University of the West of England
BRISTOL

# MODULE SPECIFICATION

| Part 1: Information | | | |
|---|---|---|---|
| Module Title | Advanced Radiation Engineering | | |
| Module Code | USSKLD-30-3 | Level | 3 |
| For implementation from | September 2017 | | |
| UWE Credit Rating | 30 | ECTS Credit Rating | 15 |
| Faculty | Health & Applied Sciences | Field | Applied Sciences |
| Department | Applied Sciences | | |
| Contributes towards | BSc (Hons) Healthcare Science (Clinical Engineering) | | |
| Module type: | Standard | | |
| Pre-requisites | USSKLB-30-2 Advanced Clinical Engineering<br>USSKLC-30-2 Applied Clinical Engineering | | |
| Excluded Combinations | N/A | | |
| Co- requisites | N/A | | |
| Module Entry requirements | Level 5 (or equivalent) biomedical engineering qualification | | |

**Part 2: Description**

This module examines the science and principles supporting Radiation Engineering. The syllabus covers:

- Ionising Radiation Physics
  - Atomic structure
  - The laws of radioactive decay
  - Mechanism of radioactive decay
  - Interaction of radiation with matter
  - Natural Sources of Radiation
- Clinical Sources of Radiation
  - Production of X-rays
  - Types of X-ray tube and design features
  - X-ray generators
  - Sealed sources
  - Unsealed radioactive materials
- Radiation Protection
  - As Low as Reasonable Achievable (ALARA)
  - Principles of dose limitation
  - Net positive benefit, dose limits
  - National and International legislation and recommendations
  - Controlled and supervised areas, classified persons
  - Roles and responsibilities of staff, including the Radiation Protection Adviser (RPA) and Radiation Protection Supervisor (RPS)

- Hospital organisation of radiological protection; radiation safety policies and local rules
- Personnel and environment dose monitoring
- Instrument calibrations
- Registration, safe custody, transport, use and disposal of radioactive sources
- Notification of radiation accidents and incidents
- Contingency plans, including radiation emergencies
- Biological and effective half life
- Record keeping
- Design considerations

- Radiobiology
  - Effects of radiation on cells and tissues
  - Cell survival concepts of tissue tolerance, fractionation, oxygenation, cell proliferation
  - Radiation hazards: early and late reactions; genetic and carcinogenic risks
- Diagnostic Radiology Techniques
  - Diagnostic Radiography
  - Fluoroscopy: over-couch and under-couch system, fluorography
  - Computer Tomography (CT)
  - Digital systems (radiography, subtraction and enhancement techniques)
  - Mobile units, dental units, dental panoramic tomography, cephalometry
  - Mammography
  - Room layouts, control cubicles, shielding
  - Primary beam, scatter, leakage
  - Image processes
  - Factors affecting patient dose
- Radiotherapy Treatment
  - Room design, shielding
  - Linear accelerators, technology applications to Treatment
    - X-ray Beam Therapy, Electron Beam Therapy, Intensity Modulated Radiotherapy (IMRT), Image Guided Radiotherapy (IGRT), Proton Therapy, Arc Therapy, Tomotherapy Hybrid Systems (combined imaging and treatment machines)
  - Superficial Therapy
  - Beam generation, energy and delivery
  - Active Source Therapy
    - Brachytherapy, Cobalt Therapy
  - Imaging Techniques
    - X-Ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine
  - Hybrid Systems
  - Treatment Planning systems and Process
- Dose distribution
- Dose measurement
- Immobilisation devices and their purpose in radiotherapy treatment or Diagnostic Radiology
- Quality assurance
  - Field quality and alignment

There will be 3 weeks of contact time at UWE in 3 x 1 week blocks. Included in each block week are laboratory workshops, lectures and tutorials. The contact time will equate to approximately 12 hours per block (a total of 36 hours).

In addition to the allocated hours on campus learning, students will engage in synchronous and asynchronous online learning. This will comprise a total of approximately 36 hours of online engagement through a combination of lectures, synchronous online tutorials, synchronous and asynchronous discussions, online quizzes, and collaborative group work.

Theoretical material within the module will be presented to the students in the form of regular lectures throughout each of the semesters in the academic year. During those times of work based learning, these lectures will be delivered online and involve a number of technological enhancements. The learning of lecture content will be reinforced through time spent in independent learning by the directed reading of recommended texts and through the use of technology enhanced learning resources that will be provided online. This online learning and engagement will be delivered through several avenues:

- Synchronous online tutorials in protected learning time where the student will contribute/attend an online activity appropriate to the content at the time at which the academic will be present online to facilitate and lead this scheduled/timetabled session. This tutorial will be themed/planned.
- Asynchronous discussions in the student's own time (or during protected time where permitted and appropriate) where they will engage/collaborate with other students on the course or in specified groups, and in which the academic is permitted to moderate where necessary, but is not expected to contribute.
- Synchronous surgery sessions timetabled for a specific time in which the academic will be available online to answer live questions via discussion boards/blogs/collaborate or to respond to questions posted/asked prior to the session.
- Interactive, online formative quizzes made available either following a particular package of knowledge exchange/learning, or in specified sessions/time periods.
- Lectures delivered online through a combination of one or more of the following: visual/audio/interactivity/personal formative assessment

A number of relevant practical sessions will be incorporated during the campus based blocks in addition to the work based learning that must be achieved under supervision by a workplace supervisor. Practical sessions will both drive hands on learning and the acquisition of technical skills at both an individual and group working level.

