

Doctor of Philosophy in Pathology

Program code: 057070

INTRODUCTION

The Department of Pathology (Faculty of Medicine) offers a Ph.D. program in **Pathology**. The objective of the program is: to promote excellent and independent scientific and ethical approaches to the design, acquisition and analysis of experimental data, and to provide the student with supervised teaching experience. A graduate successfully completing this program will be expected to have an in depth knowledge in specific areas of Pathology: (Histology, Clinical Chemistry, Hematology, Molecular Pathology and Cytology). A major part of the program is the dissertation, which requires high quality research in a specific area of Pathology.

PROGRAM REQUIREMENTS

33 TOTAL COURSE CREDITS

9-15 Course credits in the major specialization

0570-601	Electron Microscopy	(3)
0570-602	Genetics and Cytogenetics	(3)
0570-603	Molecular Pathology	(3)
0570-604	Experimental Pathology	(3)
0570-605	Molecular Pathology of Cancer	(3)
0570-606	Clinical Chemistry at the extremes of life	(3)
0570-607	Clinical Chemistry of Cancer	(3)
0570-608	Metabolic Diseases	(3)
0570-612	Cytopathology – Basic Cytopathology	(3)
0570-613	Advanced Cytopathology	(3)
0570-614	Application of Radioisotopes in Medical Research	(3)
0570-615	Seminar I	(1)
0570-616	Seminar II	(1)
0570-617	Seminar III	(1)
0570-618	Advances in Haematology	(3)
0570-619	Advances in Clinical Chemistry	(3)
0570-620	Advances in Histopathology	(3)

0-6 Courses outside the major specialization

0510-601	Biostatistical Methods in Medical Research	(3)
0520-601	Molecular Techniques and Instrumentation	(3)
0520-604	Advanced Immunology	(3)
0540-562	Molecular Biology and Biotechnology	(2)
2000-501	Scientific Writing and Communication Skills	(3)
2000-503	Ethics and Professionalism	(2)
2050-509	Genetics of Complex Diseases	(3)
2050-512	Molecular Medicine	(3)

* Students may study other appropriate Graduate Level Courses outside the Program of Pathology, with the approval of the Program Director.

18 COMPULSORY COURSES

0570-697	Dissertation	(0)
0570-698	Dissertation	(0)
0570-699	Dissertation	(18)

COURSE DESCRIPTION

0570 – 601: ELECTRON MICROSCOPY CR: 3

The course is designed to introduce the graduate student to the different types of electron microscope in common usage in medical research. The student is also required to understand the operation of each type of electron microscope and to participate in the preparation and examinations of specimens using the microscope. At the end of the course, the student is expected to know the areas of medical research in which the electron microscope can be of use, and be able to apply it to his own research. The course deals with the components and physics of the different types of electron microscopes, tissue processing for electron microscopy, comparison between transmission and scanning electron microscopes, image analysis, enhancement and interpretation, application of electron microscopy in diagnosis and research, immuno-electron microscopy, future of electron microscopy.

0570-602: MOLECULAR GENETICS AND CYTOGENETICS CR: 3

This course is designed to introduce the graduate student to the principles of molecular genetics and cytogenetics as applied to diagnostic testing, including direct mutational analysis, linkage analysis, karyotyping, FISH and comparative genomic hybridization analysis. The course will cover mode of inheritance. The major clinical indications for molecular testing and the clinical implications of test results. The students will be introduced to calculation of genetic risk and the integration of molecular and clinical data. The course will emphasize a wide variety of inherited disorders at the levels of genes and chromosomes with special appreciation of issues pertaining to quality assurance, necessary in the management of a diagnostic laboratory. Ethical issues in genetics, particularly those raised by molecular diagnostic testing will be highlighted.

0570-603: MOLECULAR PATHOLOGY CR: 3

This course is designed to introduce the graduate student to the fundamentals of molecular biology.

