Factfile

Typical entry requirements
Applicants will normally possess a minimum of a science degree in a relevant subject, together with workplace experience in toxicology or a closely related field. Registration requires two scientific referees willing to support the application. Application to register for the Postgraduate Diploma or MSc can be made following the first or second module attended. Retrospective application is permitted provided not more than four modules have been completed.

There are no formal entrance requirements for participants not wishing to register for the MSc/Postgraduate Diploma, although a scientific background to at least degree level is recommended. Proficiency in English is a prerequisite.

Programme length
3 to 6 years part-time

Planned intake
32 per module

Assessment
Each module is assessed by a written examination on the final day of the course and a home assignment to be completed within ten weeks of the end of the module. An integrative, non-credit-bearing final assessment is undertaken after completion of the eight compulsory modules.

Conditions of Acceptance
Applications should be received at least one month prior to attending a module, at which time the pre-course reading will be distributed.

Enquiries
For further information, please contact the Programme Administrator in the first instance or log on to our website: www.surrey.ac.uk/PHM/PG_ taught_courses/applied- toxicology.htm

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MSc/PGDip

Applied Toxicology

This part-time modular training programme, running in its present form since 1992, is the largest training programme of its type in Europe and attracts participants from all over the world. It is designed to provide in-post scientists with advanced training and a higher qualification in toxicology. Participants include employees in government departments, contract laboratories and pharmaceutical, chemical and consumer product industries.

Industry, contract and government agencies throughout the world need experienced staff with expert knowledge in toxicology. There is increasing demand for formal qualifications and qualification validation in the health-related professions. Economic pressures and work commitments make long-term release of staff for training in toxicology a challenge. This modular training programme in Applied Toxicology meets this challenge.

Participants are often science, medical or veterinary graduates currently working in a toxicology environment or seeking to use knowledge of toxicology in their careers. It is ideal for research managers, regulatory affairs specialists, occupational and environmental health scientists and physicians, research scientists and anyone who needs to keep abreast of the developments in modern toxicology without having to enrol on a full-time training programme.

The programme is accredited by the Royal College of Pathologists for the award of continuing professional development (CPD). It also contributes towards the requirements for the Register of Toxicologists. The overall aim is to enhance understanding of the underlying scientific disciplines involved in toxicology, the mechanisms of action of various types of toxic agent and the application of toxicology to meet regulatory requirements.

Programme Structure

This part-time programme is designed for those in full-time employment. It consists of eight compulsory modules essential for the basic understanding of toxicology, and a number of supplementary optional modules. The compulsory modules are an obligatory component of the MSc/Postgraduate Diploma in Applied Toxicology. Four compulsory modules and four optional modules are offered each year.

Each module is an intensive, self-contained, five-day taught course, preceded by preparatory study (for which carefully selected distance learning material will be provided), followed by consolidation and assessment. The eight compulsory modules are scheduled in a two-year cycle, accompanied by four optional modules per year. The optional modules are offered subject to demand. Teaching methods include lectures, discussion panels, tutorials, case studies, demonstrations and home assignments. Lectures are given by recognised experts in their field. Each module on the programme is approved by the University for the accumulation of credits towards the MS or Postgraduate Diploma in Applied Toxicology.

The Postgraduate Diploma requires the successful completion of the eight compulsory modules, one optional module and an integrative final assessment in toxicology. Candidates for the Postgraduate Diploma have a maximum of 48 months from the date of registration to complete the programme.

The MSc requires either an additional three optional modules or successful completion of a dissertation. Candidates for the MS in Applied Toxicology have a maximum of 72 months from the date of registration to complete the programme.

Compulsory modules:
- Carcinogenicity and Mutagenicity
- Principles of Experimental Toxicology and Risk Assessment
- Principles of Toxicological Pathology
- Reproductive Toxicology
- Target Organ Toxicology – Systems I: Liver, Kidney, Gastrointestinal Tract and Skin
- Target Organ Toxicology – Systems II: CNS, PNS, Endocrine and Musculoskeletal Systems
- Target Organ Toxicology – Systems III: Cardiorespiratory and Haematopoietic Systems
- Toxicokinetics and Metabolism

