Module Specification

Practice of Radiation and Radiotherapy Physics

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Contents

Part 1: Information

Module title: Practice of Radiation and Radiotherapy Physics

Module code: USSKLQ-30-3

Level: Level 6

For implementation from: 2023-24

UWE credit rating: 30

ECTS credit rating: 15

Faculty: Faculty of Health & Applied Sciences

Department: HAS Dept of Applied Sciences

Partner institutions: None

Field: Applied Sciences

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: Not applicable

Features: Module Entry Requirements: Level 5 (or equivalent) medical physics qualification

Educational aims: This module explores advanced topics in radiation physics and nuclear medicine and contains two distinct units, namely:

Unit 1: Practice of Radiation Physics
Unit 2: Practice of Radiotherapy Physics

Students complete one of these units as prescribed by their pathway.

Unit 1 aligns to the Healthcare Science (Medical Physics) Radiation Physics pathway.
Unit 2 aligns to the Healthcare Science (Medical Physics) Radiotherapy Physics pathway.

Outline syllabus: The syllabus includes:

Practice of Radiation Physics (Radiation Physics pathway):

The overall aim of this unit is to ensure that the student has an understanding of the performance testing of a wide range of equipment, understanding the measurement of patient doses and dose optimisation and audit.

Equipment performance testing: quality assurance, calibration and dosimetry:
To include critical examination of diagnostic: X-ray tubes and generators (conventional, CT, dental, mammography), Ultrasound – diagnostic and therapeutic, MRI, Lasers, UV and ILS, Dose measurement devices, Record keeping

Patient dosimetry in diagnostic X-ray:
Factors affecting patient dose
Patient dose measurements
Patient dose surveys
Diagnostic reference levels
Optimisation and image quality

Patient doses in UV therapy:
Factors affecting patient dose
Patient dose measurements
Patient dose surveys

Room design:
Shielding calculations
Design features
Engineering controls

Survey procedures:
Measurements of machines, barriers, including appropriate choice of measuring device: diagnostic X-ray departments, dental X-ray rooms and clinics, wards, operating theatres, etc., radiotherapy rooms, brachytherapy, nuclear medicine, lasers, UV and ILS

Procedures for dealing with emergency situations:
Procedure for radioactive patients leaving hospital: patient dose rate, removal of temporary implants, information card with travel dates, work dates, and personal contact dates
Death of radioactive patients: removal of implants, informing pathologists, etc., of precautions for postmortems, dose levels for embalming, burial and cremation

Practice of Radiotherapy Physics (Radiotherapy Physics pathway):
The overall aim of this unit is to ensure that the student understands the basis of radiotherapy equipment, dose measurement, calibration and QA, and how they affect patient treatment. The student should also have an appreciation of accidents in radiotherapy and the processes in place to mitigate risk.

External beam radiation treatment equipment:
Construction and principles of operation of very low energy, low energy, medium energy X-ray equipment
Linear accelerator
Photon beam generation
Electron beam generation
Cobalt teletherapy and gamma knife
Tomotherapy

Stereotactic equipment for stereotactic ablative radiotherapy (SABR) and stereotactic radiosurgery (SRS)
Proton therapy equipment
Operation and controls of treatment equipment
Imaging equipment (see MPRP(i) and MP(iii))

Dose distribution:
Central axis depth dose, tissue maximum ratio, tissue phantom ratio (TPR)
Irregular fields – equivalent square – sector integration
Off-axis dose – dose in shielded regions – scatter, primary beam hardening
Isodose curves
Beam quality, source size, source surface distance, source collimator distance, beam flatness, flattening filters, field size, penumbra, oblique incidence, tissue heterogeneity
Large field treatment techniques, e.g. total body irradiation (TBI) and total skin electron irradiation (TSEI)
Effect of change in radiation beam energy

Dose measurement:
Kerma and absorbed dose
Selection of appropriate dosimeter
Absolute dose measurement
Relative dose measurement
Beam data acquisition
Small field dosimetry
Patient dosimetry – diodes, thermoluminescent dosimeters (TLD), electronic portal imaging devices
Electron dosimetry
Phantoms

Electron beams:
Depth dose characteristics
Isodose curve characteristics
Oblique incidence

Beam shaping

Superficial and Orthovoltage Radiotherapy (SXT and DXT) dosimetry:

Back scatter factors

Lead cut-outs

Applicators

Eyeshields (internal and external)

Proton dosimetry:

Bragg peak

Stopping power

Moderators

Radiation protection:

Structural shielding (SXT/CT, Linacs, brachytherapy rooms, protons)

