of samples for molecular diagnosis of parasitic diseases; Isolation of antigens from parasites. Isolation of DNA and RNA from biological tissues; PCR; Agarose gel electrophoresis; Western blotting; Immunofluorescent technique; Construction of cDNA libraries; Cloning in Vectors; Nucleic acid/ protein estimation through spectrophotometer/ colorimeter; Molecular probes for diagnosis, epidemiology and taxonomy of Parasites; Introduction to bioinformatics tools in parasitic; Use of modern molecular biology tools for the production of recombinant vaccines against parasites; International certifications and their requirements for registration of a diagnostic laboratory; Review of literature through currently available resources on a topic of interest

Practical

Handling and operation of important laboratory equipment; Preparation of somatic, secretory and excretory antigens; Chromatographic techniques for purification of parasite antigens, antibodies or chemical compounds; Characterization of parasite proteins by SDS polyacrylamide gel electrophoresis (PAGE) and western blotting; Techniques for cell mediated and humoral response against parasites; Polymerase Chain Reaction and sequencing ; Demonstration of commercially available kits for parasitic diagnosis

Suggested Readings:

1. Marr JJ, TW Nilsen and RW Komuniecki, 2003. Molecular Medical Parasitology. Elsevier Publications, London, UK
2. Halton JDW, M Behinke and L Marshal, 2001. Practical Exercises in Parasitology. Blackwell Science Publication, Ames, Iowa, USA
3. Crampton JM, CB Beared and C Louis (Eds.), 1997. Molecular Biology of Insect Disease Vectors: A Methods Manual. Springer, UK
4. Marr J and M Muller (Eds.), 1995. Biochemistry and Molecular Biology of Parasites. Academic Press, New York, USA
5. Maizels RM, ML Blaxter, BD Robertson and ME Selkirk, 1991. Parasite Antigens, Parasite Genes: A Laboratory Manual for Molecular Parasitology. Cambridge University Press, New York, USA
6. Garcia LS and DA Bruckner, 1988. Diagnostic Medical Parasitology. Elsevier Science Publishing Co. Inc., New York, USA
7. Electronic sources – digital libraries, books, journals, etc.

PARA-702 Immunoparasitology 3(2-2)

Learning Objectives:

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

- have in-depth knowledge about the principles of immune mechanisms in response to parasitic infection/infestation.
- understand, plan and conduct experiments on exploring immunity against parasites
- understand basic concepts of development of anti-parasitic vaccines and biologics

Theory

Introduction; Types of parasitic antigen(s) and their characterization; Immunity in parasitic infections/infestations; Basis of the immune response and the origin of the immune cells; Immune responses produced by various parasites; Factors affecting the immune responses; Immune evasion /Escape mechanism(s); Pathology of host parasite interactions; Mechanism(s) involved in premunition, Hypobiosis, self cure and spring rise phenomenon in parasites; Immunomodulation, its types and uses; Vaccines and vaccination against parasitic infections/infestations; Constraints in the production of parasitic vaccines, Prospective of DNA vaccines against parasites; Review of Literature on latest research on the developments of parasitic vaccines

Practical

Preparation of somatic, secretory/excretory antigens; Raising of rabbit polyclonal antisera and demonstration of various immunodiagnostic techniques for the diagnosis of parasitic infections/infestations.

Suggested Readings:

1. Delves PJ, SJ Martin, DR Burton and IM Roitt, 2011. Roitt's Essential Immunology. 12th Ed., Wiley-Blackwell Publishers, London
2. Barton AW, 2010. Host-Pathogen Interactions: Genetics, Immunology and Physiology. Nova Science Publication Inc., New York, USA
3. Jirillo E and O Brandonisio (Eds), 2010. Immune Response to Parasitic Infections. Vol.1,
4. Protozoa. Bentham Science Publishers Ltd., Italy
5. Ertl H, 2003. DNA Vaccines. 1st Ed., Springer, UK
6. Goldsby RA, TI Kindt and BA Osborne, 2002. Kuby Immunology, 4th Ed., WH Freeman and Company. New York, USA
7. Hay, F.C. and O.M.R. Westwood, 2002. Practical Immunology, 4th Ed., Blackwell Science, UK
8. Wakelin, D., 1996. Immunity to Parasites. 2nd Ed. Cambridge University Press, London.
9. Electronic sources – digital libraries, books, journals, etc.

