MODULE SPECIFICATION

Part 1: Information			
Module Title	Applied Radiotherapy Physics and Nuclear Medicine		
Module Code	USSKLP-30-3	Level	3
For implementation from	September 2018		
UWE Credit Rating	30	ECTS Credit Rating	15
Faculty	Health and Applied Sciences	Field	Applied Sciences
Department	Department of Applied Sciences		
Contributes towards	BSc (Hons) Healthcare Science (Medical Physics)		
Module type:	Standard		
Pre-requisites	None		
Excluded Combinations	None		
Co- requisites	None		
Module Entry requirements	Level 5 (or equivalent) medical physics qualification		

Part 2: Description

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

- Unit 1: Cancer, Radiobiology and Clinical Radiotherapy Physics
- Unit 2: Clinical Indication, Pathology and Patient Care

Students complete one of these units as prescribed by their pathway. Unit 1 aligns to the Healthcare Science (Medical Physics) Radiotherapy Physics pathway. Unit 2 aligns to the Healthcare Science (Medical Physics) Nuclear Medicine pathway.

The syllabus covers:

1. Cancer, Radiobiology and Clinical Radiotherapy Physics [Radiotherapy Physics pathway]

The overall aim of this unit is to ensure that the student has an understanding of the treatment planning process and the physics that underpins it, and appreciates its place within the clinical context of radiotherapy. All of the below should be considered for photon and charged particle therapy. Intensity-modulated radiotherapy (IMRT) should be considered to include both fixed beam and dynamic arc therapy.

Clinical evaluation including application of medical imaging to radiotherapy

- Referral pathways, including national pathway guidelines
- Clinical evaluation – pathology, staging, investigations
- Therapy options, including new technologies

- Aim of radiotherapy – radical, adjuvant, palliation
- Follow-up
- Imaging, including the choice and appraisal of different techniques: multiplanar sectional anatomy from CT and MRI, functional imaging –PET and SPECT

Radiobiology related to radiotherapy

- Linear energy transfer and radiobiological effect: Cell survival curves – shape, cell kill, chromosomes and cell division, Dose response relationship, Radiosensitivity, Tumour systems, Dose – time relationship, Radiation pathology – acute and late effects, Radiation carcinogenesis, Radiobiological models – linear quadratic, Biological effective dose

Tumour pathology

- Anatomy, pathology, lymphatic drainage and associated critical structures: head and neck, central nervous system, pituitary, thorax, breast, abdomen, pelvis
- Hodgkin's disease
- Leukaemia
- Extremities
- Metastases

Treatment planning considerations

- Prescribed dose
- Target delineation
- Treatment techniques (site specific)
- Typical tissue heterogeneities
- Beam weighting
- Guidelines for field arrangement
- Field matching
- Energy

Positioning and immobilisation

- Back pointers
- Patient positioning equipment
- Patient care in the mould room
- Immobilisation (site specific)
- Motion management, e.g. deep inspiration breath hold (DIBH), gating
- Dosimetric effects of equipment

Localisation

- CT localisation: inhomogeneities, surface contours and organs at risk
- Use of other imaging and image fusion (MRI, PET-CT)
- Data transfer

Dose planning and display

- Treatment planning algorithms, including pencil beam, collapsed cone and Monte Carlo
- International Commission on Radiological Units & Measurements (ICRU) recommendations
- Planning target volume – margins
- Computer planning: 3-dimensional and 4-dimensional plans, beam's eye view
- Plan evaluation: isodose distributions, dose volume histograms
- Conformal planning
- Optimisation, including inverse planning techniques and IMRT
- Forward planned segmented field techniques

Beam modification

- Collimation – beam matching
- Beam shaping and shielding
- Bolus and compensators
- Wedges: mechanical, dynamic, virtual

Dose calculations

- Dose distribution computation
- Organs at risk (critical organs and dose constraints
- Dose prescription
- Phantom scatter factors: back scatter factor, peak scatter factor
- Head scatter
- Radiation output
- Computation of treatment time/set dose
- Effect of inhomogeneities

Verification

- Positional accuracy and tolerances
- Dosimetric accuracy – patient dose monitoring
- Record and verify systems
- Image guided radiotherapy (IGRT)
- Adaptive radiotherapy

Brachytherapy preparation and planning for temporary and permanent implants

- Key clinical applications
- Guidance and recommendations
- Sources – nuclide, structure, identification
- After-loading equipment
- Calculation algorithms
- Units of measurement
- Source calibration
- Calculation of dose distributions

2. Clinical Indication, Pathology and Patient Care [Nuclear Medicine pathway]

The overall aim of this unit is to ensure that the student has the underpinning knowledge to allow them to carry out a range of nuclear medicine investigations. All of the content in this unit should consider both adult and paediatric applications.

