1. **Title of the module**

EENG6670 (EL667) Embedded Computer Systems

1. **School or partner institution which will be responsible for management of the module**

Engineering and Digital Arts

1. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**

Level 6

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Autumn and Spring

1. **Prerequisite and co-requisite modules**

Pre-requisite:

CO527 - Operating Systems and Architecture

EL560 - Microcomputer Engineering

1. **The programmes of study to which the module contributes**

BEng Electronic and Communications Engineering

BEng Electronic and Communications Engineering with a Year in Industry

BEng Computer Systems Engineering

BEng Computer Systems Engineering with a Year in Industry

MEng Electronic and Communications Engineering

MEng Electronic and Communications Engineering with a Year in Industry

MEng Computer Systems Engineering

MEng Computer Systems Engineering with a Year in Industry

BSc Computer Science

1. **The intended subject specific learning outcomes.
On successfully completing the module students will be able to:**

1. Demonstrate an understanding of the design and operation of embedded systems;

2. Demonstrate an understanding of real time software and hardware system requirements;

3. Demonstrate practical experience of embedded systems based on case studies and laboratory experiments.

1. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**

1. organise information clearly and coherently,

2. produce written documents

3. explore optimal and alternate solutions.

1. **A synopsis of the curriculum**

This module introduces the theory and practice of employing computers as the control and organisational centre of an electronic or mechanical system, and examines issues related to time critical systems. It also provides exposure to practical embedded systems design through practical work, with one assignment exploring the ideas of real-time operating systems introduced in the lectures and a second using a microcomputer programmed in 'C' to control the ignition timing of a simulated petrol engine.

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**

Core Text

* Shaw, AC (2001) Real-time systems and software, John Wiley, New York, Chichester
* Simon, DE (1999) n embedded software primer, Addison Wesley, Boston, London
* Qiu, Meikang, Li, Jiayin (c2011) Real-time embedded systems: optimization, synthesis, and networking, CRC, Taylor & Francis [distributor], Boca Raton, Fla, London

Recommended Reading

* Toulson, Rob and Wilmshurst, Tim (2012) Fast and Effective Embedded Systems Design Applying the ARM mbed, Newnes ISBN 978-0-08-097768-3
* Stallings, William (c2012) Operating systems: internals and design principles, Pearson, Boston (Mass), London
* Stallings, William (c2010) Computer organization and architecture: designing for performance, Prentice Hall, Upper Saddle River, NJ
* Valvano, Jonathan W (2011) Embedded Systems, Createspace, [Texas?]
* Valvano, Jonathan W (c2012) Embedded systems: introduction to the Arm® Cortex(TM)-M3: 1, Jonathan W. Valvano, [Texas?]
* Upton, Eben, Halfacree, Gareth (2012) Raspberry Pi user guide, John Wiley & Sons Ltd, Chichester.
* Buttazzo, Giorgio C. (c2011) Hard real-time computing systems: predictable scheduling algorithms and applications, Springer, New York.
1. **Learning and teaching methods**

Total contact hours: 25

Private study hours: 125

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods
* Microcomputer Architecture Assignment (17.5%)
* Embedded Software Assignment (17.5%)
* Exam 2 hours (65%)

In order to obtain credit for this module on IET accredited programmes, the coursework mark and the exam mark must each be greater than or equal to 30% as well as achieving the pass mark for the module. This module will only be considered for compensation if the coursework mark and exam mark are each greater than 30%.

13.2 Reassessment methods

Reassessment instrument: like-for-like

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 9.1 | 9.2 | 9.3 |
| **Learning/ teaching method** |  |  |  |  |  |  |
| Private Study | **x** | **x** |  | **x** | **x** | **x** |
| Lectures  | **x** | **x** |  | **x** | **x** | **x** |
| Support classes | **x** | **x** | **x** | **x** | **x** |  |
| **Assessment method** |  |  |  |  |  |  |
| Assignments |  |  | **x** | **x** | **x** | **x** |
| Exam | **x** | **x** |  |  |  |  |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered**

Canterbury

1. **Internationalisation**

This module covers two core subjects that are essential for the design of modern embedded systems. The C programming language and Real-Time Operating Systems (RTOS). Modern microcontroller devices are used to illustrate how to program embedded systems using C and also how to develop more complex systems using the principle of an operating system. Modern digital systems rely on C (and C++) and RTOS design concepts. It is hard to imagine how our smart-phones, TVs and all other types of consumer and industrial electronic systems could be developed, designed and implemented without these tools and methods, which are used by engineers all over the world.

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**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
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Revised FSO Jan 2018