PARA-703 Chemotherapy of Parasitic Diseases 3(2-2)

Learning Objectives:

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

- demonstrate the knowledge and practices of chemotherapy of parasites
- attain practical skills for the administration of antiparasitic drugs.
- plan experiments on assessing efficacy of various chemicals used for the control of parasites

Theory

Introduction; Targets for antiparasitic chemotherapy; Biochemical functions of parasites; Different groups of antiparasitic compounds and their mode of action (static vs cidal drugs); Treatment of intestinal and systemic helminths, Treatment of intestinal and systemic protozoa; Treatment of insects/arachnids; Various modes and precautions in administration of antiparasitic compounds i.e. parenteral, drench, spray, dip etc.; Deworming/chemotherapeutic schedules for cattle/buffalo, sheep/goat, horse/donkey and poultry; Drug resistance, toxicity and side effects; Safety testing of antiparasitic drugs; Chemotherapeutic index, LD₅₀, ID₅₀, ED₅₀; Considerations to introduce a new drug in a commercial market (Residual effects of antiparasitic drugs in animal products; environmental pollution by insecticides/acaricides and bioremediation); Economics of using antiparasitic compounds; Antiparasitic activity of medicinal plants; Recent developments in the chemotherapeutic agents against parasites; Review of Literature on recent advancements in the development of antiparasitic drugs

Practical

In vitro and *in vivo* trials for evaluation of anthelmintics; *In vitro* and *in vivo* trials for evaluation of insecticides and acaricides; Evaluation of antiparasitic activity of indigenous plants; Demonstration of various modes of administration/application of antiparasitic compounds; Tests for detection of anthelmintic and acaricidal resistance

Suggested Readings:

1. Campbell WC and Rew RS, 2012. Chemotherapy of parasitic Diseases. Springer-Verlag New York Inc., USA.
2. Mansour TE, 2002. Chemotherapeutic Targets in Parasites. 1st Ed., Cambridge University Press, UK.
3. Georgi JR, ME Georgi and VJ Theodorides, 1999. Parasitology for Veterinarians, 7th Ed., W.B. Saunder's Company, London
4. Radostits OM and DC Blood, 1994. Veterinary Medicine, 8th Ed., W.B. Saunder Company, London.
5. Gillman AG, TW Rall, AS Nies and P Taylor, 1991. The Pharmacological Basis of Therapeutics, 8th Ed., Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, New York, USA.
6. Booth NH and LE Medonald, 1988. Veterinary Pharmacology and Therapeutics. Iowa State University Press, Iowa, USA
7. Electronic sources – digital libraries, books, journals, etc.

PARA-704 Medical Protozoology and Helminthology 3(2-2)

Learning Objectives:

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

- demonstrate detailed knowledge and understanding of the biology, life cycles, pathogenesis, and diagnosis of parasitic infections in humans and their relevance for human health and strategies for control
- demonstrate the ability to design a laboratory or field-based research project, apply relevant research skills, critically analyze and interpret data, and work with minimal supervision

Theory

Introduction to the medically important protozoa and helminths; Anatomy/Structure, locomotion, nutrition, reproduction and life cycle of protozoa and helminths; Epidemiology, Immunobiology, Pathogenesis, treatment, control and prevention of protozoa and helminthes of medical importance; Opportunistic parasitic Infections, Parasitic infections in immunocompromised hosts, Parasitic zoonoses; Laboratory acquired parasitic infections; Outbreak management for parasitic diseases, Review of literature through currently available resources on a topic of interest

Practical

Demonstration of various spp. of protozoa and helminthes from human stool samples; Conventional and modern diagnostic assays for the examination of blood, urine, sputum and cerebrospinal fluid for parasites, Visit of Medical hospitals for data collection of prevalent parasitic diseases

