Anglia Ruskin University

Course Information Sheet

BSc (Hons) Forensic Science

Mode and course length – Full-Time (4 years)

Location – ARU Cambridge Campus

Awarding Body – Anglia Ruskin University. As a registered Higher Education provider Anglia Ruskin University is regulated by the Office for Students.

Overview

Criminal prosecutions depend on evidence which has been safely and appropriately collected, stored, examined, analysed and reported by forensic scientists.

This course will teach you the fundamental principles of forensic science from crime scene to court. You'll learn how to analyse and investigate a range of evidence at crime scenes and in the forensic laboratory. In the first year of your degree, you will cover key forensic concepts including how to package evidence correctly and perform preliminary tests for body fluids and drugs of abuse. You will also gain knowledge in the scientific disciplines to equip you for the more advanced analytical modules you will encounter as the degree progresses. During your degree you will have the opportunity to analyse a range of 'real' samples including ignitable liquid residues, drugs of abuse, trace evidence such as paint and fibres and biological material. By the time you graduate, you will have developed an understanding of the UK legal system and your role in it as a forensic scientist. You will be able to present your observations and conclusions as evidence in a court of law. You will also have learnt how to conduct thorough, independent research, and feel confident about presenting comprehensive reports, both verbally and in writing.

You will have the opportunity to gain hands-on experience of a range of analytical techniques including Raman spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, Inductively Coupled Plasma-Optical Emission (ICP-OES) spectroscopy, Microspectrophotometry (MSP) and various Gas Chromatography (GC) and Liquid- Chromatography (LC) instruments with different detection systems. For biological analysis we have a range of instruments available including a Nanodrop 1000 spectrophotometer, Qubit fluorometer, Lightcycler 96 real-time PCR system and an AB 3130 genetic analyser. In addition, we have a variety of microscopes available including comparison, polarizing light and confocal, as well as a selection of specialised forensic equipment.

Our lecturers are all research-active and have first-hand experience of crime scene examination or the analysis of forensic evidence. As well as benefitting from their knowledge, you'll have guest lectures from visiting professionals and get an understanding of the workplace through visits to places such as the Magistrates Court, Crown Court, and other field trips.

Course Delivery

Our courses are delivered through teaching and learning methods which provide students with the widest possible exposure to a modern and innovative higher education experience.

These methods vary and could include attendance at lectures and seminars, undertaking laboratory exercises or work-based activities, practical work, performances, presentations, field trips, other relevant visits and e-learning through Canvas, our online learning management system.

Each course is divided into a number of 'modules' which focus on particular areas, each of which has a specific approach to its delivery. This information is published to students for each module they take via the Module Definition Form (MDF) and Canvas.

Assessment

Throughout the course, we will use a range of assessment methods to measure your progress and ensure you are developing

the knowledge and skills required. This course has a hands-on approach and most of the modules you take will have a practical element, so you will be able to develop your crime scene and laboratory skills. Your written, verbal, numerical and problem solving skills will be assessed through examinations, class-tests, laboratory reports, portfolios, role play, presentations and a final year research project in a forensic area of your choice.

Fees

Information about your course fee including any annual fee increases or deposits (if required) can be found in your offer letter.

Additional Costs

SD memory card - £8

Fine-tipped permanent marker pens - £3

Cost of printing dissertation/individual project

CD / memory stick for dissertation submission.

Cost of printing A1 poster for dissertation - £15

Scientific Calculator

Modules

Core Modules

Year 1: Foundation in Optometry, Medical and Life Sciences

This module will provide students with the necessary skills to begin studying at level 4 in courses related to Optometry, Medical Science and Life Sciences.

Students will be introduced to the core skills necessary to succeed in higher education, including thinking critically, researching and referencing appropriately, demonstrating appropriate numeracy and ICT skills, and communicating effectively verbally and in writing.

In addition to these fundamental study skills, Students will be given an introduction to the various scientific disciplines underpinning the life sciences. Fundamental mathematical skills will be covered in order to support students' other subjects and give them confidence in manipulating data.

Students will be introduced to molecular and cellular biology, and how these fields are applied to real-world investigations. Students will also study the biology of micro and macro organisms, with reference to both human and animal structures.

Students will be introduced to the core concepts of chemistry, with a particular focus on organic chemistry, and will also be given a grounding in the core principles of physics, applied to living organisms.