The remainder of the independent learning time allocated to the module should be spent preparing written assessments for submission [B1], and undertaking revision for the exams [A1, A2].

**Scheduled learning** includes lectures, seminars, tutorials, project supervision, demonstration, practical classes and workshops; fieldwork; external visits; work based learning; supervised time in studio/workshop.

**Independent learning** includes hours engaged with essential reading, case study preparation, assignment preparation and completion etc. These sessions constitute an average time per level as indicated in the table below. Scheduled sessions may vary slightly depending on the module choices you make.

## Part 3: Assessment

The Assessment Strategy has been designed to support and enhance the development of both subject-based and more general skills, whilst ensuring that the modules learning outcomes are attained, as described below.

**Component A**

The written exam will provide students with an opportunity to demonstrate both their knowledge on a broad range of topics through a series of short essay questions.

The in-class open book test will assess the students' ability to research relevant information and provide critical thinking in a variety workplace scenarios where the application of knowledge is required.

**Component B**

Component B will provide an opportunity for students to demonstrate their ability to apply the principles of their relevant area of clinical engineering to an unseen problem and/or case study and evidence their skills in approaching and interpreting it appropriately.

Formative feedback is available to students throughout the module through group discussions, and in workshops. Students are provided with formative feed-forward for their exam through a revision and exam preparation session prior to the exam and through the extensive support materials supplied through Blackboard.

All work is marked in line with the Faculty's Generic Assessment Criteria and conforms to university policies for the setting, collection, marking and return of student work. Where an individual piece of work has specific assessment criteria, this is supplied to the students when the work is set.

This assessment strategy has been designed following best practice on effective assessment from JISC (http://www.jisc.ac.uk/whatwedo/programmes/elearning/assessment/digiassess.aspx) and The Open University's Centre for Excellence in Teaching and Learning (http://www.open.ac.uk/opencetl/centre-open-learning-mathematics-science-computing-and-technology/activities-projects/e-assessment-learning-the-interactive-comp).

Technical design and deployment of the activities will also follow best practice developed at UWE by the Education Innovation Centre in collaboration with academic colleagues across the university. Staff guidance and support are already in place (http://info.uwe.ac.uk/online/Blackboard/staff/guides/summative-assessments.asp).

| | | |
|---|---|---|
| Identify final timetabled piece of assessment (component and element) | A2 | |
| **% weighting between components A and B** (Standard modules only) | **A:** **50** | **B**: **50** |
| | | |
| **First Sit** | | |
| **Component A** (controlled conditions) **Description of each element** | **Element weighting** **(as % of component)** | |
| 1. Examination (1.5 hours) | 50% | |
| 2. Open book in-class test (1.5 hours) | 50% | |
| **Component B** **Description of each element** | **Element weighting** **(as % of component)** | |
| 1. Case study integrated assignment (2000 words) | 100% | |
| **Resit (further attendance at taught classes is not required)** | | |
| **Component A** (controlled conditions) **Description of each element** | **Element weighting** **(as % of component)** | |
| 1. Examination (3 hours) | 100% | |
| **Component B** **Description of each element** | **Element weighting** **(as % of component)** | |
| 1. Case study integrated assignment (2000 words) | 100% | |

## Part 4: Teaching and Learning Methods

### Learning Outcomes

On successful completion of this module students will be able to:

- Critically evaluate the science behind and the differences between ionising and nonionising radiation [A1]
- Critically evaluate radiation protection principles, practices and protocols including safety requirements, radiation scatter and leakage [A1, B1]
- Critically evaluate the effects of different types of radiation on the human [A1, B1]
- Demonstrate an understanding of the principles that underpin the operation of radiation imaging and treatment equipment [A1, A2]
- Critically evaluate new technology and applications of existing technologies to be used in the imaging or treatment of the human body [A1, A2, B1]

### Key Information Sets Information (KIS)

**Key Information Set - Module data**

*Number of credits for this module* 30

| Hours to be allocated | Scheduled learning and teaching study hours | Independent study hours | Placement study hours | Allocated Hours |
|---|---|---|---|---|
| 300 | 72 | 228 | 0 | 300 |

### Contact Hours

The table below indicates as a percentage the total assessment of the module which constitutes a;

**Written Exam**: Unseen or open book written exam
**Coursework**: Written assignment or essay, report, dissertation, portfolio, project or in class test
**Practical Exam**: Oral Assessment and/or presentation, practical skills assessment, practical exam (i.e. an exam determining mastery of a technique)

### Total Assessment

| Total assessment of the module: | |
|---|---|
| Written exam assessment percentage | 50% |
| Coursework assessment percentage | 50% |
| Practical exam assessment percentage | 0% |
| | 100% |

### Reading List

Modernising Scientific Careers Programme Training Manual for appropriate Division and Specialist Route. Available from http://www.nshcs.hee.nhs.uk/curricula

Podgorsak, E.B. (2010) Radiation Physics for Medical Physicists (Biological and Medical Physics, Biomedical Engineering). 2nd ed. New York: Springer.

Key, T. (2014) Nuclear and Radiation Physics In Medicine: A Primer. Singapore: World Scientific Publishing Company.

Hoskin, P.J. and Goh, V. (2010) Radiotherapy in practice: imaging. Oxford: Oxford University Press.

Symonds, P., Deehan, C., Meredith, M., and Mills, J. (2012) Walter and Miller's Textbook of Radiotherapy London: Churchill Livingstone.

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| First CAP Approval Date | 23 February 2017 | | | |
| Revision CAP Approval Date | | Version | 1 | Link to MIA-10627 |