Suggested Readings:

1. Leventhal R and R Cheadle, 2011. Medical Parasitology: A Self-instructional Text, 6th Ed., FA Davis Company, USA
2. Satoskar AR, GL Simon, PJ Hotez and M Tsuji (Eds.), 2009. Medical Parasitology. Landes Bioscience Publishers, Texas, USA (ISBN 978-1-57059-695-7).
3. Gilles HM (Ed.), 1999. Protozoal Diseases. Oxford University Press, UK
4. Maudlin I, 2004. The Trypanosomiases. Oxford University Press, UK
5. Mehlhorn H, (Ed). 2001. Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy. Springer Verlag, UK
6. Rathore VS, 2005. Parasitic Zoonoses. Pointer Publishers, Jaipur, India
7. Sterling CR and RD Adam, 2004. The Pathogenic Enteric Protozoa. Kluwer Academic Publishers, USA.

PARA-705 Medical Entomology 3(2-2)

Learning Objectives:

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

- understand taxonomy and identification of ecto-parasites of medical importance
- demonstrate the role of vector of ecto-parasites of medical importance in transmission of diseases
- control strategies for ecto-parasites of medical significance.

Theory

Introduction to Medical Entomology; Arthropods as a cause and carrier of diseases; Development and Classification of insects; Arthropods, arachnids and crustaceans; Classification of various Mouth parts of insects and their importance in the transmission of diseases; Morphology, life cycle, medical importance and control of insects and arachnids; Cockroaches and beetles; Siphonaptera (fleas); Bed bugs, conenose and other bugs, pediculosis; Sucking and biting lice; Dipterans: Simulid Gnats, Phlebotomus flies and Mosquitoes; Tabanidae; Horse flies, Deer flies, Snipe flies, Syrphid flies, Muscoid flies, Louse fly; House fly; Tsetse flies, Stomoxys flies; Horn flies; Myiasis; Psychodidae (moth flies, sand flies) and Ticks; Mites and Pentasomids; Venomous and Urticarial Arthropods: Paederus (Staphylinidae); Araneae (spiders); Bees; wasps and ants stings; Delusory parasitosis (entomophobia); Lonomia achelous; Maggot's therapy; Forensic entomology; Specific association between vector pathogen and host for the transmission of viral, bacterial, parasitic, Rickettsial and fungal diseases; Zoonoses; Review of literature

Practical

Inventory of medically important insects and arachnids; Collection, preservation of adult insects and arachnids of medical importance; Mouth parts of insects and arachnids; Wing venation of insects; Demonstration of life cycle stages of typical insect and arachnids; Pinning of adult insects and arachnids of medical importance; Xenodiagnosis; Methods of preparation and examination of skin scrapings for mites; Methods for dissecting arthropod vectors to determine infection rates; Identification of various species of cockroaches, beetles, bugs, lice, flies, fleas, ticks and mites.

Suggested Readings:

1. Mullen GR and Lance AD, 2009. Medical and Veterinary Entomology. 2nd ed. Academic Press, Elsevier.
2. Khan MN, Zia S and Abdul J, 2003. Manual of Veterinary Entomology, ISBN 969-8490-05-1. Friends Science Publishers, Faisalabad-Pakistan
3. Herms WB and James MT, 1996. Medical Entomology. The McMillian Co. New York, USA.
4. Kettle DS, 1995. Medical and Veterinary Entomology. CAB International, Wallingford, Oxan, U.K.
5. Service MW. 1980. A guide to Medical Entomology. The McMillan Press Ltd. London.
6. Iqbal Z, Nisar K and Abdul J, 2003. An Illustrated Textbook of Veterinary Entomology, ISBN 969-8490-06-1. University of Agriculture Press, Faisalabad-Pakistan
7. Cheng TC. 2006. General Parasitology. 2nd Ed. Academic Press. Elsevier.
8. Electronic sources – digital libraries, books, journals, etc.

