Module Specification

Applied Renal and Medical Engineering

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Contents

Part 1: Information

Module title: Applied Renal and Medical Engineering

Module code: USSKLH-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: Advanced Clinical Engineering 2023-24, Applied Clinical Engineering 2023-24

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module explores the clinical environment and contains two distinct units, namely:

Unit 1: Applied Renal Technology
Unit 2: Applied Medical Engineering

Students complete one of these units as prescribed by their pathway. Unit 1 aligns to the Healthcare Science (Clinical Engineering) Renal Technology pathway. Unit 2 aligns to the Healthcare Science (Clinical Engineering) Medical Engineering pathway.

Features: Module Entry requirements: Students must have a level 5 (or equivalent) biomedical engineering qualification

Educational aims: On successful completion of this module students will be able to fulfil the learning outcomes from 1 of the following 2 Clinical Engineering themed units of study:

Unit 1: Applied Renal Technology

Unit 2: Applied Medical Engineering

Unit 1 aligns to the Healthcare Science (Clinical Engineering) Renal Technology pathway.
Unit 2 aligns to the Healthcare Science (Clinical Engineering) Medical Engineering pathway.

Generic Graduate Skill: Communication
Evidenced

Generic Graduate Skill: Professionalism
Evidenced

Generic Graduate Skill: Critical Thinking
Evidenced

Generic Graduate Skill: Digital Fluency
Evidenced

Generic Graduate Skill: Innovative and Enterprising
Practiced

Generic Graduate Skill: Forward Looking
Practiced

Generic Graduate Skill: Emotional Intelligence
Practiced

Generic Graduate Skill: Globally Engaged
Practiced

Outline syllabus: The syllabus covers:

Applied Renal Technology (Renal Technology pathway):

Water Treatment and Quality, Biochemistry Microbiology and Virology at the point of Dialysis:
Hospital dialysis unit, satellite unit, home

Alternative Therapies and Modalities

Daily dialysis including short hour and long hour regimes

Peritoneal dialysis

Haemofiltration (HF):
History, configuration of blood and substitution fluid circuits, differences from Heamodialysis, bag and on-line systems with pre- and post dilution, Gibbs-Donnan effects, impact on sodium balance, fluid balance controlling systems, heating systems for substitution fluids, requirements on microbiological quality of the substitution fluid, efficiency assessment (mathematical description included)

Haemodiafiltration (HDF):
Configuration of blood and dialysate circuits, differences from Haemofiltration, bag and on-line systems with pre- and post dilution, fluid balance controlling systems,

requirements on microbiological quality of the substitution fluid
Efficiency assessment (mathematical description included), special
Haemodiafiltration techniques; paired filtration dialysis (PFD), Acetate free biofiltration (AFB), push-pull Haemodiafiltration

Haemoperfusion:
Principles, scope of use, differences in sorbent materials, efficacy, anticoagulation, combined haemodialysis/haemoperfusion

Plasma exchange

Transplantation

Diet

Apheresis, plasmafiltration, cascade plasmafiltration:
Principles, scope of use, differences in membrane materials, efficacy, heparinisation, specific requirements on plasmafiltration technology (such as accuracy of fluid balance system)

Peritoneal dialysis (PD)

On-line therapies and associated technologies:
Continuous blood volume monitoring including automated ultrafiltration (UF) control
Temperature and thermal balance monitoring and control
Ionic dialysance
Electrolyte balance
Urea concentration and dialysis dose monitoring
Basic physiology of peritoneal transport
Peritoneal dialysis clearance and schedules – intermittent peritoneal dialysis (IPD), continuous ambulatory peritoneal dialysis (CAPD), nightly peritoneal dialysis (NPD), tidal peritoneal dialysis (TPD)
Peritoneal dialysis cyclers – flow diagram, construction, monitoring and safety systems

Risks associated with renal replacement therapy to both patients and staff:
Contaminants, blood borne viruses, equipment /resource failure

Risks associated with medical devices in the renal replacement therapy setting:
Installation
Environment including physical risks, services (electricity, water)
Safety testing
Functional testing
Interference
Sources of artefacts
Systems
Additional equipment

Use of failsafe devices and alarms

Psychological and social implications of Renal Replacement Therapy:
Pre dialysis clinic and preparation for treatment
Transplantation and transplant failure
Communication skills to facilitate clinical investigations
Interpersonal and listening skills
Clinical history recording
Communication methodology using written and oral techniques

Psychosocial aspects of disease:
Altered status awareness
Substance abuse
Transmissible diseases
Chronic illness
Links between lifestyle and health and disease
Stress and disease
Cognitive behaviour therapy
Coping mechanisms
Stress management

Relaxation techniques
Disability awareness

Health promotion awareness and strategies for delivery to clients

Applied Medical Engineering (Medical Engineering pathway):

Understand the clinical use of a range of medical devices and the common faults or problems that may be experienced

Typical clinical uses may be for example:
Pressure measurement: Invasive, Non Invasive
Temperature Measurement
Monitoring or recording of Physiological signals which are electrical in origin
Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG):
Respiratory measurements
Pulse Oximetry
Electrosurgery
Infusion procedures
Gas analysis and monitoring
Endoscopic procedures
Physiotherapy treatments
Life support procedures