- Review, with reference to the planning and interpretation of radionuclide tests and therapy: anatomy and physiology, immunology, infection (acute, chronic, pus, abscess, differential diagnosis between abscess, cyst and tumour), neoplastic disease (tumours, primary and secondary (metastases), benign and malignant tumours, assessing the extent of malignant involvement)
- Review of radiobiological effects of ionising radiation
- Radiopharmaceuticals used in nuclear medicine: the design and operation of the radiopharmacy, Good Manufacturing Practice, the types of preparation, sterilisation techniques, maintaining and monitoring the pharmaceutical environment, waste disposal
- Radiochemistry and QC: the chemistry of commonly used radionuclides, radiochemical techniques, production of radiopharmaceuticals, labelling of blood products, selection of appropriate radiopharmaceutical
- Techniques requiring the assay of radioactive samples in vitro non-imaging

The clinical application of nuclear medicine
Assessment of appropriateness of commonly requested tests or procedures, for all the body systems listed below, which should include an understanding of:

- The radiopharmaceutical used, activity administered and route of administration, half-life, energy,
- The preparation of the patient
- The views and samples that must be obtained, dynamic protocols, static protocols, SPECT, SPECT-CT, PET-CT, PETMR: the use of any special data handling techniques or display mode, any special features of the study, possible artefacts, setting up the equipment – energy windows, collimation, etc., the clinical context in which radionuclide tests may be of value and the influence of the test results on patient management, the radiation dose to the patient and the risks and benefits of the particular radionuclide test to a particular patient, new developments in nuclear medicine, and the changing role of nuclear medicine in the diagnosis and treatment of disease and the relevant imaging modalities used in reaching a diagnosis

All the above should be applied to the following body systems: Skeletal system, Central nervous system, Endocrine system, Cardiovascular system, Respiratory system, Urinary system, Gastrointestinal system, Hemopoietic and lymphatic system, Reproductive system, Oncological applications, Infection and inflammatory imaging

Therapeutic applications of radionuclides in nuclear medicine

- Dosimetry in molecular radiotherapy
- Radionuclide therapy in thyroid carcinoma
- Radionuclide therapy in benign thyroid disease
- Radionuclide therapy in neuroendocrine tumours
- Radionuclide therapy in hepatocellular carcinoma
- Radioimmunotherapy in lymphoma and other blood disorders

- Radionuclide therapy of refractory metastatic bone pain
- Radiosynovectomy
- Future developments in therapeutic nuclear medicine applications
- Nursing implications for patients undergoing radionuclide metabolic therapy

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 [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: Strategy and Details

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 their knowledge on a broad range of topics through a series of short essay questions (and will be embedded in the second block release).

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 (and will be embedded

in the third block release).

The resit element of Component A will cover both the written exam and in-class open book test components.

Component B

Component 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 (http://info.uwe.ac.uk/online/Blackboard/staff/guides/summative-assessments.asp).

All students will be issued with the same exam paper [A1], integrated assignment [B1] & in-class test [A2], where they will complete the sections specific to their unit, i.e. Unit 1: Cancer, Radiobiology and Clinical Radiotherapy Physics or Unit 2: Clinical Indication, Pathology and Patient Care.

Identify final timetabled piece of assessment (component and element)	Component A2

% weighting between components A and B (Standard modules only)	**A:**	**B:**
	50%	**50%**

First Sit	
Component A (controlled conditions) **Description of each element**	**Element weighting** **(as % of component)**
1. Examination (1 hour)	50%
2. Open book in-class test (1 hour)	50%
Component B **Description of each element**	**Element weighting** **(as % of component)**
1. Case study integrated assignment (1500 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 (2 hours)	100%
Component B **Description of each element**	**Element weighting** **(as % of component)**
1. Case study integrated assignment (1500 words)	100%

Part 4: Learning Outcomes & KIS Data	
Learning Outcomes	On successful completion of this module students will be able to fulfil the learning outcomes from 1 of the following 2 Medical Physics themed units of study: • Unit 1: Cancer, Radiobiology and Clinical Radiotherapy Physics • Unit 2: Clinical Indication, Pathology and Patient Care Unit 1 aligns to the Healthcare Science (Medical Physics) Radiotherapy Physics pathway. Unit 2 aligns to the Healthcare Science (Medical Physics) Nuclear Medicine pathway. **1. Cancer, Radiobiology and Clinical Radiotherapy Physics [Radiotherapy Physics pathway]** • Critically evaluate the role of radiotherapy in the cancer pathway and critically review tumour pathology of some common tumour sites [B1] • Describe and critically evaluate the principles of radiobiology applied to external beam radiotherapy [A1] • Compare and contrast the range of treatment planning techniques available, and critically appraise the choice of physical parameters required when preparing treatment plans [B1] • Discuss the requirements relating to patient care in the mould room and specify and appraise factors, principles and constraints that affect treatment regimens and treatment planning [A1] • Explain target volumes as defined in current national and international standards [A2] • Define dose prescriptions and reporting as per current national and international standards [A2] **2. Clinical Indication, Pathology and Patient Care [Nuclear Medicine pathway]** • Explain the anatomy and physiology relating to the practice of nuclear medicine [A1] • Critically discuss the problems associated with the care of patients undergoing nuclear medicine investigations or treatments [B1] • Explain and critically evaluate the procedures, radiation protection and legislative issues surrounding the administration of radioactive materials with adult and paediatric patients [A1] • Appraise a range of radiopharmacy techniques, including generators, isotope properties and blood labelling techniques [A1] • Describe and critically analyse the role of nuclear medicine in the diagnosis of disease, with reference to a range of different body systems [A2] • Discuss and evaluate radiopharmaceuticals in terms of radionuclide chemistry, biological behaviour and factors affecting product quality [A2] • Critically review and evaluate applications of nuclear medicine in terms of diagnosis and therapy for a range of body systems with due reference to patient care needs [A2, B1]
Key Information Sets Information (KIS)	

Contact Hours

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

Total Assessment

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

Reading List

The module reading list can be accessed through the following link:

https://uwe.rl.talis.com/lists/85B8BE86-6DE1-E72A-3685-C7066F203EB4.html

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First UVP Approval Date	20 March 2018			
Revision Approval Date *Update this row each time a change goes to CAP*		Version	*1*	*Link to CAR ID 4581*