Optional modules:
- Alternative Methodologies to the Use of Animals in Toxicology
- Bioinformatics and Omics
- Biologics
- Biomarkers
- Carcinogenicity – Interpretation of Pathological Changes in Rodent and Non-Rodent Species
- Dermal Toxicology
- Design of in vivo Studies
- DNA Lesions
- Ecotoxicology
- Endocrine Pathology
- Experimental Inhalation Toxicology
- Food Chemical Safety Evaluation
- Haematology and Clinical Biochemistry
- Immunotoxicology
- Metabolism and Human Variation
- Mutagenicity Testing I and II
- Mutations and Human Health
- Occupational Toxicology (including REACH implementation and legislation)
- Paediatric Toxicology
- Plant Protection Products and Plant Biotechnology
- Safety Assessment of Pharmaceutical Agents
- Study Design, Quality and Interpretation in Genotoxicity Testing
- Techniques in Safety Assessment
Compulsory Modules

Carcinogenicity and Mutagenicity
It was established in the early 1900’s that the administration of certain chemicals could result in cancers in laboratory animals. Early epidemiological studies had shown that some human cancers were influenced by environmental factors. In modern times, there has been considerable concern about the potential for some natural and synthetic chemicals to cause human cancer, and stringent regulations cover the manufacture and use of such chemicals. Sophisticated test batteries and research methods have been developed for the study of mutagenesis and carcinogenesis.

This module includes cancer, mutation and gene structure; mutagenicity testing in vitro; mutagenicity testing in vivo; human monitoring; the need and rationale for carcinogenicity testing; the pathogenesis of cancer; theories of growth control and carcinogenesis; initiation and promotion – skin; cancer epidemiology; structure-activity relationships and carcinogenesis; human oncogenes and human cancer; DNA repair; mutagenicity testing – structure-activity relationships; testing procedures and protocols; neoplasia by non-genotoxic agents – the kidney; neoplasia by genotoxic and non-genotoxic agents; initiation and promotion – bladder; classification and morphology of tumours; risk assessment – statistics/mathematical models/ extrapolation to man.

Principles of Experimental Toxicology and Risk Assessment
Many toxicity-testing procedures are based on general principles established for a broad spectrum of chemicals. However, there is an increasing need for a more rational approach to toxicity testing of chemicals and drugs to ensure safety, and to make the process of safety assessment cost-effective. This module takes a critical approach to the conduct and interpretation of toxicity studies, emphasising the need to employ a flexible approach in order to maximise understanding of the underlying mechanisms of toxicity and their relevance to human risk assessment.

This module includes the history and philosophy of toxicological evaluation; the rationale for acute toxicity testing: the limitation of currently accepted methods; the rationale for sub-acute and chronic toxicity testing; carcinogenicity testing; the role of mutagenicity testing; basic requirements for toxicological evaluation; the rationale for reproductive toxicity testing; the role of biochemical, metabolic and toxicokinetic studies in the evaluation of toxic hazard and risk; the evaluation of immunotoxicity; the integration of toxicological studies with the technical development of industrial chemicals; the integration of toxicological studies with the technical development of pesticides; the integration of toxicological studies with the technical development of drugs; environmental aspects of risk assessment; risk assessment for food contaminants; mathematical models in risk assessment; occupational risk assessment; and international guidelines on toxicological evaluation.

Principles of Toxicological Pathology
Histopathology plays a central part in toxicological evaluation. Although most major studies employ an experienced pathologist, it is necessary for all toxicologists to appreciate the basic principles of pathology. This module aims to introduce the principles of pathology, including the preparation and examination of tissues from toxicity studies.

This module includes themes, causes and processes in pathology. It also covers the causes of pathological changes; chemical mediators of inflammation; acute and chronic inflammation; disorders of the immune response and of tissue growth – hypertrophy, dysplasia and neoplasia; tissue restoration and repair; cell necrosis and degeneration; thrombosis and embolism – their origins and consequences; new techniques used in histology and electron microscopy; and cell organelles and their response to toxic agents.

Reproductive Toxicology
Reproductive toxicology studies assumed increasing importance following the thalidomide disaster of the 1960s, and detailed reproductive toxicity studies are now a routine part of toxicity screening. Such studies may screen the effects of germ cell and pre-natal exposure on several generations of animals. In recent years, behavioural effects have attracted increasing interest. In addition, in vitro screening systems are now being applied to complement conventional approaches.

This module includes the principles of reproductive toxicology; principles of pharmacokinetics; timing of pregnancies (mouse, rat, rabbit); timing of pregnancies (monkey); embryology I: from the zygote to organogenesis; genetic defects; morphology of the male and female reproductive systems; spermatogenesis and oogenesis; studies on male fertility; multigeneration studies; embryology II: organogenesis; visceral evaluations; behavioural toxicology; embryology III: the foetal period; perinatal development of enzyme systems; legal requirements for reproductive toxicology testing; whole-embryo culture; limb-bud culture; other in vitro systems; and the significance and limitations of in vitro systems.