Defibrillators, ventilators, Anaesthetic equipment

Safety controls and systems associated with the device operation

Typical set up procedures including, limits and alarms, and how they may affect the practical operation of the equipment

Installation, maintenance, repair, testing, calibration and environmental issues encountered with equipment in a range of clinical environments, including knowledge of the electrical infrastructure, the requirement of uninterruptable power supplies and

possible sources of interference and interaction between devices. Example of the type of clinical areas that may be considered:
Accident and Emergency
Wards
Clinics
Operating Theatres
Magnetic Resonance Imaging (MRI) suite
Intensive care unit
Paediatric environments
Maternity
Polyclinics
General Practice (GP) surgeries
Outreach clinics

Safety testing of portable medical devices, complex medical devices and systems

Safety testing fixed installations of complex medical devices and systems

Principles of wireless technologies applied to clinical engineering applications

Technical implications and challenges associated with equipment being brought into the clinical environment

Sources of interference/artefacts

Quality systems applied to clinical engineering:
Documentation, Audit, Information storage and retrieval

Interactions between equipment in the clinical environment

Practical application of networking, wireless and other technologies

Working with third parties service providers:
Contractual agreements, Monitoring, Auditing

Practical Risks associated with medical devices in clinical settings:
Installation
Environment including physical risks, services (for example, electricity, gases)
Safety testing
Functional testing
Interference
Sources of artefacts
Systems
Additional equipment

Training and competence: User, Technical and Functional

Practical application of Legislation and Guidance and other information including Controls Assurance 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. 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 for assessments, and undertaking revision for the exams.

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. These sessions constitute an average time per level. 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 Applied Renal Technology (Renal Technology pathway): Critically evaluate the implications of providing renal replacement therapy in different settings

MO2 Applied Renal Technology (Renal Technology pathway): Critically analyse the purpose and types of safety and functional tests performed in the renal replacement therapy treatment and discuss the suitability of the procedures used for both individual devices and systems

MO3 Applied Renal Technology (Renal Technology pathway): Critically discuss different the various renal replacement techniques available and the advantages and disadvantages of each therapy, including outlining the advantages and disadvantages of peritoneal dialysis as compared to haemodialysis

MO4 Applied Renal Technology (Renal Technology pathway): Critically evaluate the testing procedures used in order to monitor water quality

MO5 Applied Renal Technology (Renal Technology pathway): Critically discuss the psychological and social implications of renal replacement therapy

MO6 Applied Renal Technology (Renal Technology pathway): Understand the empathy and sensitivity needed when dealing with the patient experience of long-term conditions and terminal illness

MO7 Applied Medical Engineering (Medical Engineering pathway): Critically analyse the purpose and types of safety and functional tests performed in a

range of clinical environments including potential risks to patients' visitors and staff from the use and misuse of medical devices

MO8 Applied Medical Engineering (Medical Engineering pathway): Critically evaluate the causes of interference and artefacts associated with medical devices

MO9 Applied Medical Engineering (Medical Engineering pathway): Demonstrate a practical knowledge and understanding of the various standards and guidelines applicable to the clinical environment

MO10 Applied Medical Engineering (Medical Engineering pathway): Critically evaluate the different types of technologies that may be used to enable the delivery of modern healthcare and technical services; for example, Wireless, networking, telephony

MO11 Applied Medical Engineering (Medical Engineering pathway): Understand how to work within a quality management system and the need to keep accurate records

MO12 Applied Medical Engineering (Medical Engineering pathway): Apply risk management principles to medical devices and their management

MO13 Applied Medical Engineering (Medical Engineering pathway): Understand the empathy and sensitivity needed when dealing with the patient experience of long-term conditions and terminal illness

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/modules/ussklh-30-3.html

Part 4: Assessment

Assessment strategy: Assessment 1: Case Study
The 2000 word case study will be an opportunity for the student to demonstrate application of learning from the module to the workplace context.

Assessment 2: Presentation
The 15 minute presentation (with 5 minute questions) will be an opportunity for the apprentice to evaluate how theoretical knowledge supports the relevant engineering field in the clinical environment.

Assessment tasks:

Case Study (First Sit)
Description: 2000 word case study
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO10, MO13, MO5, MO6, MO7

Presentation (First Sit)
Description: 15 minute presentation with 5 minutes of questions
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO10, MO11, MO12, MO13, MO2, MO3, MO4, MO5, MO6, MO7, MO8, MO9

Case Study (Resit)
Description: 2000 word case study
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO10, MO13, MO5, MO6, MO7

Presentation (Resit)

Description: 15 minute presentation with 5 minutes of questions

Weighting: 50 %

Final assessment: Yes

Group work: No

Learning outcomes tested: MO1, MO10, MO11, MO12, MO13, MO2, MO3, MO4, MO5, MO6, MO7, MO8, MO9

Part 5: Contributes towards

This module contributes towards the following programmes of study:

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

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

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