Topics include nucleic acid structure, DNA replication and repair, transcription and translation, DNA and protein sequence analysis, accessing DNA and protein sequence databases on the internet, protein secondary structure prediction, searching for motifs and domains in proteins, protein 3D structure, molecular graphics.

0570-604: EXPERIMENTAL PATHOLOGY CR: 3

Pathology, as other areas of biology, employs various experimental systems for the investigation of different medical conditions, as well as testing and monitoring of agents before they can be applied to the human. The graduate student must be familiar with these systems and their application in medical research. The student is expected to know the different experimental systems that are in common use in medical research. The course will deal with science and experimentation, experimental systems in medicine, human experimentation, animal experimentation, ethical aspects of human and animal experimentation, methods in animal experimentation, animal models for different diseases (e.g. diabetes, coronary artery disease, osteoporosis and cancer), alternatives to animal and human experimentation, problems of validity and reliability in animal experimentation, safety methods.

0570-605: MOLECULAR PATHOLOGY OF CANCER CR: 3

This course will cover the identification and mechanisms involving environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous mechanisms, nucleotide excision repair and mismatch repair. The discovery, biochemistry, and function of oncogenes and tumour suppressor genes, growth factors, signal transduction pathways, and regulators of the cell cycle, including cyclins, cyclin dependent kinases and their inhibitors, apoptosis, telomerases and cell to cell matrix interactions will be discussed. Molecular mechanisms of cancer metastasis, tumour angiogenesis and molecular basis of cancer diagnosis, prognosis and treatment will be emphasized.

**0570-606: CLINICAL CHEMISTRY AT THE
EXTREMES OF LIFE
CR: 3**

This course is designed to show that there are differences in disease processes which arise at the extremes of life which the graduate student should be aware of. At the end of the course the student will be required to be familiar with the rational use of the clinical laboratory in the diagnosis of these diseases. The course covers postnatal investigations of the small for date infants, neonatal respiratory disorders and their investigations, neonatal hydrogen ion disturbances, neonatal hypoglycaemia and their investigations, investigation of disorders of calcium and phosphorus metabolism, neonatal hyperbilirubinaemia, inborn errors of metabolism, congenital hypothyroidism, biochemical aspects of ageing, factors that affect laboratory results in geriatric patients, screening for diseases in geriatric patients.

**0570-607: CLINICAL CHEMISTRY OF
CANCER
CR: 3**

The objective of the course is to introduce the graduate student to the metabolic effects of tumours and the biochemical markers of cancers. The course will cover the biochemistry and clinical investigations of carcinoid tumours, multiple endocrine neoplasia, ectopic hormone secretions, metabolic changes in malignancy, paraneoplastic syndromes, tumour markers, assays for tumour markers, critical assessment of the usefulness of tumour markers by tumour origin.

**0570-608: METABOLIC DISEASES
CR: 3**

This course is designed to cover the concepts and mechanisms of metabolic diseases. It will cover introduction to metabolism, links between carbohydrate, protein and lipid metabolism, biochemistry, principles of investigation and diagnosis of diabetes mellitus, hypoglycaemic syndromes, glycogen storage diseases, disorders of haemosynthesis and porphyrias, metabolic bone diseases, hyperlipidaemias and atherosclerosis.

**0570-612: BASIC CYTOPATHOLOGY
CR: 3**

Basic morphological description of cells from different body sites, collection of samples for gynaecological and nongynaecological exfoliative cytology and their routine staining; collection of samples by fine needle aspiration (FNA) (of

superficial and deep seated organs) with and without imaging guidance, their preparation and staining; screening programmes in cytology; cervical cytology with brief history of classification and details of Bethesda system of classification; respiratory cytology other than FNA (sputum, bronchial brush and bronchial lavage), effusions of body cavities (pleural, pericardial, ascitic and CSF); urinary cytology, infections in cytology: FNA cytology of head and neck lesions; FNA cytology of thyroid; FNA cytology of lymphomas and leukemias, FNA cytology of breast.

