MODULE DESCRIPTOR

Module Title

Embedded Systems

Reference	EN3544	Version	1
Created	November 2018	SCQF Level	SCQF 9
Approved	May 2019	SCQF Points	15
Amended		ECTS Points	7.5

Aims of Module

To provide the student with the ability to evaluate the operation of microprocessor-based computer systems and to design and implement software for interfacing and real-time operation.

Learning Outcomes for Module

On completion of this module, students are expected to be able to:

1	Describe and evaluate the design of microcontroller input/output sub-systems.
2	Implement and test programs incorporating: C and assembly language, linking, polled and interrupt driven peripheral interfaces.
3	Design, build and test a component employing the hardware and software essentials of a small real-time system.
4	Demonstrate proficiency in coding, testing and aspects of design to prescribed programming tasks.

Indicative Module Content

Microprocessor system design: nature of embedded real-time systems, hardware requirements, impact on software development, exceptions and interrupts, industrial applications, case studies. Integrated and external peripherals: timers, analogue to digital and digital to analogue conversion, serial peripheral interfaces (e.g. SPI, I2C), serial bus peripherals and memory; working with manufacturers data sheets and application notes. Software development: software development process; cross-compilation and linkage of C and assembly language; debugging support; input/output programming - polled and interrupt driven (e.g. ADC, SPI, Key Wakeup);

Module Delivery

The module is taught largely in the laboratory using a structured programme of lectures, tutorials, set laboratory exercises and student-centred learning leading to a integrative project-like programming activity.

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Indicative Student Workload	Full Time	Part Time
Contact Hours	36	36
Non-Contact Hours	114	114
Placement/Work-Based Learning Experience [Notional] Hours	N/A	N/A
TOTAL	150	150
Actual Placement hours for professional, statutory or regulatory body		

ASSESSMENT PLAN

If a major/minor model is used and box is ticked, % weightings below are indicative only.

Component 1

Type:	Coursework	Weighting:	50%	Outcomes Assessed:	1, 2, 3
Description:	Portfolio of software development exercises involving microprocessor interfacing and control.				

Component 2

Type:	Practical Exam	Weighting:	50%	Outcomes Assessed:	4
Description:	In-class software development and microcontroller hardware practical examination.				

MODULE PERFORMANCE DESCRIPTOR

Explanatory Text

The module grade is calculated as the weighted average of the component marks. To pass the module the student must achieve a minimum of a grade D and at least 35% in all components.

Module Grade	Minimum Requirements to achieve Module Grade:
A	70% - 100%
B	60% - 69%
C	50% - 59%
D	40% - 49%
E	35% - 39%
F	0% -34%
NS	Non-submission of work by published deadline or non-attendance for examination

Module Requirements

Prerequisites for Module	None.
Corequisites for module	None.
Precluded Modules	None.

INDICATIVE BIBLIOGRAPHY	
1	MAZIDI, M.A., CHEN, C., GHAEMI, E. and NAIMI, S., 2017. Atmel ARM Programming for Embedded Systems. MicroDigitalEd.
2	MAZIDI, M.A., NAIMI, S. and NAIMI, S., 2016. ARM Assembly Language Programming and Architecture. MicroDigitalEd.
3	NAIMI, S., NAIMI, S., and MAZIDI, M.A., 2017. The AVR Microcontroller and Embedded Systems Using Assembly Language and C: using Arduino Uno and Atmel Studio. MicroDigitalEd.
4	YIU, J. 2015., The Definitive Guide to ARM Cortex-M0 and Cortex-M0+ Processors, 2nd edn. Newnes.