Kingston University London

# Aerospace Engineering Modules for Erasmus Students 2021/22

Aerospace engineering at Kingston has an innovative curriculum, excellent links with industry and cutting-edge facilities. These include a Lear Jet, a 747's cockpit, a flight simulator, a satellite ground station, a rocket lab, and open and closed channel wind tunnels.

Level 5 modules introduce specialised topics in aerospace engineering such as aerodynamics, propulsion, structures, dynamics and materials. It includes further study of mathematics, electronics, control and computing.

At level 6, modules are offered with more advanced studies of aerodynamics, propulsion, structure, materials and dynamics including applied computational techniques widely used in industry.

*Updated May 2021/PJW*

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| **Entry requirements** | Nomination of Erasmus student by home institution |
| **Pre-requisites** | • **Level 5:** prior study of aerospace engineering topics covering relevant engineering maths and physics.<br>• **Level 6:** substantial prior study of aerospace engineering topics is required. |
| **Taught at** | Roehampton Vale campus. |

**Notes:**

1. *Students enrolled on Study Option 1 are required to study the entire module over both semesters.*
2. *Whilst the University makes every effort to ensure that this information is correct at the time of updating (May 2021), it cannot accept responsibility for omissions or subsequent changes. Module availability and content may be subject to change, as part of the University's policy of continuous improvement and development.*

Kingston University London

# Aerospace Engineering Modules for Erasmus Students 2021/22

| MODULE CODE | TITLE | SUITABILITY | | |
|---|---|---|---|---|
| | **LEVEL 5 - INTERMEDIATE** | | | |
| AE5020 | Aerodynamics, Propulsion and Analytical Methods | 1 | | |
| AE5022 | Aerospace Structures, Materials & Dynamics | 1 | | |
| EG5014 | Engineering Project Management | 1 | | |
| ME5012 | Electronic Systems, Control and Computing | 1 | | |
| | **LEVEL 6 – ADVANCED** | | | |
| AE6020 | Further Aerodynamics and Propulsion and Computational Technique | 1 | | |
| AE6022 | Further Aerospace Structures, Materials and Dynamics | 1 | | |
| AE6024 | Individual Project | 1 | | |
| AE6030 | Space Vehicle Design | 1 | | |
| AE6204 | Aerospace Technology | 1 | | |
| | **LEVEL 7 – POSTGRADUATE** | | | |
| AE7001 | Aerospace Systems Engineering | 1 | | |

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

## LEVEL 5 – INTERMEDIATE

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| **Module Code** | **AE5020** |
| **Module Title** | **Aerodynamics, Propulsion and Analytical Methods** |
| **Level** | 5 |
| **Prerequisites** | Prior study of engineering mathematics and thermodynamics. |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module is based upon material introduced at level 4 and provides further learning more specifically required for the potential aerospace engineer. The basics of aerodynamics and aerospace propulsion are introduced with a view to provide the ability to analyse, formulate and solve elementary problems. The mathematics side of the module is taught in the context of the solution of engineering problems.<br><br>Two dimensional potential flows, production of aerodynamic forces, wind tunnel testing, compressible flows, shock waves and computational fluid dynamics (CFD) are some of the topics covered on the aerodynamics part of the module. The propulsion side revisits and extends conservation of energy and the laws of thermodynamics. Gas turbines, heat transfer and combustion processes are some of the other areas that receive attention. Solutions of ordinary and partial differential equations, Eigen values and Eigen vectors are some of the topics considered in the analytical methods side of the module.<br><br>**Autumn semester:** propulsion subject and analytical methods<br>**Spring semester:** aerodynamics subjects |
| **Teaching** | Formal lectures, tutorials, laboratory exercises and electronic learning tools |
| **Assessment** | Study Option **1:**<br>• 2 x Maths in-class tests (20%)<br>• a portfolio of lab reports (4 reports with 5% for each) (20%)<br>• 3-hour exam (60%) |
| **Last updated** | 15/06/21 PJW |