PARA-706 Epidemiology of Parasitic Diseases 3(2-2)

Learning Objectives:

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

- Understand basic principles and practices of epidemiology of parasites
- Develop hypotheses, design questionnaire and surveillance for parasitic diseases
- Understand the concept of bias and statistical interpretation

Theory

Orientation to Epidemiology and its role in the investigation and control of parasitic diseases; Types of Epidemiology; Measurement of disease frequency and production in population. Risk assessment and prevention: Disease Modeling; Patterns of disease occurrence; Population and its types; Agent, host and environment triad and related determinants influencing parasitic diseases; Sources, transmission and maintenance of parasitic infections in population: Horizontal transmission, Vertical transmission; Formulation and testing of causal hypothesis of disease; Concept of randomization; Sampling; basic concepts; sample size determination; Designing questionnaire for parasitic disease surveillance; Surveillance introduction and examples, Active surveillance, passive surveillance, Methodology of surveillance, Sero-surveillance of parasitic diseases; Sero-epidemiology: serodiagnostic tests for parasitic infections; Evaluation of diagnostic tests; Collection and management of data; Use of Geographic information system (GIS) as a tool for mapping of various parasitic diseases; Application of meteorological data for the control of parasitic diseases; Disease prevention, control and eradication. International disease reporting, Orientation to epidemiological software (Epiinfo, Survey Toolbox, EpiCalc); Review of literature

Practical

Calculation of epidemiological data and their analysis; Sample size determination using different sampling methods; Designing a questionnaire for some specific diseases; Surveillance studies for parasitic infections by gross examination; Determination of epidemiology of some selected parasitic diseases in the identified areas; Analysis and interpretation of data; Disease distribution using various methods; Formation of climatographs for various areas to forecast parasitic diseases; Designing strategies for parasite control and eradication.

Suggested Readings:

1. Pfeiffer D, 2009. Veterinary Epidemiology: An Introduction. John Wiley & Sons, West Sussex, UK.
2. Thrusfield M, 2007. Veterinary Epidemiology. Wiley-Blackwell, Oxford, UK
3. Smith RD, 2006. Veterinary Clinical Epidemiology. Taylor and Francis, Philadelphia, PA, USA.
4. Cockcroft PD and MA Holmes, 2003. Handbook of Evidence-based Veterinary Medicine. Blackwell Science Publication, Ames, Iowa, USA.
5. Matrin SW, AH Meek and P Willeberg, 1993. Veterinary Epidemiology: Principles and Methods. International Book Distributing Company, Lucknow, India.
6. Mead R, RN Curnow and AM Hasted, 1993. Statistical Methods in Agriculture and Experimental Biology. Chapman and Hall, London, UK.
7. Soulsby EJL, 1986. Helminthes, Arthropods and Protozoa of Domesticated Animals. The English Language Book Society, Bailiere Tindall, UK
8. Electronic sources – digital libraries, books, journals, etc.

PARA-707 Invertebrate Cell Culture 3(2-2)

Learning Objectives:

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

- Understand and practice cell/tissue culture techniques and their application in the control of parasites

Theory

Introduction; History and scope of cell and tissue culture; Basic and specialized techniques of invertebrate cell culture including proper use of a biological safety cabinet, sterile technique, cell enumeration and media preparation; Nutritional and growth requirements of insect cell culture; *In vitro* techniques for parasite cultivation; Concept of primary and secondary cell culture and established cell lines; Development of cell lines for parasite cultivations; Application of invertebrate cell culture in immunology, biotechnology and toxicology.

Practical

Laboratory facilities for cell culture; Organization of a cell culture laboratory; Preparation of glassware and culture media; *In vitro* cultivation of insect cells and their microscopic examination of cultured cells.

