Module Specification

Biomedical Engineering Systems

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Contents

Part 1: Information

Module title: Biomedical Engineering Systems

Module code: USSYQG-60-2

Level: Level 5

For implementation from: 2025-26

UWE credit rating: 60

ECTS credit rating: 30

College: College of Health, Science & Society

School: CHSS School of Applied Sciences

Partner institutions: None

Field: Applied Sciences

Module type: Module

Pre-requisites: Foundations of Engineering Science 2024-25, Life Science for Clinical Engineering 2024-25

Excluded combinations: None

Co-requisites: None

Continuing professional development: Yes

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module of learning is a consolidation of engineering, life science and regulatory systems that underpin and govern the deployment of a range of biomedical systems within Clinical Engineering settings.

Pre-requisites: Students must have passed USSJRN-45-1 Foundations of

Engineering Science and USSJS3-45-1 Life Science for Clinical Engineering before starting this module.

Features: Not applicable

Educational aims: This overall aim of the module is to ensure that the trainees are aware of the systems (equipment, regulatory and management) that are common in Clinical Engineering including:

-The theory of operation and clinical application of a range of Biomedical Measurement and Therapy devices.
-The Life Cycle, Regulation & Quality Systems relating to Biomedical Engineering.
-System Innovation, Development & Validation in a Biomedical setting.
-The principles and knowledge required to analyse the performance of a range of Biomedical Engineering Systems.

The module consolidates the Knowledge, Skills and Behaviours (KSB) required in Engineering with Life Science disciplines and it will prepare the trainees for their transition to their specialist training.

Outline syllabus: The indicative syllabus of the module is as follows:

Biomedical Measurement & Therapy
-The origin, nature, transmission and characteristics of Physiological Signals covering biomechanical, bipotential, bioelectric, optical and radiological applications
-Biomechanical & Electrophysiological Analysis & Models.
-Basic principles and technology employed in a range of commonly used transducers

Biomedical Device Innovation & Development
-The Project Brief & Technical File including guidelines, regulations and legislation.
-Specification development including user, environment and technical.
-Safety Requirements for Programmable Medical Electrical Systems.
-Risk Management and requirements for device development, modification or using equipment in a way not specified by the Original Equipment Manufacturer.
-Evaluation of the design and material properties of component parts and the concept of choosing an appropriate solution for a design application taking into

consideration chemical, electrical, mechanical, and biocompatibility properties.
-Design evaluation and testing including Validation, Verification, Quality Assurance and Control
-Medical Equipment Embodiment Documentation requirements and methods.

Biomedical Device Life Cycle & Quality Systems
-Quality systems & record keeping across the equipment life cycle.
-Hazards and risk mitigation strategies in the patient environment including safety testing and user training.
-Procurement processes Pre-purchase assessments for medical devices
-Inservice management of biomedical systems including Acceptance, Reliability, Planned Preventative Maintenance and Repair.
-The control of infection, decontamination, sterilisation and biocompatibility for biomedical engineering systems.
-The correct processes for Decommissioning and Disposal of medical devices including meeting information governance requirements.
-Incident investigation/reports through evaluation of factual evidence

Biomedical System Analysis
-Appropriate mathematical methods that can be used to analyze device performance, circuit behavior and electrical signals.
-The methods, principle of operation and limitations in displaying results.
-Operational Amplifiers and Advanced Analogue Circuit Elements
-Digital and Logic Electronics.
-Microprocessor and Microcontroller System Architecture and integration.
-Systematic methodology that can be applied to analyze the performance of analogue circuits, digital circuits, microprocessor and network enabled systems.
-Electromagnetic interference (EMI) and the effect it can have in a clinical environment.

Part 3: Teaching and learning methods

Teaching and learning methods: This module will be delivered via a blended approach of on-campus practical and skills development activities held during block release weeks, and online lectures, seminars and tutorials, held throughout the academic year. This will be backed up by the apprentices carrying out guided self-study.

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.