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# Aerospace Engineering Modules for Erasmus Students 2021/22

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|---|---|
| **Module Code** | **AE5022** |
| **Module Title** | **Aerospace Structures, Materials & Dynamics** |
| **Level** | 5 |
| **Prerequisites** | prior knowledge of statics, materials and dynamics at university level |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module reinforces the students prior knowledge of statics, materials and dynamics and introduces topics of particular relevance to aerospace studies. The module includes further work on the analysis of beams, materials used in aerospace such as composites and develops the students understanding of vibration theory as well as application of dynamics of particles and rigid bodies in aerospace. Topics such as Bredt-Batho theory and aircraft dynamic performance and stability and Finite Element application in static and dynamic analysis of structures are also introduced.<br><br>**Topics:**<br>➢ **Aerostructure Analysis**<br>• Analysis of beams<br>• Torsion in thin-walled structures<br>• Buckling of Structures<br>• Shear stress and shear centre<br><br>➢ **Dynamics of Rigid and Flexible Bodies**<br>• Applications of dynamic in Aerospace, Flight mechanics and Aircraft Performance<br>• Aircraft stability and control<br>• Vibrations<br><br>➢ **Materials and Composites**<br>• Materials and Composites<br>• Manufacturing Techniques of Composites<br>• Micromechanics<br>• Thermal Protection Systems, Stealth Technology, Radar/Radomes<br><br>➢ **Finite Element Analysis**<br>• Practical CAD modelling with Design Modeler<br>• Structural Analysis using ANSYS<br>• Thermomechanical modelling using ANSYS<br>• Vibrations Analysis using ANSYS |
| **Teaching** | formal lectures, computing workshops for finite element analysis and practical Aerostructure and Dynamics labs. |

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| **Assessment** | Study Option **1:**<br>• Exam (50%)<br>• 3 in-class tests (8%,8%,4% each<br>• FEA assignment (20%)<br>• 2 group lab reports (5% each) |
| **Last updated** | 15/06/21 PJW |

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|---|---|
| **Module Code** | **EG5014** |
| **Module Title** | **Engineering Project Management** |
| **Level** | 5 |
| **Prerequisites** | None |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module considers the principles and practices for the management of engineering projects and how organisations undertake and monitor projects. It continues to develop effective team working skills to prepare students for larger group projects in subsequent years of study and employment. The group project at the end of the module enables students to demonstrate their ability to apply their subject specific knowledge in a realistic context and helps prepare them for their individual project in the following year.<br><br>**Topics:**<br><br>• Knowledge of the principles, procedures and application of tools for project and risk management.<br>• The legal and ethical framework of projects in relation to the law of contract, to tort and to health and safety legislation.<br>• Project planning, scheduling and resource levelling, including use of proprietary software<br>• Utilisation of financial tools to undertake economic assessment and analysis of projects<br>• Quality management requirements of engineering projects, including aspects of ISO9000.<br>• Basic statistical tools and techniques.<br>• Development of group and interpersonal skills in project management. |
| **Teaching** | Lectures, tutorials, pc lab sessions |

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| **Assessment** | Study Option **1:**<br>• Class test/ quizzes (30%)<br>• Group project (60%)<br>• Employability portfolio (10%) |
| **Last updated** | 15/06/21 PJW |

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|---|---|
| **Module Code** | **ME5012** |
| **Module Title** | **Electronic Systems, Control and Computing** |
| **Level** | 5 |
| **Prerequisites** | Prior study of Analytical Methods, Computing, Electrical and Electronic Systems such as ME4012 (or equivalent) |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module builds upon prior study at level 4 extending electronics teaching to more complex devices and methods for analysis. It deals with advanced electronic systems and concepts from classical control, including feedback control systems and analysis of their response and the effects of the feedback loop. The content of this module is informed by the research performed by the teaching team. In order to improve students' employability, a range of engineering programming tools are used to model and analyse the performance of engineering systems, enabling learning of the functionality of control analysis and design software<br><br>**Topics:**<br><br>• Operational amplifiers, electronic filters.<br>• ADC and DAC converters.<br>• Boolean algebra and logic circuits.<br>• Mathematical models and computer simulation.<br>• Velocity feedback.<br>• PID controllers, step response, stability, Routh-Hurwitz.<br>• Flow control: loops and decisions, selection structures.<br>• Assignments and logical compares.<br>• Data types, functions and variables.<br>• Strings and arrays, multidimensional arrays.<br>• Standard I/O, file I/O. |

