UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Instrumentation, Measurement & Control Systems
Module Code	MHT5013-B
Academic Year	2020/1
Credits	20
School	Department of Mechanical and Energy Systems Engineering
Subject Area	Mechanical and Automotive Engineering
FHEQ Level	FHEQ Level 5
Pre-requisites	N/A
Co-requisites	N/A

Contact Hours	
Type	Hours
Directed Study	149

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Academic Year

Module Aims

1. To develop an understanding of basic sensors and actuators, their application in measurement and control systems and their connection to computer systems.
2. To consolidate the theoretical part of the module with applied design and lab. work
. 3. To provide the student with a working knowledge of computers, microcontrollers and the range of appropriate programming languages.
4. To provide the student with a knowledge and understanding of advanced instrumentation methods used in a broad range of applications

Outline Syllabus

IIntroduction to computer based instrumentation. Common sensors and their behaviour:

temperature, light, position, speed, strain, pressure, sound and optical. Applications of the Wheatstone bridge in signal conditioning and control circuits. Review of resistors, capacitors, diodes and transistors in circuits. The transistor in ?switch? and emitter follower configurations, with applications. Actuators and servo mechanisms ? negative feedback. The "three term" control method (proportional-integral-derivative). Pulse Width Modulation (PWM) and applications. The Operational amplifier and application as amplifier, buffer and in feedback circuits. Calibration of sensors and general sensor characteristics. Interfacing: the comparator. The Analogue to Digital Convertor (ADC): types, operation, aliasing and dynamic range. The Digital to Analogue Convertor (DAC). Signal conditioning and noise. Noise sources and solutions. Filters, Sample and Hold devices and multiplexers. Digital: Logic gates and truth tables. Decimal, binary and hexadecimal number systems, with uses. Introduction to computer architecture. The microcontroller. Arduino microcontrollers and interfacing to measurement and control electronics. Embedded systems and Wireless Sensor Networks. Computer programming language levels. Advanced applications: Condition monitoring techniques; frequency domain condition monitoring and other frequency domain techniques. Computerised tomography, beamforming methods and applications: ultrasonic imaging, phased-arrays, underground and underwater imaging, crack detection and passive beamforming applications. Side-scan imaging.

Learning Outcomes

Outcome Number	Description
01	Describe basic sensors and associated signal conditioning circuits.
02	Describe and analyse key actuator elements and servo-related systems.
03	Design circuits to operate and connect sensors and actuators to computer systems, and design computer based instrumentation and control systems.
04	Explain advanced topics in instrumentation, including beamforming methods and frequency domain methods applied to a wide range of disciplines.

Learning, Teaching and Assessment Strategy

Lectures and tutorials [LOs 1,2,3,4] and laboratory based teaching/learning [LOs 2,3] will be used to provide theory, knowledge and methods;practical application of these will be achieved by In-class demonstrations and practical Labview programming and interfacing with sensors [LOs 2,3]. Directed study will be preparation for practical sessions and background reading to deepen understanding of the material.

Formative feedback will be through worked examples from tutorial questions, and from feedback in practical classes. Assessment is through a design project that follows on from practical and laboratory work to assess a student's ability to develop an instrumentation and control system [LOs 1,2,3], and from a final examination [LOs 1,2,4].

This module satisfies the below Learning Outcomes as specified by the Accreditation of Higher Education Programmes: Third Edition (AHEP3) as published by The Engineering Council in-line with the UK Standard for Professional Engineering Competence (UK-SPEC). These outcomes specify six key areas of learning: Science and Mathematics (SM), Engineering Analysis (EA), Design (D), Economic, Legal, Social, Ethical and Environmental Context (EL), Engineering Practice (P) and Additional General Skills (G). SM1b, SM2b, SM3b, EA2, EA4b, P2, G1, SM4m, SM6m. Further details of these learning outcomes can be found at https://www.engc.org.uk/.

Mode of Assessment

Type	Method	Description	Length	Weighting
Summative	Coursework	Individual design project (1500-2000 words) based on online lab work and application of taught material	N/A	30%
Summative	Coursework	A set of design and analysis tasks to address all relevant learning outcomes	N/A	70%
Referral	Coursework	A set of design and analysis tasks to address all relevant learning outcomes	N/A	100%

Reading List

To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html

Please note:
This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.

https://bradford.ac.uk