Module Specification

Fundamental Aero-Propulsion

Version: 2021-22, v3.0, 26 Apr 2022

Contents

Part 1: Information

Module title: Fundamental Aero-Propulsion

Module code: UFMFTU-15-2

Level: Level 5

For implementation from: 2021-22

UWE credit rating: 15

ECTS credit rating: 7.5

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Delivery locations: Frenchay Campus, University Centre Weston

Field:

Module type: Standard

Pre-requisites: Aerospace Thermofluids 2020-21

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: A thorough knowledge of the principles of aero propulsion is essential for the design of engines and to optimise performance. In this module students will continue building on their knowledge gained at level 4 and apply their knowledge to realistic situations that would be encountered by an aerospace engineer. Performance of the engine is assessed through application of fundamental aerodynamics and thermodynamics.

Features: Not applicable

Educational aims: The course aims to provide a fundamental knowledge and understanding of aero-engine performance in various flight applications.

Outline syllabus: Indicative curriculum:

Aircraft and Engine Issues: Aircraft Drag, Weight, Lift and Flight Envelopes; Propulsion Requirements for an Aircraft; Range, Engine Thrust, Engine Weight and Fuel Consumption

Momentum Theory, Thrust and Efficiencies: Simple Model for Thrust Equation; Net Thrust, Gross Thrust, Ram Drag; Propulsive, Thermal and Overall Efficiencies

Gas Turbines and Jet Engine Cycles: Gas Turbine or Brayton Cycle; Thermal Efficiency; Actual vs. Ideal Brayton Cycle; Compressor and Turbine Isentropic Efficiencies; Net Work and Net Power; Power vs. Efficiency

Principle and Layout of Jet Engines: Working Principle; Layouts and Variations of Turbojet Engines; High Bypass Ratio Engine; Terminology and Station Numbering; Turbine Entry Temperature

Compressible Fluid Flow: Total Pressure and Temperatures; Impact of Compressibility on Engine Variables; Analysis of Compressible Flows Relating to Aero-engines; Choked Nozzle; Non-dimensional Mass Flow Rate

Bypass Ratio Selection: Significance of Bypass Flow; Design Decision on Bypass Ratio

Design Analysis Cycle: Design Point and Off Design Points; Compressor Working Line; Propelling Nozzle

Component Characteristics: Fan Operation; Polytropic and Isentropic Efficiency; Combustor Design and Operation; Ancillary Components; Certification Tests

Part 3: Teaching and learning methods

Teaching and learning methods: This module will combine lectures and lectorials to learn concepts and principles, as well as practicals to allow students to experience working on real engineering challenges.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Competently assess the overall gas turbine thermodynamics cycle within the context of aerospace applications. (SM3b, EA1b, P1)

MO2 Describe fundamental thermodynamics and property changes undergone by fluid in aero-engine making up a complete thermodynamic cycle. (EA2, EP)

MO3 Calculate the changes in fluid properties at specific engine stations and, from these, estimate the overall engine performance. (EA3b, P3)

MO4 Interpret mission requirements and propose suitable propulsion solutions. (D2, D3b, P4, P8)

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Laboratory work = 12 hours

Total = 150

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/modules/ufmfw6-15-3.html

Part 4: Assessment

Assessment strategy: The module will be assessed using two components.

Components A is a written end-of-semester exam to assess mathematical

competencies in an engineering context as well as fundamental understanding of various aspects of gas turbine engine performance.

Component B is a group project involving the use of simulation and modelling tools will be used to expose the students to modern methodological approaches and real engineering problems. Submission of presentation slides with supporting work files and a 30 minute group presentation including Q/A.

A peer review process will be used to moderate the group work mark in accordance with Department's Group Work Policy.

The resit assessment will differ from the first sit assessment in that component B will involve an appropriately scaled individual project. A written submission on a re-sit project with supporting work files. Student does not need to give a presentation.

Assessment components:

Examination (Online) - Component A (First Sit)
Description: Online examination: 5 hours
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3

Presentation - Component B (First Sit)
Description: 30 minute group presentation including Q/A.
Weighting: 50 %
Final assessment: No
Group work: Yes
Learning outcomes tested: MO1, MO2, MO4

Examination (Online) - Component A (Resit)
Description: Online examination: 5 hours
Weighting: 50 %

Final assessment: Yes

Group work: No

Learning outcomes tested: MO1, MO2, MO3

Report - Component B (Resit)

Description: Written submission on a re-sit project (10 pages)

Weighting: 50 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO2, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Aerospace Engineering [Sep][FT][Frenchay][3yrs] BEng (Hons) 2020-21

Aerospace Engineering [Sep][SW][Frenchay][4yrs] BEng (Hons) 2020-21

Aerospace Engineering [Sep][FT][Frenchay][4yrs] MEng 2020-21

Aerospace Engineering [Sep][SW][Frenchay][5yrs] MEng 2020-21

Aerospace Engineering with Pilot Studies [Sep][FT][Frenchay][3yrs] BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][4yrs] BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies [Sep][FT][Frenchay][4yrs] MEng 2020-21

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][5yrs] MEng 2020-21

Aerospace Engineering {Apprenticeship-UCW} [Sep][FT][UCW][4yrs] BEng (Hons) 2020-21

Aerospace Engineering {Apprenticeship-UWE} [Sep][FT][UCW][4yrs] BEng (Hons) 2020-21