The module is made up of the following 8 constituent elements:

- Interactive Learning Skills and Communication (ILSC)
- Information Communication Technology (ICT)
- Critical Thinking
- Maths for Scientists
- Cellular Biology
- Biology – Physiology
- Chemistry
- Physics for Life Sciences

Year 2: Introduction to Forensic Methodologies

'Introduction to Forensic Methodologies' provides a comprehensive introduction to the fundamental practical skills and

knowledge base required of anyone seeking a career in forensic or other investigative sciences. The module covers key aspects ranging from the management of crime scenes and the appropriate recovery of items found within them, to the interpretation and analysis of evidence. Scientific principles will be applied to situations encountered in forensic investigation.

A range of the most common types of evidence will be introduced, along with the techniques used to examine them. The practical component of the module will enable students to master basic laboratory skills used within analytical sciences, including the appropriate handling, packaging and preparation of specimens. Issues relating to the continuity of evidence for legal purposes will be presented throughout the module.

Incorporating personal development planning, 'Introduction to Forensic Methodologies' provides the grounding upon which the students' forensic knowledge will be based.

Year 2: United Kingdom Legal Systems and Law for Forensic Scientists

This module will introduce students to the three separate legal systems of the United Kingdom: England and Wales, Scotland and Northern Ireland. We will look at the development of law in the English, Scottish and Northern Ireland legal systems and will examine the Jury system and the investigation of crime with each of these systems. We will look at the development of law in England and Wales, Scotland and Northern Ireland, examining the different members of the legal profession, requirements of juries and the investigation of crime within each of these systems.

Close examination will be made of the powers and requirements relevant to the Scene of Crime Officer (S.O.C.O.) /Forensic Scientist. Detailed examination will be made of the laws of evidence as they relate to the S.O.C.O./Forensic Scientist and also of the codes of practice of the Crown Prosecution Service (CPS)/ Procurator Fiscal. As part of the module, the students must visit the magistrates/crown court in order to observe how trials are conducted in UK courts, which will help them get a better understanding of the criminal justice system during trials.

Year 2: Applied Science for Forensic Investigators

This module is designed to allow students to develop an understanding of the basic scientific principles which underlie forensic investigations.

Students will be introduced to the broad scientific disciplines within forensic science, including chemistry, biology, physics and mathematics. Students will be provided with the analytical skills necessary to interpret forensic evidence and apply scientific principles to forensic case studies.

Students will learn about the periodic table and properties of elements, atomic structure and chemical bonding, as required as a basis of forensic analytical chemistry. In addition, chemical equations, stoichiometry and dilutions relevant to forensic and investigative sciences will be covered. Students will also study the basics of molecular biology, including the structure and function of DNA and RNA. They will be introduced to the polymerase chain reaction (PCR) and short tandem repeats (STRs) and how these are used in forensic and investigative sciences. Students will also learn basic biochemistry and human anatomy, and how biological evidence may be used in forensic cases. In addition, basic physics, as required in areas such as blood spatter analysis and ballistics, will be introduced.

Each lecture will be followed by a tutorial where students will be able to apply the scientific principles learned to relevant forensic situations. Relevant areas of maths will be introduced in a series of workshops, to familiarise students with Microsoft Excel and allow student learning through interactive problems.

A practical element is also included in this module, for students to gain competence and confidence in performing basic laboratory techniques. These practical sessions include an introduction to wet lab techniques (e.g. the use of micropipettes), microscopy, presumptive testing, and thin layer chromatography (TLC).

Year 2: Physical and Quantitative Chemistry for Forensic Scientists

This module introduces some fundamental concepts of physical chemistry and a basic introduction to chemical analysis. Examples will be drawn from throughout the forensic sciences. The main areas of the physical chemistry content of the module include: chemical equilibria, thermodynamic, thermochemistry and kinetics. These topics are of great importance in acquiring an understanding of why chemical changes occur and gives a good understanding of concepts for students progressing onto a number of modules on the forensic science course. The quantitation part of the module, will introduce basic chemical analysis

and emphasis is placed on the acquisition of good laboratory practice and basic calculations applicable to quantitative analytical techniques. Learning resources will be available through the library and relevant websites, for example the Royal Society of Chemistry website.

Year 2: Introduction to Police and Forensic Photography

This module will introduce students to the theoretical and practical application of photography in the forensic context.

The module will be delivered through a series of lectures, introducing various aspects of police photography, and practical sessions developing core skills required by Police photographers and crime scene investigators (CSIs). This skills are also transferable to laboratory scientists who undertake photographic recording of evidential material in the forensic laboratory.