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| | • Complex numbers.<br>• 1st and 2nd order ODEs with applications.<br>• Partial differentiation and applications. |
| **Teaching** | lectures, analytical and programming tutorials and laboratory exercises |
| **Assessment** | Study Option **1:**<br>• Exam (50%)<br>• In-class test (25%)<br>• Measurement and programming assignment (25%) |
| **Last updated** | 15/06/21 PJW |

## LEVEL 6 – ADVANCED

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|---|---|
| **Module Code** | **AE6020** |
| **Module Title** | **Further Aerodynamics and Propulsion and Computational Technique** |
| **Level** | 6 |
| **Prerequisites** | Completion of AE5020 and AE5022 or equivalent |
| **Credits** | Full Year: 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |

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| **Content** | This module extends the analysis of aerodynamic and propulsive systems with a view to provide the ability to design and evaluate aerodynamic loadings on aerospace vehicles as well as their propulsion systems. It also extends student knowledge and skill base on solving aerospace engineering problems with advanced analytical approaches, namely Computational Fluid Dynamics (CFD) with a view to equip students with up-to-date flow & structure analysis techniques.<br><br>Subsonic, supersonic, compressible, incompressible, boundary layer, inviscid and viscous flows are all considered in High-speed and Low-speed Aerodynamics. On the propulsion side, the topics considered are air breathing cycles, axial flow turbo-machines, and combustion systems. The computational fluid dynamics part includes basic concept and solution procedure for problems such as flow over airfoil and wing by using commercial package suit ANSYS as a major tool.<br><br>**Topics:**<br><br>➢ **Aerodynamics**<br>• Subsonic Aerodynamics<br>• Supersonic Aerodynamics<br>• Compressible flow<br>• Incompressible flow<br>• Inviscid flow<br>• Viscous flow<br>• Boundary layer<br><br>➢ **Propulsion**<br>• Air breathing cycles<br>• Thrust principle<br>• Basic analysis of gas turbine engine<br>• Inlets and Nozzles<br>• Compressors and Turbines<br>• Combustors and afterburners<br><br>➢ **Computational Flow Dynamics (CFD) technologies**<br>• Navier-Stokes equations<br>• Finite-difference and finite volume methods<br>• Turbulence flow<br>• ANSYS simulation |

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| **Teaching** | Lectures, tutorials, seminars, computing laboratory exercises |
| **Assessment** | Study Option **1:**<br><br>• Exam (50%)<br>• CFD Coursework 1 – 3,000 words/15 pages(25%)<br>• CFD Coursework 2 (25%) |
| **Last updated** | 15/06/21 PJW |

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|---|---|
| **Module Code** | **AE6022** |
| **Module Title** | **Further Aerodynamics and Propulsion and Computational Technique** |
| **Level** | 6 |
| **Prerequisites** | Completion of AE5020 and AE5022 or equivalent |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This advanced module extends and deepens the student's ability to apply the analytical techniques used to design aerospace structures. In this module analytical techniques are used to enhance the student's understanding of the functions of typical aerospace structural components. The students will study the multifaceted discipline of materials technology applicable to typical aerospace structures based on fracture and fatigue analysis and the finite element method. It also provides students with an understanding of aircraft dynamic stability, performance, and structural dynamics characteristics. This is achieved not only through analysis but also through a live flight test. The wide-ranging set of topics considered in the module gives students ample opportunity to see how the various disciplines interact in the aerospace design process.<br><br>**Topics:**<br><br>➢ **Flight Dynamics:**<br>• steady level flight, drag polar equation, stall speed, minimum drag condition.<br>• Range performance<br>• Steady climb performance<br>• Introduction to Stability<br>• Dynamic stability: introduction<br>• Longitudinal Dynamics stability: Phugoid and SPO |

