ES2G5-15 Medical Device Design

25/26

Department
School of Engineering
Level
Undergraduate Level 2
Module leader
Thomas Popham
Credit value
15
Module duration
15 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES2??-15 Healthcare Technology Engineering Design

Module web page

Module aims

To develop a firm understanding of the principles of modern design, manufacturing, maintenance and assessment of healthcare technologies, and particularly medical devices. This module will follow the World Health Organization (WHO) healthcare technologies definition, which includes: medical devices (including medical software), equipment, treatments and drugs for health and care (i.e., prevention, diagnoses, treatment, rehabilitation and end of life management). Students will learn how to generate and collect relevant clinical evidence, how to assess clinical needs, and how to consider cost-efficacy constrains, ethical issues, regulatory frameworks and management methods and tools.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The module will be organized in 3 parts:

- Part 1: health technology design
  o Physical and physiological principles, block diagrams and ordinary maintenance issues of exemplar medical devices will be presented (e.g., electrocardiography, medical devices for radiology unit, assistive technologies, point of care devices, diagnostics, active implantable devices, monitors and medical devices for intensive care units or surgery units, principal medical devices for surgery or technologies for minimally invasive surgery).
  o Block diagrams and technical requirements for exemplar medical locations or settings: hospital wards; surgery units, emergency units.
  o Information and communication technologies for healthcare
  o Human centered design
  o User need elicitation to inform the design of medical devices
- Part 2: clinical engineering
  o The medical device life cycle
  o European legislation for medical devices and comparison with the USA Food and Drugs Administration (FDA)
  o Medical software
  o Risk management in hospital: patient and healthcare professionals safety
  o Healthcare technology management
- Part 3: health technology assessment
  o Introduction to the evidence based medicine
  o Methods for systematic literature reviews
  o Standard methods to measure the impact of medical devices: the quality of life
  o incremental cost-efficacy analysis
  o Cost minimization analysis
  o Cost-utility, cost-effectiveness and cost-benefit assessment

Learning outcomes

By the end of the module, students should be able to:

- Describe the physical and physiological principles that underpin medical devices
- Apply engineering knowledge to design a healthcare technology or device [C5, M5, C13, M13, C4, M4]
- Analyse the appropriateness of innovative health care technologies by reading a health technology assessment report [C4, M4]
- Analyse the technological feasibility and cost-effectiveness of a new medical device. Identify, classify, prioritize medical or epidemiological needs and participate in studies aiming to identify the most suitable technological solutions to satisfy those needs. [C5, M5]
- Apply teamwork skills to design a medical device [C16, M16]
- Identify, classify and prioritise the main ethical issues arising from the design, regulation and use of medical devices [C8, M8]

Indicative reading list

1. Miniati, Roberto, Ernesto Iadanza, and Fabrizio Dori. Clinical engineering: from devices to

systems. Academic Press, 2015.
2. Tony Easty, "Human Factors for Health Technology Safety: Evaluating and improving the use of health technology in the real world” (to be published in June 2014)
3. E. IAdanza, “Clinical Engineering Handbook", Elsevier Academic Press, 2020, ISBN: 9780128134672
4. Selected articles from scientific journals, including:

Subject specific skills

Ability to conceive and make a valid argument to support an engineering decision

Ability to develop solutions using published and validated literature

Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality

Ability to seek to achieve sustainable solutions to problems and have strategies for being creative and innovative

Ability to be risk, cost and value-conscious, and aware of their ethical, social, cultural, environmental, health and safety, and wider professional engineering responsibilities

Ability to communicate across engineering disciplines in a constructive way to progress a project

Transferable skills

Apply problem solving skills, information retrieval, and the effective use of general IT facilities

Communicate (written and oral; to technical and non-technical audiences) and work with others

Exercise initiative and personal responsibility, including time management, which may be as a team member or leader

Awareness of the nature of engineering business and enterprise in the creation of economic and social value

Overcome difficulties by employing skills, knowledge and understanding in a flexible manner

Ability to formulate and operate within appropriate codes of conduct, when faced with an ethical issue

Appreciation of the global dimensions of engineering, customers, commerce and communication

Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.

Study

Study time

Type	Required
Lectures	1 session of 1 hour (1%)
Seminars	3 sessions of 1 hour (2%)
Project supervision	8 sessions of 1 hour (5%)
Demonstrations	(0%)
Online learning (independent)	18 sessions of (0%)
Private study	138 hours (92%)
Total	150 hours

Private study description

Guided independent learning 138 hr

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Individual Assignment 2000 words max	40%		Yes (extension)
Group Project Max 3500 words + peer assessment	60%		No

Feedback on assessment

Coursework and Group Project marked with detailed comments
Face-to-face feedback in seminars

Availability

Courses

This module is Core for:

- Year 3 of UESA-H161 BEng Biomedical Systems Engineering
- Year 3 of UESA-H163 MEng Biomedical Systems Engineering
- UESA-H162

This module is Core optional for:

- Year 4 of UESA-H164 MEng Biomedical Systems Engineering with Intercalated Year
- UESA-H162

This module is Optional for:

- Year 3 of UESA-H106 BEng Engineering
- Year 4 of UESA-H118 BEng Engineering with Intercalated Year
- UESA-H107 MEng Engineering
    - Year 3 of H107 Engineering MEng
    - Year 3 of H10E Engineering with Appropriate Technology MEng
    - Year 3 of H10J Engineering with Automotive Engineering MEng
    - Year 3 of H10C Engineering with Business Management MEng
    - Year 3 of H10G Engineering with Communications MEng
    - Year 3 of H10H Engineering with Computer Engineering MEng
    - Year 3 of H10M Engineering with Fluid Dynamics MEng
    - Year 3 of H10F Engineering with Instrumentation MEng
    - Year 3 of H10K Engineering with Robotics MEng
    - Year 3 of H10D Engineering with Sustainability MEng
    - Year 3 of H10L Engineering with Systems Engineering MEng
- Year 4 of UESA-H115 MEng Engineering with Intercalated Year