1. **Title of the module**

EENG8750 (EL875) - Advanced Sensors and Instrumentation 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 7

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)**

Spring

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

None

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

MSc/PGDip in Advanced Digital Systems Engineering (option)

MSc/PGDip in Advanced Electronic Systems Engineering (option)

MSc/PGDip in Information Security and Biometrics (option)

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

Have:

1. An understanding of the principles of measurement and instrument design.
2. An understanding of modern sensors and optical sensing systems.
3. An understanding of imaging based instrumentation systems.
4. An understanding of intelligent measurement technology.
5. The necessary skills to design and implement embedded instrumentation systems.
6. The knowledge and skills to design and implement specialised measurement and monitoring systems.
7. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**

Demonstrate skills in generating, analysing, presenting and interpreting data, will learn to use ICT, and will develop core key skills, such as learning effectively, critical thinking and time management, contributing to the Transferable/Key Skills in the generic learning outcomes in the appropriate curriculum maps.

1. Students will show an ability to deal with complex issues systematically and creatively and make judgements in the absence of complete data, and show that they are capable of self-direction and problem solving.
2. The ability to use and understand a range of modern CAD tools and general ICT.
3. Demonstrate the ability to communicate complex ideas and concepts to specialist and non-specialist audiences.
4. Show that they are capable of learning independently, use critical thinking and analysis and demonstrate autonomy in time and resource management.
5. **A synopsis of the curriculum**

Sensors and Sensing Systems:

Measurement terminology and error analysis.

Sensors and transducers.

Optical sensing techniques.

Signal processing techniques:.

Imaging based Measurement and Monitoring Techniques:

Digital imaging technologies.

Imaging systems.

Image processing techniques.

Intelligent Measurement and Monitoring Techniques:

Soft computing techniques for measurement and monitoring.

Smart sensors and intelligent monitoring.

Industrial Case Studies.

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**
* Usher, M. J., Keating, D. A. (1996) Sensors and Transducers: Characteristics, Applications, Instrumentation and Interfacing
* Bentley, John P. (2005) Principles of Measurement Systems
* Webster, J. G. Eren, H. (2014) Measurement, Instrumentation, and Sensors Handbook
* Northrop R. B. (2014) Introduction to Instrumentation and Measurements
* Elgar P. (1998) Sensors for Measurement and Control Paperback
* Joint Committee for Guides in Metrology (JCGM), International Vocabulary of Metrology (VIM-Vocabulaire international de Métrologie) – Basic and General Concepts and Associated Terms, 2012.
* Joint Committee for Guides in Metrology (JCGM), Evaluation of Measurement Data — Guide to the expression of Uncertainty in Measurement (GUM), 2008.
* Trussell J., Vrhel M. (2008) Fundamentals of Digital Imaging
* Gonzalez R. C., Woods R. E., Woods R. E. (2008) Digital Image Peocessing
1. **Learning and teaching methods**

Total contact hours: 46

Private study hours: 104

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Problem solving (12%)

Practical (28%)

Examination (60%)

13.2 Reassessment methods

Reassessment Instrument: 100% exam

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section 12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | *8.1* | *8.2* | *8.3* | *8.4* | *8.5* | *8.6* | *9.1* | *9.2* | *9.3* | *9.4* |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |
| **Private Study** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| *Lectures* | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  |  | **X** |
| *Laboratory* | **X** | **X** | **X** |  | **X** |  | **X** | **X** | **X** | **X** |
| *Example Classes* | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  |  | **X** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |
| *Examples and lab classes* | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** |
| *Exam* | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  | **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**

Some practical work is undertaken using the internationally recognised software tool MATLAB to process signals and images from a range of sensors and to analyse experimental data. Some real-life examples in the industrial case studies are derived from the internationally collaborative projects undertaken by the Instrumentation team at Kent.

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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.**

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| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
| 21/01/2020 | Major | January 2021 | 8, 10, 11, 13 | No |
|  |  |  |  |  |

Revised FSO Jan 2018