Introduction to digital single lens reflex cameras and their basic functions will be made. This will include the choice of f.stop and associated shutter speed, using the through-the-lens metering systems to produce correctly exposed images. Additionally, the use of depth-of-field in forensic photography and exposure control will also be covered. These key skills will underpin the students' ability to develop further understanding regarding the practical approaches to crime scene photography.

The use of further technical photography equipment will be introduced, including the use of flash.

These skills will be utilised in practical sessions enabling students to produce evidential photographs as they would be produced in the criminal justice system.

Students will be introduced to the approaches taken for general crime scene photography, in addition to contextual and close-up evidence-specific photographs. This will include the use of evidence markers and scales where appropriate. The production of 1:1 photographs is essential in forensic comparison of footwear marks and fingerprints. Forensic photographers are required to understand and practise the specific requirements in capturing finger mark and footwear images and students will be taught these skills.

An additional skill requirement of forensic photography is to take photographs of injuries, to be used for charging purposes, for interpretation by medical practitioners and for presentation in court. Students will have the opportunity to develop practical skills in injury photography.

Further to these practical skills, students will also attend lectures to develop further their theoretical understanding of the role of the forensic photographer. Learning will include the use of photography in fluorescent examination of crime scenes and evidence recovery, photography at the scene of road traffic accidents and the photography of the deceased.

Lectures will also detail the use of photographic images in the criminal justice system, including capture, continuity, storage, development and presentation in court. Furthermore, recent advances in imaging of crime scenes, crime scene reconstruction and 3D and graphical representation in court will be covered during lectures.

Year 2: Physical Criminalistics

The examination of most physical forensic evidence requires a broad, but not necessarily deep, knowledge of the characteristics of a wide range of materials. A forensic scientist has no way of predicting what evidential types will be available and/or significant when an investigation begins, so all criminalists require a basic knowledge of the main evidence types. This module looks at the physical (as opposed to chemical or biological) properties of the most common types of evidence encountered, and also encourages you to learn the professionalism needed to seek more highly qualified or expert advice when necessary, "if in doubt then do no harm". You will focus on evidence, though some new methodologies like the scanning electron microscope and x-ray diffraction will be introduced, and will cover the basic principles of a forensic examination, the physical properties of documents, glass fragments (including fracture patterns and optical properties), paint, tool, tyre and footwear marks, soil and vegetation, and finger marks as well as other body prints. The importance of context, physical fit comparisons and, above all, accurate description is emphasised here

Year 2: Personal and Professional Development – Level 4

At Anglia Ruskin University we strive to ensure that students receive an outstanding academic education and student experience and understand that, whilst embedding employability skills within the credit-bearing curriculum is important, it is only part of the set of achievements needed in order to obtain career employment.

This 0-credit module will be used to track and verify the progress students have made with respect to key employability skills and endeavour. Students

will work closely with their personal tutor, SU Volunteering Service, Study Skills Plus, and the Faculty Employability Advisor to engage with co-curricular and extracurricular opportunities and activities to enhance their personal attributes.

Year 3: Forensic Analytical Chemistry

This module is designed to provide students with knowledge and experience of: (i) analysing "real" forensic science samples using a variety of chromatographic (LC and GC and relevant detectors) and spectroscopic techniques (ICP and UV-Vis); and (ii) an understanding of the underlying quality management principles that are involved in such analyses, good laboratory practice and method validation.

Knowledge of the appropriate choice of analytical method, the results that are generated (specifically for the technique) and their interpretation are central to this module. Examples will be drawn from the forensic sciences. The course will be delivered through lectures, tutorials and practicals.

Year 3: Scene and Laboratory Investigation

Scene and Laboratory Investigation builds on the knowledge gained at Level 4 relating to evidence recovery and packaging. The module provides the student with the opportunity to undertake practical work in the recovery of evidence at various scenes and highlights the problems that different types of scenes can bring. The module will build on the knowledge already gained in relation to contamination issues and also issues in the chain of continuity of evidence. Students will receive a practical introduction in the use of different laboratory techniques, which they can use to examine and analyse evidence recovered from crime scenes, such as fingermark development (using physical and chemical development). This module will particularly focus on the correct recording of crime scenes through photography, sketching, and contemporaneous note taking.