Target Organ Toxicology
Although the principles of toxicology can be applied broadly to many organ systems, an understanding of the toxicology of individual organ systems is necessary for accurate risk assessment. These modules examine the pathology, anatomy, physiology and toxicology of the liver, kidney, gastrointestinal tract, skin, central and peripheral nervous system, endocrine organs, musculoskeletal system, cardiorespiratory system and haematopoietic system. The modules take examples of compounds from the literature that result in toxic effects on such organs.
Systems I: Liver, Kidney, Gastrointestinal Tract and Skin

Liver: structure and functions; xenobiotic metabolism; acute pathological changes; mechanisms of acute hepatotoxicity; adaptive and toxic changes in the liver of rodents; chronic hepatotoxicity, repair, cirrhosis; hepatocarcinogenesis; assessment of hepatic function and damage in animal species; cholestasis

Gastrointestinal Tract: structure; regulation of secretions; NSAIDS and ulcer formation; the rodent forestomach; toxicology of the caecum; acute and chronic toxicity of the glandular stomach and intestines; hypersensitivity, Peyer's patches and the gastric immune system; carcinogenesis in the glandular stomach and intestine; carcinogenesis in the pancreas.

Kidney: structure and functions of the mammalian kidney; assessment of renal function and damage in animal species; nephrotoxins I – the tubule; nephrotoxins II – glomerulus and papilla; secondary effects of kidney failure.

Skin: normal skin structure and function; absorption of compounds into and across skin; chemically induced skin damage, irritation and repair; sensitisation and hypersensitivity reactions; UV-induced skin damage and photosensitisation.

Systems II: CNS, PNS, Endocrine and Musculoskeletal Systems

Nervous system: this includes an introduction to the gross anatomy and histology of the CNS and PNS; basic neurophysiology; basic neuropharmacology; selective vulnerability by area and cell type; behavioural changes in animals; behavioural toxicity of antidepressants; general toxicological principles: acute and chronic toxicity of organophosphates and carbamates; delayed neuropathy by organophosphates; neuronal necrosis and water disposition: organotins and organoleads; physiological aspects of neurotoxicity in man and animals; neurotoxic chemicals including pesticides; brain tumours; toxicology of the eye and the ear; and the neurotoxic effects of metals.

Endocrine system: toxicology of the hypothalamic-pituitary axis; adrenocortical toxicology; toxicology of the thyroid; general endocrine interactions; endocrine tumours; and the neuroendocrine effects of alcohol.

Musculoskeletal system: including bone as a target organ; effects of metals on bone; the structure and biochemistry of muscle; and chemically induced myopathies.

Systems III: Cardiorespiratory and Haematopoietic Systems

Cardiorespiratory: This includes the anatomy and physiology of the cardiovascular system; direct-acting cardiotoxicants and angiotoxicants; secondary effects on the cardiovascular system; measurement of cardiovascular function; structure and histopathology of the upper respiratory tract; structure and physiology of the lung; an introduction to inhalation toxicology; pulmonary function assessment; toxicology of the lung.

Haematopoietic system: This includes the biochemistry and physiology of haematopoiesis; introduction to practical haematology; naturally occurring haematological disorders in animals; anaemias caused by chemicals; biochemistry of platelets; chemically induced disorders of blood coagulation; and the effects of chemicals on leucocytes.

Toxicokinetics and Metabolism

A good knowledge of the principles of xenobiotic metabolism is central to toxicology because many compounds undergo enzymic metabolism to form toxic metabolites. Similarly, many toxicants are inactivated by the action of xenobiotic metabolising enzymes. Toxicokinetics is the study of the rates of absorption, distribution, metabolism and excretion of toxicants, and is central to an understanding of the exposure of target tissues to toxicants. This module focuses on toxicokinetics and xenobiotic metabolism with particular emphasis on risk assessment.

This module covers an overview of lung, oral and intestinal absorption; metabolism – phases I and II; skin absorption and metabolism; stereoselectivity in drug metabolism and toxicology; enzymology and molecular biology; distribution and excretion; toxicodynamic effects, reactive molecules and dose-response curves; basic xenobiotic metabolism and the implications for drug development; techniques for measuring xenobiotics; plasma monitoring for therapeutic optimisation; basic pharmacokinetics; bioavailability; interspecies comparison in drug metabolism and toxicokinetics; extrapolation of data from animals to man; and pharmacokinetic modelling.