Interactive, online formative quizzes made available either following a particular package of knowledge exchange/learning, or in specified sessions/time periods.

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 individual and group working level.

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

MO1 Demonstrate an understanding of the scientific principles that underpin biomedical measurement and therapy systems including biomechanical, bipotential, bioelectric, optical and radiological applications.

MO2 Discuss the importance, and apply the processes to the control of infection, decontamination, sterilisation and biocompatibility for biomedical engineering systems .

MO3 Discuss how each stage of the medical equipment life cycle from design and development through to decommissioning and disposal is implemented in

healthcare; explaining the role of regulations, standards and Quality management systems have and the impact if not followed correctly.

MO4 Critically evaluate a medical device specification that meets clinical requirements whilst adhering to the relevant standards and legislation, review the existing product available, draw conclusions about suitability and be able to develop a design proposal that addresses any shortcomings.

MO5 Explain and apply the systematic engineering methodologies used to develop and implement innovative technical solutions to clinical problems. This should include the the general requirements for mechanical, electrical, radiological and information governance safety, incorporating discrete, computer-based and network-capable devices.

MO6 Apply and critically evaluate the systematic and logical methodology, to test, calibrate, quality assure and maintain, a wide range of Biomedical Engineering Systems commonly used in healthcare and during their development.

Hours to be allocated: 600

Contact hours:

Independent study/self-guided study = 200 hours

Face-to-face learning = 80 hours

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/ussyqg-60-2.html

Part 4: Assessment

Assessment strategy: Assessment 1: Written Assignment (2500 words)
This assessment enables the apprentices to demonstrate their knowledge of how biomedical measurement and therapy equipment function and for them to critically analyse the operation and innovations of these systems in order to optimise performance in clinical application.

Early in the module the cohort will complete a common example formative exercise, and feedback will be given by peers and academic staff. During the delivery of the module, the trainees will be asked to complete and submit an individual formative exercise which will be complemented by the evaluation and discussion of a series of case studies from the respective disciplines. The formative advice can then be fed forward into the summative assessment which will be delivered in controlled conditions in order to mitigate variations in apprentices work place arrangements.

Assessment 2: Portfolio (3000 words maximum)
A portfolio of clinical evidence collected from the workplace throughout the academic year, as required by the National School of Healthcare Science, to demonstrate attainment of professional competence.

Formal work place assessment and feedback is delivered through Direct Observation of Practical Skills(DOPS)and Case Based Discussions (CbD) which they will already be familiar. For level 5 apprentices will also need to complete an Observed Communication/Clinical Events (OCE)which will require them to interact with patient or other clinicians.

All of the DOPS, OCE and CbD will need to be completed to pass the module. Some of these activities will be set and graded by the module teaching team, this is to ensure parity across different work places. The record of each activity (DOPS, OCE or CbD) will not exceed 1500 words up to a cumulative total of 3000 words.

Assessment tasks:

Written Assignment (First Sit)
Description: Critical evaluation or analysis of scientific literature, specified biomedical engineering systems or a pre-configured datasets. (2500 words)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO4, MO5, MO6

Portfolio (First Sit)
Description: Portfolio of evidence collated from the workplace.
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO2, MO3, MO5, MO6

Written Assignment (Resit)
Description: Critical evaluation or analysis of scientific literature, specified biomedical engineering systems or a pre-configured datasets. (2500 words)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO4, MO5, MO6

Portfolio (Resit)
Description: Portfolio of evidence collated from the workplace.
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO2, MO3, MO5, MO6

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Healthcare Science (Medical Engineering) {Apprenticeship-UWE} [Frenchay] BSc (Hons) 2024-25

Healthcare Science (Radiation Engineering) {Apprenticeship-UWE} [Frenchay] BSc (Hons) 2024-25

Healthcare Science (Rehabilitation Engineering) {Apprenticeship-UWE} [Frenchay] BSc (Hons) 2024-25

Healthcare Science (Renal Technology) {Apprenticeship-UWE} [Frenchay] BSc (Hons) 2024-25