Suggested Readings:

1. Freshney RI, 2010. Culture of Animal Cells: A Manual of Basic Techniques, 6th Ed., John Wiley & Sons, Inc. USA
2. Martin BM, 2004. Tissue Culture Techniques: An Introduction. Academic Press, New York, USA
3. Gupta PK, 1998. Elements of Biotechnology. Rastogi Publication, India
4. Smyth JD, 1990. *In Vitro* Cultivation of Parasitic Helminths, 1st Ed., CRC. Press, Inc. Boca Raton, Florida, USA
5. Mitsubishi J, 1989. Invertebrate Cell System Applications. Vol. I. CRC. Press, Inc., Boca Raton, Florida, USA
6. Mitsubishi J, 1989. Invertebrate Cell System Applications. Vol. II. CRC Press, Inc., Boca Raton, Florida, USA
7. Taylor AER and JR Baker, 1987. *In Vitro* Methods for Parasite Cultivation. Academic Press, New York, USA
8. Electronic sources – digital libraries, books, journals, etc.

PARA-708 Vector Borne Zoonoses 3(2-2)

Learning Objectives:

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

- demonstrate the life cycle, pathology, epidemiology and control of vector borne diseases
- propose and conduct research on public health significance of vector borne diseases

Theory

Orientation and introduction to vector borne diseases; Public health significance of vector borne parasitic diseases; Vector borne Zoonoses; Role of dipterans in the transmission of various parasitic diseases; Emerging and re-emerging vector born zoonotic diseases; Epidemiology of vector borne zoonotic diseases; Prevention and control of vector borne diseases; Review of literature.

Practical

Cytological methods for diagnosis of vector borne diseases; Sterile male technique; Pheromones; Transgenic vectors to control vector borne diseases; Application of flea collars and slow releasing implants.

Suggested Readings:

1. Richardson DJ, 2010. North American Parasitic Zoonoses. Kluwer Academic Publishers, Norwell, MA, USA.
2. Satoskar AR, GL Simon, PJ Hotez and M Tsuji (Eds.), 2009. Medical Parasitology. Landes Bioscience Publishers, Texas, USA (ISBN 978-1-57059-695-7).
3. Rathore VS, 2007. Parasitic Zoonoses, 2nd Ed., Pointer Publishers, Jaipur, India.
4. Urquhart GM, J. Armour JL, Duncan AM, Dunn and FW Jennings, 2003. Veterinary Parasitology. English Language Book Society, UK.
5. Soulsby EJJ, 1982. Helminths, Arthropods and Protozoa of Domesticated Animals. English Language Book Society, Baillere Tindall, London, UK.
6. Electronic sources – digital libraries, books, journals, etc.

PARA-709 Special Problem 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 parasitic 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 parasites.

PARA-710 Seminar 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 parasitic 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 parasites and present as a seminar.

PARA-711 Research Planning and Scientific Writing 3(3-0)

Learning Objectives:

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

- plan their research according to recommended ethical protocols
- find out possible ways to search the literature and relevant subject research papers
- understand the safety measures during conducting their research.

Theory

Introduction to Scientific Writing; Scientific paper; Components of research paper, review paper, short communication, extension article and case report; Essentials for writing research paper, synopsis, thesis and scientific research proposals; Formats for research/scientific writings; Ethics of scientific writing; Plagiarism and its different types; Citation of different sources of references; Introduction to different data searching databases; Accepted abbreviations; Oral and poster presentations of scientific data; Research ethics; Introduction to patents and how to patent a research

Suggested Readings:

1. LSE Public Policy Group, 2011. Maximizing the Impacts of Your Research: A Handbook for Social Scientists (<http://cssp-jnu.blogspot.com/2011/06/lse-releases-maximizing-impacts-of-your.html>)
2. Blum D, M Knudson and RM Henig, 2005. A Field Guide for Science Writers. Second Edition, Oxford University Press, USA.
3. Day RA, 1988. How to Write and Publish a Scientific Paper, 3rd Ed., Oryx Press, New York, USA.

PARA-712 Current Topics In Parasitology 1(1-0)

Learning Objectives:

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

- attain knowledge and review the selected topics on recent developments in parasitology and emerging parasitic diseases

In-depth look at one or a few parasites of special interest relative to small and large animal medicine; Presentation of details of taxonomy, biology, epidemiology, clinical presentation, and preventive and curative treatment; The course is presented in lectures/discussions format.

Suggested Readings:

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