Year 3: Forensic Spectroscopy Techniques

Much of the routine work of the practising forensic scientist involves the identification and quantitative analysis of many substances (drugs, explosives, fibres, paint pigments, amongst many others). It is a fact of life that many forensic samples are extremely small (e.g. a few grains of gun-shot residue, the ink on a forged bank note), and for evidential reasons, it is advantageous to use non-destructive techniques (i.e. techniques that do not consume any portion of the sample) or techniques which minimise sample destruction. In many instances, the analytical methods of choice are spectroscopic in character, that is, techniques that examine the way the sample interacts with electromagnetic radiation. Such techniques include Raman spectroscopy, infrared spectroscopy and x-ray diffraction.

Knowledge on the appropriate choice of analytical method, the results that are generated (specifically for the technique) and their interpretation are central to this module. Examples will be drawn from the forensic sciences. The course will be delivered through lectures, tutorials and practicals.

Year 3: Project Preparation

The main purpose of this module is to prepare students to carry out a project in their final year. The precise content of the module will depend upon the project itself, but common features are likely to be: the selection of a suitable project, usually with advice from the potential supervisor; instruction on how to use relevant sources of published information; carrying out a literature survey on the subject of the planned project; and the writing of a literature review and project plan. Where appropriate, students will gain instruction in hazard assessment. The module will be chiefly student-managed. The time will be spent in planning the project by reference to the literature. Each student will be allotted a supervisor, who will meet with the student on a regular and scheduled basis to advise and review progress. Students will also gain experience of projects by having the opportunity to listen to the project presentations by final year students.

Year 3: The Forensic Analysis of DNA and Biological Material

This module focusses on the application of biology and genetics to the field of forensics and the use of these in criminal investigation. Students cover both the biological principles and the practical applications surrounding the different stages involved in the processing of evidence. These stages include the recovery of evidence from a scene of crime, preliminary tests used for body fluid identification, processing of samples to generate DNA profiles, and the interpretation and presentation of such evidence.

The lectures cover the foundations of molecular genetics including DNA structure and function, DNA replication and population

genetics. We then focus on current DNA analytical methods to generate DNA profiles i.e. the use of STRs and DNA 17, together with the use of other markers such as mtDNA, Y-STRs and SNPs in different case scenarios. Other topics related to the field will be covered including the latest technology, markers, and procedures used for DNA analysis.

Students also gain practical experience of the DNA workflow (i.e. sample collection, extraction, quantification, amplification, separation of fragments) as well as statistical interpretation of DNA profiles. (i.e. calculating match probability, likelihood ratios and providing statements in court).

Year 3: Chemical Criminalistics

This module provides an introduction to chemical aspects of criminalistics involving a number of chemical evidence types including greasy marks and stains, oily materials (shoe polish and lipsticks, for example) and evidence which is left by everyday materials. This module describes how these materials are analysed and how reports are generated from such data. The module also includes a basic guide to the chemistry of arson accelerants and explosives and their chemical natures and explores the methods used for fire debris analysis. Learning resources will be available through the digital library.

Year 3: Personal and Professional Development – Level 5

At Anglia Ruskin University we strive to ensure that students receive an outstanding academic education and student experience and understand that, whilst embedding employability skills within the credit-bearing curriculum is important, it is only part of the set of achievements needed in order to obtain career employment.

This 0-credit module will be used to track and verify the progress students have made with respect to key employability skills and endeavour. Students will work closely with their personal tutor, SU Volunteering Service, Study Skills Plus, and the Faculty Employability Advisor to engage with co-curricular and extracurricular opportunities and activities to enhance their personal attributes.

Year 4: Undergraduate Major Project

The individual Final Project module allows students to engage in a substantial piece of individual research and / or product development work, focused on a topic relevant to their specific discipline. The topic may be drawn from a variety of sources including: Anglia Ruskin research groups, previous / current work experience, the company in which they are currently employed, an Anglia Ruskin lecturer suggested topic or a professional subject of their specific interest (if suitable supervision is available). The project topic will be assessed for suitability to ensure sufficient academic challenge and satisfactory supervision by an academic member of staff. The chosen topic will require the student to identify / formulate problems and issues, conduct literature reviews, evaluate information, investigate and adopt suitable development methodolgies, determine solutions, develop hardware, software and/or media artefacts as appropriate, process data, critically appraise and present their finding using a variety of media. Regular meetings with the project supervisor should take place, so that the project is closely monitored and steered in the right direction.

