

# This Version is No Longer Current

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#### **Module Title**

Embedded Systems			
Reference	EN3544	Version	3
Created	August 2021	SCQF Level	SCQF 9
Approved	May 2019	SCQF Points	15
Amended	August 2021	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.

	Module Ref:		EN3544 v3		
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		
TOTAL			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				
Туре:	Coursework	Weighting:	50%	Outcomes Assessed:	1, 2, 3
Description:	: Portfolio of software development exercises involving microprocessor interfacing and control.				
Component 2					
Туре:	Coursework	Weighting:	50%	Outcomes Assessed:	4
Description: Mini project development by employing the concepts covered in the 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:						
		Α	В	С	D	Е	F	NS
	Α	А	А	В	В	Е	Е	
	В	А	В	В	С	Е	Е	
	С	В	В	С	С	Е	Е	
Coursework:	D	В	С	С	D	Е	Е	
	Е	Е	Е	Е	Е	Е	F	
	F	Е	Е	Е	F	F	F	
	NS	Non-submission of work by published deadline or non-attendance for examination					l ination	

Module Requirements				
Prerequisites for Module	None.			
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.