**MODULE SPECIFICATION**

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|---|---|---|---|---|---|
| **Module Title:** | UAS Technology and Applications | **Level**: | 7 | **Credit Value**: | 20 |

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|---|---|---|---|---|---|
| **Module code**: | ENG759 | **Is this a new module?** | YES | **Code of module being replaced**: | |

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|---|---|---|---|
| **Cost Centre**: | GAME | JACS3 **code**: | H400 |

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|---|---|---|---|
| **Trimester(s) in which to be offered:** | 1, 2 | **With effect from:** | September 17 |

| | | | |
|---|---|---|---|
| **School:** | Applied Science, Computing & Engineering | **Module Leader:** | R.Bolam |

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|---|---|
| Scheduled learning and teaching hours | 40 hrs |
| Guided independent study | 160 hrs |
| Placement | 0 hrs |
| **Module duration (total hours)** | 200 hrs |

| **Programme(s) in which to be offered** | Core | Option |
|---|---|---|
| MSc Unmanned Aircraft System Technology | ✓ | ☐ |

| **Pre-requisites** |
|---|
| None |

Office use only
Initial approval February 17
APSC approval of modification N/A Version 1
Have any derogations received Academic Board approval? Yes ✓ No ☐

**MODULE SPECIFICATION**

| **Module Aims** |
|---|
| To support the development of the student in the following areas:<br>• To apply advanced modelling and analysis to the solution of drone technology related problems.<br>• To be able to specify, select and assemble flight and payload components and sub-systems suitable to an advanced UAV application.<br>• Demonstrate a proficiency in the skills required to safely operate a UAS. |

**Intended Learning Outcomes**

Key skills for employability

| | |
|---|---|
| KS1 | Written, oral and media communication skills |
| KS2 | Leadership, team working and networking skills |
| KS3 | Opportunity, creativity and problem solving skills |
| KS4 | Information technology skills and digital literacy |
| KS5 | Information management skills |
| KS6 | Research skills |
| KS7 | Intercultural and sustainability skills |
| KS8 | Career management skills |
| KS9 | Learning to learn (managing personal and professional development, self-management) |
| KS10 | Numeracy |

| At the end of this module, students will be able to | | Key Skills | |
|---|---|---|---|
| 1 | Demonstrate a comprehensive understanding of the technology and terminology relating to the component elements of an unmanned aircraft system. | KS1 | KS3 |
| | | KS4 | KS10 |
| | | KS6 | |
| 2 | Critically analyse the airworthiness of a UAS, considering the role, limitations and purpose of the components that comprise a UAS. | KS1 | KS3 |
| | | KS4 | KS10 |
| | | KS5 | |
| 3 | Analyse the flight stability, control, power and associated operational parameters required to conduct an advanced UAS mission. | KS3 | KS3 |
| | | KS4 | KS10 |
| | | KS10 | |
| 4 | Demonstrate a systematic understanding of the knowledge and a critical awareness of the current problems associated with the successful and safe conduct of a drone mission. | KS1 | KS2 |
| | | KS3 | KS7 |

**Derogations**

A derogation from regulations has been approved for this programme:

Students are required to achieve a minimum overall module mark of 50%, with each element of assessment (where there is more than one assessment) requiring a minimum mark of 40%.

**Assessment:**

Assessment 1: The coursework shall comprise a series of tasks relating to the technology associated with component elements of UAS and a series of flight tests during which the student will demonstrate correct pre and post flight preparation (including mission planning documentation) and practical drone piloting skills with and without GNSS assisted flight modes.

Assessment 2: Report shall be based on computerised simulation and analysis of UAS flight stability and control or a critical investigation into UAS design for airworthiness using approved safety analyses techniques.

| Assessment number | Learning Outcomes to be met | Type of assessment | Weighting (%) | Duration (if exam) | Word count (or equivalent if appropriate) |
|---|---|---|---|---|---|
| 1 | 1,4 | Coursework | 50 | | 2500 |
| 2 | 2,3 | Report | 50 | | 2500 |

**Learning and Teaching Strategies:**

The module will be taught with lectures, laboratory and workshop sessions, actual and simulated flight exercises including, team exercises, mock missions and mission planning using way-point flying techniques. Also the use of computer modelling software such as MATLAB, SIMULINK and ANSYS.

**Syllabus outline:**

UAV System Technology

The anatomy of a drone. Types of drones: fixed wing and multi-rotor designs. Aerodynamics. Power storage and Propulsion systems. Control technology: Transmitters and Receivers, Flight Controllers, auto-pilots. Operational and performance envelopes. GPS, Inertial Navigation Systems. Gyro stabilisation and gain selection. UAS flight stability and control theory.

UAS Design for Airworthiness

The meaning and importance of airworthiness, reliability and maintenance procedures to a UAS design. An overview of airworthiness legislation for manned flight and its relevance to UAS. Reliability analyses: Functional Hazard Assessments, Failure Mode Effect Analyses, Fault Tree and Markov Analyses, UAS Inspection, Safety Studies and the design for

redundancy and dormant failure modes. UAS maintenance procedures and Failsafe provisions.

Payload Technology

Payload centre of gravity, freight conveyancing techniques, camera technology, video storage, Real-time video transmission systems. Photographic equipment capabilities and limitations.

Drone Operations

Mission planning and Risk Assessment for safe drone operation. UK Airspace operating principles. Airmanship and aviation safety. Navigation and charts. Waypoint flying and associated software systems. Practical flying exercises both simulated and real.

**Bibliography:**

**Essential reading**

Elliott, A. (2016) *Build Your Own Drone Manual. The Practical Guide to Safely Building, Operating and maintaining an Unmanned Aerial Vehicle (UAV)*. Haynes.

**Other indicative reading**

Garner,W.B (2009) *Model Airplane Propellers.* DCRC Club Newsletter, Vol 55, Issue 4/5.
Juniper, A. (2015) *The Complete Guide to Drones.* Octopus Publishing Group
Austin, R. (2010) *Unmanned Aircraft Systems: UAVs Design, Development and Deployment*. Wiley-Blackwell.
Marshall,D.M., Barnhart,R.K.,Shappee,E.,Most,M.T.(2016) *Introduction to Unmanned Aircraft Systems, Second Edition*. CRC Press.