**0570 - 613: ADVANCED CYTOPATHOLOGY
CR: 3**

This Course will include FNA cytology of thorax, FNA cytology of G.I. tract and associated organs (pancreas, liver and gall bladder); FNA cytology of genitourinary system (kidney, prostate, ovary and testis); role of morphometry and image analysis in cytology, role of electron microscopy in cytology, role of flow cytometry in cytology; role of cytochemistry in cytology; role of immunocytochemistry in cytology; role of molecular biology techniques in cytology, ThinPrep and automation in screening of smears, use of experimental animals for research in cytology and quality assurance in cytology.

**0570-614: APPLICATION OF
RADIOISOTOPES IN MEDICAL
RESEARCH
CR: 3**

The course will cover basic principles of nuclear medicine, radiation safety procedures, radiation dosimetry, measurement of radiation in vivo and in-vitro; techniques of radiolabelling, and application of nuclear technology in tracing metabolic products, scanning organs and tissues, and imaging techniques for various organs and systems. The course contents will comprise the following:- Basic principles of nuclear physics; Nuclides and radionuclides; origin of nuclides, - cyclotron, nuclear reactor, fission products; nature of radioactivity, mechanisms of radioactive decay, interaction of electrons, x-rays and δ -radiation with matter; radiopharmaceutics; in-vitro radiolabelling techniques; quality control of "hot lab" ; radiation detection and relevant instrumentation; imaging techniques in the study of pathology in different organs and tissues; scintigraphy in neoplastic and non-neoplastic lesion in various organs and tissues; application of monoclonal antibodies in scintigraphic techniques; autoradiography.

**0570-615: SEMINAR I
CR: 1**

The candidate will be assigned a topic to his/her area of specialization in pathology. He/she will be asked to critically review the literature and present it in the department.

**0570-616: SEMINAR II
CR: 1**

The candidate will be assigned a topic to his/her area of specialization in pathology. He/she will be asked to critically review the literature and present it in the department.

**0570-617: SEMINAR III
CR: 1**

The candidate will be assigned a topic to his/her area of specialization in pathology. He/she will be asked to critically review the literature and present it in the department.

**0570-618: ADVANCES IN HAEMATOLOGY
CR: 3**

This course is designed to cover molecular principles of blood coagulation including role of platelets, endothelial cells and coagulation protein and their cellular interactions, regulatory process of coagulation including fibrinolysis, clinical and laboratory evaluation of hemorrhagic and thrombotic disorders including both hereditary and acquired disorders. It also includes principles of hematopoiesis, growth factors required for erythropoiesis, myelopoiesis and thrombopoiesis. Anemias will be addressed in reference to nutritional causes such as iron deficiency anemia and deficiency of vitamin B12 and folic acid and mode of diagnosis. Hemolytic anemias are also covered. This includes methods of detection of hemolysis, classification of causes. Hemoglobinopathies are also included emphasizing the genetic and molecular background and methods of diagnosing these disorders. It also covers principles and recent discoveries of cytogenetic and other molecular causes underlying acute and chronic leukemias especially addressing important mutations leading to clinical presentation and development of new therapeutic modalities.

**0570-619: ADVANCES IN CLINICAL
CHEMISTRY
CR: 3**

This course is designed to prepare the students for a career in postgraduate research in the discipline. The programme will consist of tutorials, seminars and practical exercises designed to facilitate the

acquisition of knowledge on recent developments in the field. The subject matter to be covered will focus on the more specialized tests performed in a modern clinical biochemistry routine and/or research laboratory.

**0570-620: ADVANCES IN
HISTOPATHOLOGY
CR: 3**

This course is designed to prepare the students for a career in postgraduate research in the discipline. The program will consist of tutorials, seminars and practical exercises designed to facilitate the acquisition of knowledge on recent developments in the field. The subject matter to be covered will focus on the more specialized tests performed in a modern clinical biochemistry routine and/or research laboratory.

**0570-697 DISSERTATION
CR:0**

**0570-698 DISSERTATION
CR:0**

**0570-699 DISSERTATION
CR:18**