Year 4: Forensic Pathology

Forensic Pathology is a discipline of pathology concerned with the investigation of deaths where there are medico-legal implications, for example, suspected homicide and other complex medico-legal cases. Forensic pathologists are medically qualified doctors who perform autopsies on sudden, unexpected and suspicious deaths. The forensic investigation of death is a multi-disciplinary approach that involves collaboration between pathologists, crime scene investigators, forensic scientists and other experts in the forensic field. This module develops the knowledge of the students in relation to the subject of forensic pathology, which contributes to the investigation of suspicious death and identification of the deceased. The module covers the role of forensic pathology in fulfilling the key functions of the medico-legal autopsy determination of cause of death, post-mortem changes after death, estimate of time since death, traumatic causes of death and asphyxias. Various case studies and peer-reviewed articles relating to the subject area will also be discussed in the lecture/seminar sessions.

Year 4: Advanced Fire and Explosion Investigation

This module follows on from the basic fire part of the Chemical Criminalistics module, which is a necessary precursor. It gives a more detailed insight into the factors involved in the initiation and propagation of fires and explosions, starting with gases, liquid vapours and solids and the various states of combustion, progressing through a full compartment fire. This knowledge is then

considered within fire and explosive investigation, including calculations to explore possible causes, including electrical and ignition energy. Various aspects of explosive analysis will be explored, requiring specialist facilities for this type of forensic analysis. In addition, the analysis of fire debris and ignitable liquids residues (ILR) are studied and discussed, including the techniques GC-MS-EIC and GC-MS-ATD as well as building on students' knowledge on GC-FID and GC-ECD and other instrumental methods for explosive analysis. Practical work will also be carried out on the analysis of an ILR with GC-MS-EIC, using a standard method that is used and accepted in UK courts. Learning resources will be available through the digital library and identified through the course of the module.

Year 4: Advanced Forensic Methodologies

This module is designed to provide forensic science students with an appreciation of the diversity of evidence available from a crime scene, and the context in which they must operate as 'expert witnesses'. It will provide details of the nature and types of evidence, the circumstances under which it is obtained and the uses to which it will be put. Students will be exposed to case studies and then asked to provide their own assessments of 'raw' evidence and critiques of methodologies. Students will be expected to conduct their own investigation into the nature and interpretation of the evidence and its presentation in a court of law. The module will stress the impartiality which is required and give some experience of the way in which this evidence is tested in court. Students will give critical appraisals of example evidence and participate in role playing scenarios designed to give them a realistic experience of a courtroom situation. This module will also incorporate personal development planning.

Year 4: Forensic Analysis of Drugs and Poisons

Drug trafficking, use and addiction are responsible for much of the crime which occurs in our society. In this respect Forensic Scientists have an important role to play both in the determination of drugs in seizures and the analysis of drugs in body fluids. This module provides the students with a link between these two important disciplines. Many of the techniques used for quantitative analysis of street drugs and toxicological specimens are identical. In both cases the definitive results arise from mass spectrometric determination. There are however essential differences in the actual procedures which will be discussed in detail in this module. Forensic toxicology essentially combines the specialist areas of analytical chemistry and pathology. In general, a forensic toxicologist detects and identifies foreign chemicals (toxins) in the body. In order to accurately interpret toxicological findings it is essential that the toxicologist also has an understanding of the pharmacology of that substance and the pathological effects it has on the body. The main focus of street drug analysis will be on the processes used in drug identification and profiling. The materials that can be used and the processes themselves will be discussed and methodologies critically evaluated. The data generated will be discussed and the interpretation of such data critically appraised. The presentation of both toxicological and drug profiling date in court will also be reflected upon Learning resources will include the digital library and suitable websites which will be identified during the module.

Year 4: Forensic Anthropology

This module develops the student's knowledge with regard to the role of the forensic anthropologist and the application of forensic anthropology to criminal investigations.

The module covers search, recovery and identification of human remains, considering the role of the anthropologist both at the crime scene and the mortuary. The module teaches how the anthropologist works with other experts within the investigative framework and covers both domestic and international applications - from single fatality investigations through to the use of anthropology during mass fatality incidents.

Methods of archaeology and osteology and their application to forensic contexts will be taught with the emphasis on basic principles and the critical application of techniques and their selection.

A variety of resources will be available, including ARU's collection of human remains and anthropological teaching aids. Case studies and peer reviewed articles will be discussed and a variety of additional resources are available through the digital library.