Measures for reducing radiation dose to staff during brachytherapy

Source handling and storage

Procedures for radioactive patients leaving hospital

Death of radioactive patients – removal of implants: informing pathologists, etc., of precautions for postmortems, dose levels for embalming, burial and cremation

Quality control and quality assurance:

Example accidents in radiotherapy

Guidance for avoidance of accidents in radiotherapy

Reporting accidents in radiotherapy

QC of external beam radiotherapy equipment

QC of CT simulator

QC of CT and MRI

QC for brachytherapy equipment and systems

QC for treatment planning systems

Treatment plan and radiotherapy prescription calculation checks

QC of dosimetry systems

Part 3: Teaching and learning methods

Teaching and learning methods: 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. These tutorials 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 for assessments (A2, B1), and undertaking revision for the open book exam (A1).

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.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Critically evaluate the principles and methods of performance testing of a range of diagnostic X-ray and nonionizing equipment and their role in ensuring patient and staff safety (Practice of Radiation Physics: Radiation Physics pathway)

MO2 Describe dosimetric methods and critically analyse dose reduction options and the risk benefit to patients (Practice of Radiation Physics: Radiation Physics pathway)

MO3 Critically appraise room design and shielding calculations (Practice of Radiation Physics: Radiation Physics pathway)

MO4 Critically evaluate the principles and methods of radiation surveys, and evaluate methods and options for improvement and dealing with radiation incidents and emergencies (Practice of Radiation Physics: Radiation Physics pathway)

MO5 Critically evaluate the principles supporting the selection of appropriate radiation for equipment testing and dosimetry measurements, including calibration and type testing (Practice of Radiation Physics: Radiation Physics pathway)

MO6 Critically evaluate treatment planning, radiation dose measurement and calculation in radiotherapy, applying skills of analysis and judgement (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

MO7 Critically evaluate radiotherapy equipment and associated QC procedures and systems (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

MO8 Discuss the requirements relating to the application of medical imaging to radiotherapy and appraise the choice of imaging technique (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

MO9 Critically appraise the principles relating to the calculation of dose distributions within patients (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

MO10 Compare and contrast radiotherapy equipment, the beams produced, their characteristics and how they are analysed (Practice of Radiotherapy Physics (Radiotherapy Physics pathway)

MO11 Explain the principles of radiation protection in radiotherapy (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

MO12 Specify the principles supporting the selection of a medical device that will ensure it is fit for purpose, including the ability to develop and evaluate basic specifications to meet user and service requirements (Practice of Radiotherapy Physics: Radiotherapy Physics pathway)

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Total = 300

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/index.html

Part 4: Assessment

Assessment strategy: 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.

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

The 20 minute presentation (with supporting evidence) will be an opportunity for the student to evaluate how theoretical knowledge supports the relevant medical physics field in the clinical environment.

Assessment task B:
Assessment task B will provide an opportunity for students to demonstrate their ability to apply the principles of their relevant area of medical physics 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.

Technical design and deployment of the activities will also follow best practice developed at UWE by the Academic Practice Directorate in collaboration with academic colleagues across the university. Staff guidance and support are already in place.

All students will be issued with the same in-class test (A1), integrated assignment (B1) and presentation brief (A2), where they will address the sections specific to their unit, i.e. Unit 1: Practice of Radiation Physics and Unit 2: Practice of Radiotherapy Physics.

Assessment tasks:

Case Study (First Sit)
Description: Case study integrated assignment (1500 words)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO10, MO3, MO6, MO8

Presentation (First Sit)

Description: 20 minute presentation with supporting evidence

Weighting: 25 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO11, MO4, MO8

In-class test (First Sit)

Description: Open book in-class test (1.5 hours)

Weighting: 25 %

Final assessment: Yes

Group work: No

Learning outcomes tested: MO12, MO2, MO5, MO6, MO7, MO9

Case Study (Resit)

Description: Case study integrated assignment (1500 words)

Weighting: 50 %

Final assessment: No

Group work: No

Learning outcomes tested: MO10, MO3, MO6, MO8

Presentation (Resit)

Description: 20 minute presentation with supporting evidence

Weighting: 25 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO11, MO4, MO8

In-class test (Resit)

Description: Open book in-class test (1.5 hours)

Weighting: 25 %

Final assessment: Yes

Group work: No

Learning outcomes tested: MO12, MO2, MO5, MO6, MO7, MO9

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Healthcare Science (Radiotherapy Physics) {Apprenticeship-UWE} [Sep][FT][Frenchay][3yrs] BSc (Hons) 2021-22

Healthcare Science (Radiation Physics) {Apprenticeship-UWE} [Sep][FT][Frenchay][3yrs] BSc (Hons) 2021-22