MODULE DESCRIPTOR

Module Title

Embedded Systems

Reference	EN3544	Version	5
Created	December 2022	SCQF Level	SCQF 9
Approved	May 2019	SCQF Points	15
Amended	August 2023	ECTS Points	7.5

Aims of Module

To provide the student with the ability to evaluate the operation of ARM microprocessor-based 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	Formulate understanding bare metal programming techniques on ARM based microcontroller systems.
2	Experiment comprehensive knowledge to learn key features of Arm processors and architectures as the basis of modern embedded computing.
3	Demonstrate the integrated approach to prototype a real work application based on logbook activities.
4	Assemble a real world application to investigate a complex system prototyping and their security risk.

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

Full-time students: This module is delivered by a combination of lectures and tutorials. It will be supported by practical examples and activities including computer based laboratory exercises. Part-time students: This module is delivered by a combination of lectures and tutorials online. It will be supported by drop-in evening sessions and labs on campus. Assessments will primarily be online although exams will be held on campus with the full-time cohorts.

Module Ref:	EN3544 v5

Indicative Student Workload	Full Time	Part Time
Contact Hours	40	40
Non-Contact Hours	110	110
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 lab activities of firmware development exercises involving microprocessor interfacing and control.				

Component 2

Type:	Coursework	Weighting:	50%	Outcomes Assessed:	4
Description:	Individual project real-world prototype development by employing the concepts covered in the ARM microcontroller laboratory exercises.				

MODULE PERFORMANCE DESCRIPTOR

Explanatory Text

The module has 2 components and to gain an overall pass a minimum D grade must be achieved in each component. The component weighting is as follows: C1 is worth 50% and C2 is worth 50%.

		Coursework:						
		A	**B**	**C**	**D**	**E**	**F**	**NS**
Coursework:	**A**	A	A	B	B	E	E	
	B	A	B	B	C	E	E	
	C	B	B	C	C	E	E	
	D	B	C	C	D	E	E	
	E	E	E	E	E	E	F	
	F	E	E	E	E	F	F	
	NS	Non-submission of work by published deadline or non-attendance for examination						

Module Requirements

Prerequisites for Module	EN2542 or Equivalent
Corequisites for module	None.
Precluded Modules	None.

INDICATIVE BIBLIOGRAPHY

1	The Definitive Guide to ARM? CORTEX?-M3 and CORTEX?-M4 Processors Book, 3rd Edition, 2014.
2	Nucleo Boards Programming with the STM32CubeIDE by Dogan Ibrahim
3	AZIDI, M.A., NAIMI, S. and NAIMI, S., 2016. ARM Assembly Language Programming and Architecture. MicroDigitalEd.