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| | • Lateral Dynamic stability : Dutch Roll, Spiral mode and Spin<br><br>➢ **Structural Dynamics**<br>• Assembling equations of motion in Matrix form using Newton's law of motion as well as Flexibility matrix method<br>• Calculating Eigen values and Eigen vectors and converting them into natural frequencies, damping parameters and mode shapes (modal parameters).<br>• Carrying out Modal analysis method to calculate responses under sinusoidal, periodic and transient forcing functions. Using MATLAB for large matrices.<br>• Studying all aspects of experimental methods (Modal testing) of extracting the modal parameters from test data in the form of Frequency response function (Transfer function), transducers, signal processing, experimental set up for impact hammer test and shaker test and interpretation of the results.<br><br>➢ **Aerostructure Analysis**<br>• **Materials:** Topics include microstructural effects on fracture in metals, ceramics, polymers, and composites, toughening mechanisms, and crack growth resistance. Also covered: fatigue damage and dislocation substructures in single crystals, stress- and strain-life approach to fatigue, fatigue crack growth models and mechanisms, variable amplitude fatigue, corrosion fatigue and case studies of fracture and fatigue in structural.<br><br>• **Stress analysis of aerostructural sections:** stress analysis and idealisation of aircraft structure, aircraft body components and aircraft materials. Various analytical models for stress analysis of fuselage and aircraft wing structures are introduced. Techniques for idealization of initial & advanced concepts, stress analysis, testing procedure, different standards & regulation and design of production processes will be covered.<br><br>➢ **Finite Element Analysis**<br>• Solving finite element based problems using one- and two-dimensional linear elements theoretically and apply FEA commercial software to solve engineering problems. |
| **Teaching** | Formal lectures, problem-solving, flipped classes, tutorials, flying and FEA laboratory exercises |
| **Assessment** | Study Option **1:**<br><br>• FEA computing lab report (20%)<br>• portfolio of three reports:<br>  ○ crash analysis case study (10%),<br>  ○ MATLAB software modelling (10%)<br>  ○ flying laboratory (10%).<br>• Exam (50%) |
| **Last updated** | 15/06/21 PJW |

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|---|---|
| **Module Code** | **AE6024** |
| **Module Title** | **Individual Project** |
| **Level** | 6 |
| **Prerequisites** | Completion of intermediate-level aerospace engineering modules. |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This major project is undertaken throughout the final year of the BEng programme, allowing the students to research and study in depth a topic in Aerospace Engineering which is of personal interest, thus allowing them to demonstrate their ability to:<br><br>• Analyse and evaluate relevant subject areas previously covered in the course.<br>• Acquire and appraise new knowledge related to the project.<br>• Show willingness to apply individual judgement to new problems.<br>• Apply creativity and show intellectual input.<br>• Show organisational capability (through arranging meetings with supervisors, setting project goals and meeting appropriate deadlines).<br>• Communicate with others (through completing reports and a log book, as well as presenting a seminar/oral presentation).<br><br>Professionally this module allows the students, to show high levels of responsibility and organisational capability (through arranging meetings with supervisors, setting project goals and meeting appropriate deadlines) as well as demonstrating effective communication with others (through completing reports and a log book, as well as presenting a seminar for the project). Furthermore the module encourages the students to recognise, question and deal with the ethical dilemmas that are likely to occur in Engineering professional practice and research. |
| **Assessment** | Study Option **1**:<br><br>• Project planning or Interim report (15%)<br>• Seminar/Presentation (15%)<br>• Final dissertation (70%) |
| **Last updated** | 15/06/21 PJW |

