University of the West of England
BRISTOL

MODULE SPECIFICATION

Part 1: Information			
Module Title	Applied Renal & Medical Engineering		
Module Code	USSKLH-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 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 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.

The syllabus covers:

1. 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

2. 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 (e.g. 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

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 [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

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

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. 20 minute presentation with supporting evidence	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. 20 minute presentation with supporting evidence	100%

Part 4: Teaching and Learning Methods

Learning Outcomes

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.

1. Applied Renal Technology [Renal Technology pathway]

- Critically evaluate the implications of providing renal replacement therapy in different settings [A1, B1]
- 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 [A1]
- 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 [A1]
- Critically evaluate the testing procedures used in order to monitor water quality [A2]
- Critically discuss the psychological and social implications of renal replacement therapy [A2, B1]
- Understand the empathy and sensitivity needed when dealing with the patient experience of long-term conditions and terminal illness [A2, B1]

2. 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 [A1, B1]
- Critically evaluate the causes of interference and artefacts associated with medical devices [A1
- Demonstrate a practical knowledge and understanding of the various standards and guidelines applicable to the clinical environment [A1
- Critically evaluate the different types of technologies that may be used to enable the delivery of modern healthcare and technical services; e.g. Wireless, networking, telephony [A1, B1]
- Understand how to work within a quality management system and the need to keep accurate records [A2]
- Apply risk management principles to medical devices and their management [A2]
- Understand the empathy and sensitivity needed when dealing with the patient experience of long-term conditions and terminal illness [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

<table>
<tr><td>Contact Hours

Total Assessment</td><td>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)

<table><tr><td colspan="4">Total assessment of the module:</td><td></td></tr><tr><td colspan="4"></td><td></td></tr><tr><td colspan="4">Written exam assessment percentage</td><td>50%</td></tr><tr><td colspan="4">Coursework assessment percentage</td><td>0%</td></tr><tr><td colspan="4">Practical exam assessment percentage</td><td>50%</td></tr><tr><td colspan="4"></td><td>100%</td></tr></table></td></tr>
<tr><td>Reading List</td><td>Modernising Scientific Careers Programme Training Manual for appropriate Division and Specialist Route. Available from http://www.nshcs.hee.nhs.uk/curricula

Applied Renal Technology

James, R. (2013) Foundations in renal technology. Tolworth: Grosvenor House Publishing.

Hansel, D.E., Kane, C.J., Paner, G.P. and Chang, S.S. (2016) The Kidney: A Comprehensive Guide to Pathologic Diagnosis and Management. New York: Springer.

Applied Medical Engineering

Guidance for healthcare and social services organisations on managing medical devices in practice. Available from: https://www.gov.uk/government/publications/managing-medical-devices

Brown, B.H., Smallwood, R.H., Barber, D.C., Lawford, P.V. and Hose, D.R. (1999) Medical physics and biomedical engineering. St Louis: Turtleback Books.

Enderle, J.D. and Bronzino, J.D. (2011) Introduction to Biomedical Engineering. 3rd ed. Cambridge: Academic Press.

Webster, J.G. (2009) Medical Instrumentation Application and Design. 4th ed. Chichester: Wiley.</td></tr>
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First CAP Approval Date	23 February 2017			
Revision CAP Approval Date		Version	1	Link to MIA-10627