University of the West of Scotland

Module Descriptor

Session: 2024/2025

Title of Module: Embedded Systems			
Code: COMP08107	**SCQF Level: 8 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Bikrant Koirala		

Summary of Module

Around 90% of electronic devices use embedded microprocessors. Mobile phones, printers, robots, drones, routers, cars, microwave ovens and washing machines are some examples of devices which are controlled by embedded microprocessors. The prevalence of these devices globally imply that it is crucial to understand the fundamentals of embedded systems design and programming. In addition, the software development for such embedded processor systems is different from the typical PC software development. This is due to the restrictions of the available processor performance, RAM, I/O, etc. This module aims to develop knowledge and practical expertise in embedded systems and learn about their basic architectural components, applications, and corresponding design constraints, as well as develop efficient and reliable software for the target application. Based on a specific microcontroller and a set of real-world applications and examples, students will learn the functionality of microcontrollers and their integration within an embedded system. This will include (but is not limited to) topics such as memory maps, GPIOs, interrupts, ADC/DAC, timers, serial/parallel communication, and power management.

Students will also get an opportunity to explore a variety of different sensors and platforms, and enhance their understanding of programming in a low-level language such as C.

This module will work to develop a number of the key 'I am UWS' Graduate Attributes to make those who complete this module:

- Universal: Critical Thinker; Ethically-minded and Research-minded
- Work Ready: Problem-Solver; Effective Communicator; and Ambitious
- Successful: Autonomous, Resilient; and Driven

Module Delivery Method

Face-To-Face	Blended	Fully Online	HybridC	Hybrid 0	Work-Based Learning

☐	☒	☐	☐	☐	☐

If this module is delivered within the BSc (Hons) IT Software Development Programme the 'Blended' module delivery method applies.

See Guidance Note for details.

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☐	☐	☐	☒	☐	☒	Add name

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☐	Term 3	☒

Learning Outcomes: (maximum of 5 statements) **These should take cognisance of the SCQF level descriptors and be at the appropriate level for the module.** At the end of this module the student will be able to:	
L1	Demonstrate a critical knowledge of embedded processor system hardware and of designing appropriate system for the target application.
L2	Write, test and debug interactive programs to handle registers, memory access, take inputs from sensors and control interfaces.
L3	Use PC based emulator tools to develop software for various embedded systems.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level **8**

	Knowledge and understanding of the scope and defining features of embedded systems, and an integrated knowledge of its main areas and boundaries. A critical understanding of the principles, principal theories, concepts and terminology associated with embedded systems.	
Practice: Applied Knowledge and Understanding	SCQF Level **8** Use the principle skills, techniques and practices related to embedded systems. Practise routine methods of enquiry to practise in a range of contexts that include a degree of unpredictability.	
Generic Cognitive skills	SCQF Level **8** Undertake critical analysis, evaluation and/or synthesis of ideas, concepts, information and issues in systems programming. Identify and analyse routine professional problems and issues. Draw on a range of sources in making judgements.	
Communication, ICT and Numeracy Skills	SCQF Level **8** Use a wide range of skills in support of established practices; Present or convey, formally and informally, information about topics to informed audiences; Interpret, use and evaluate data. Click or tap here to enter text.	
Autonomy, Accountability and Working with others	SCQF Level **8** Ability to design and carry out a solution for the practical problems with peers.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	12
Tutorial/Synchronous Support Activity	12
Laboratory/Practical Demonstration/Workshop	24
Independent Study	152
	200 Hours Total

****Indicative Resources: (eg. Core text, journals, internet access)**

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

- Barr, M. and Massa A. “Programming Embedded Systems: With C and GNU Development Tools”, 2nd Edition, O'Reilly Media, 2006.
- Blum, J. (2013) Exploring Ardunio. Wiley. ISBN-10: 1118549368, ISBN-13: 978-1118549360
- Boxall, J. (2013) Arduino Workshop: A Hands-On Introduction with 65 Projects. (1st Edition) No Starch Press.ISBN-10: 1593274483, ISBN-13: 978-1593274481
- Mazidi, M et al (2019) Arduino Programming From Beginning to Advanced. MicroDigitalEd. ISBN-10:1970054204, ISBN-13: 978-1970054200
- Popovici, K., Jerraya, A., Rousseau, F., Wolf, M. “Embedded Software Design and Programming of Multiprocessor System-on-Chip: Simulink and System C Case Studies”, Springer, 2010
- Sestoft, P. (2017) Programming Language Concepts (2nd Edition). Springer ISBN-10: 331960788X, ISBN-13: 978-331960788
- Arduino Project Book (Basic)
- Exploring Arduino by Jeremy Blum
- Arduino Workshop: A Hands-On Introduction with 65 Projects by John Boxall
- The Official Raspberry Pi Guide
- Raspberry Pi Projects Book (Russel Barnes et al)

Links to be used during the module:

- Arduino Course on Programming Electronics Academy (https://programmingelectronics.com)
- Raspberry Pi and the Internet of Things (https://www.udemy.com/from-0-to-1-raspberry-pi/)
- Lot of courses and explanations (https://www.sparkfun.com/)
- Arduino simulator (https://library.io/)
- Server for IoT projects (https://thingspeak.com/)

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

For the purposes of this module, academic engagement equates to the following:

Attending all timetabled synchronous classes and engagement with asynchronous learning activities and resources.

Equality and Diversity

The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.

Aligned with the overall commitment to equality and diversity stated in the Programme Specifications, the module supports equality of opportunity for students from all backgrounds and with different learning needs. Using our VLE, learning materials will be presented electronically in formats that allow flexible access and manipulation of content (part-time and distant learning students should check with their programme leader for any queries). The module complies with University regulations and guidance on inclusive learning and teaching practice. Specialist assistive equipment, support provision and adjustments to assessment practice will be made in accordance with UWS policy and regulations.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Computing
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Business & Applied Computing
Moderator	TBA
External Examiner	A Jindal
Accreditation Details	n/a
Changes/Version Number	1.0

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment for this module consists of a written class test and a lab-based coursework
Assessment 1 – Class test (written): The test will be held after the completion of the taught course. (40%)
Assessment 2 – Lab-based coursework: The coursework is undertaken in the second half of the module. (60%)
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Assessment Outcome Grids (**See Guidance Note)**

Component 1							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Class test (written)	x	x	x			40	2

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Portfolio of practical work	x	x	x			60	-
Combined Total for All Components						**100%**	**2 hours**