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|---|---|
| **Module Code** | **AE6204** |
| **Module Title** | **Aerospace Technology** |
| **Level** | 6 |
| **Prerequisites** | Completion of intermediate level aerospace engineering modules |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module provides an understanding of how the principles of aerodynamics, propulsion, structures and materials science all determine the configuration and performance of fixed and rotary wing aircraft.<br><br>**Topics:**<br><br>• Aerospace environment<br>• Aerodynamic characteristics of aircraft<br>• Aircraft Propulsion<br>• Aircraft performance: cruise, climb, turning, takeoff and landing<br>• Aircraft conceptual design and evaluation<br>• Rotary wing aircraft characteristics<br>• Rotary wing aircraft performance<br>• Aircraft structural layout<br>• Aircraft structural idealization<br>• Engineering beam theory<br>• Torsion of thin walled structures<br>• Thin walled pressure vessels<br>• Aerospace materials |
| **Teaching** | Formal lectures and tutorials |
| **Assessment** | Study Option **1:**<br><br>• 2,000 word assignment (30%)<br>• Unseen Test (20%)<br>• 3-hour Final Examination (50%) |
| **Last updated** | 15/06/21 PJW |

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| **Module Code** | **AE6030** |
| **Module Title** | **Space Vehicle Design** |
| **Level** | 6 |
| **Prerequisites** | Completion of intermediate level aerospace engineering modules |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | Building on the knowledge acquired in EG5014 the module is intended to teach space systems engineering as applied to the design of space vehicles.<br><br>This module builds on the introduction to space engineering given in level 5 to give a detailed understanding of space vehicle design, the space project cycle. Core components of a space vehicle will be covered.<br><br>Context will be provided through reference to past UK, European and International space missions and the development of a system model.<br><br>Aims:<br><br>• Understanding the theory and challenges of space engineering and it's industrial applications<br><br>• Carrying out basic design of core spacecraft electrical and mechanical subsystems using a system model and working within defined requirements.<br><br>• Understanding the importance of systems engineering, requirement analysis, instrument and payload selection and orbit mechanics on preliminary mission design.<br><br>• Using tools, reference material and introducing analysis principles so that basic design (selection and sizing) of core spacecraft electrical and mechanical subsystems can be carried out with confidence, in particular propulsion, structures and re-entry systems.<br><br>• Understanding and applying space engineering processes to avoid the classic engineering mistake of reinventing the wheel in the face of adverse politics and economics<br><br>• Familiarising and using space industry recognized software tools |

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| **Teaching** | Formal lectures and workshops |
| **Assessment** | Study Option **1:**<br><br>• Initial Concept Review Presentation - Lunar Gateway (20%)<br>• Space Vehicle Propulsion System Design (35%)<br>• System Model Report (45%) |
| **Last updated** | 15/06/21 PJW |

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## LEVEL 7 – POSTGRADUATE

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|---|---|
| **Module Code** | **AE7001** |
| **Module Title** | **Aerospace Systems Engineering** |
| **Level** | 7 |
| **Prerequisites** | Completion of advanced level aerospace engineering modules |
| **Credits** | 8 (US) 15 (ECTS) |
| **Suitability** | Open to suitably qualified Visiting Students enrolled at KU for Study Option 1 only |
| **Content** | This module is designed to develop the student's ability to apply a systems engineering approach to the analysis of aerospace systems. This will enable them to develop systems that are robust and able to respond to customer's needs. It will also ensure that they understand the full life cycle of aerospace systems and the associated costs. This module emphasises a variety of systems engineering techniques, which are explored through case studies. These techniques can also be used in the group project module.<br><br>Topics:<br>• Introduction to Systems Engineering<br>• Systems Engineering Process<br>• System Design Requirements<br>• Design Methodology<br>• Design Review and Evaluation<br>• Risk Evaluation and Management |

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| **Teaching** | Keynote lectures, system design and evaluation workshops. |
| **Assessment** | Study Option **1:**<br>• 3 hour unseen exam (50%)<br>• Assignment 1: Design Requirements (25%)<br>• Assignment 2: The House of Quality (25%) |
| **Last updated** | 15/06/21 PJW |

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