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| Module Title: | Propulsion Systems 2 |
| Language of Instruction: | English |
| Credits: | 10 |
| NFQ Level: | 7 |
| Module Delivered In | 1 programme(s) |
| Teaching & Learning Strategies: | The module will be taught with lectures and laboratory exercises and will be supported by on-line media that are available on the college VLE. |
| Module Aim: | The aim of this module is to provide the student with the knowledge required to analyse the performance of a diverse range of propulsion systems in the aerospace domain. |
| Learning Outcomes | |
| <i>On successful completion of this module the learner should be able to:</i> | |
| LO1 | Perform calculations relating to the performance of air breathing aerospace propulsion systems. |
| LO2 | Calculate performance of different stages of propulsion systems. |
| LO3 | Numerically evaluate performance of propellers |
| LO4 | Categorise various electric propulsion architectures |
| Pre-requisite learning | |
| Module Recommendations | |
| <i>This is prior learning (or a practical skill) that is recommended before enrolment in this module.</i> | |
| No recommendations listed | |
| Incompatible Modules | |
| <i>These are modules which have learning outcomes that are too similar to the learning outcomes of this module.</i> | |
| No incompatible modules listed | |
| Co-requisite Modules | |
| No Co-requisite modules listed | |
| Requirements | |
| <i>This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.</i> | |
| No requirements listed | |

Module Content & Assessment

Indicative Content

Introduction to Thermodynamics

Review of conservation equations: mass, momentum and energy, thermodynamics, compressible flow, Introduction: air-breathing and rocket propulsion, first Law of thermodynamics, specific heat capacity, ratio of specific heat capacities, closed systems, open system, steady state energy equation, enthalpy.

Thermodynamics

Second Law of thermodynamics, entropy, T-S Diagrams.

Thermodynamic cycles

Otto Cycle, Diesel Cycle, Brayton Cycle, Mean effective pressure, cycle efficiency, PV diagrams.

Compressors

Centrifugal compressors, Axial compressor, work required, whirl speed, power.

Combustion

Stoichiometric combustion, thermochemistry, fuels, premixed, non-premixed flames, adiabatic flame temperature, experimental and numerical methods in combustion, flammability and stability limits.

Turbines

Work, power, reaction.

Nozzles

Critical pressure, critical temperature, nozzle velocity.

Froude Momentum

Froude momentum theory, in-flow, thrust.

Torsion of shafts.

2nd Polar Moment, Torque, Power, Shear, Moment of Inertia, Radius of Gyration.

Balancing of Rotating Masses

Static Balancing and Dynamic Balancing, both numerically and graphically.

Vibration

Whirl speed, torsional vibration, Rayleigh method, Dunkerley's method.

Electric Motor Propulsion Construction

Construction of rotating electric machines (outrunner, inrunner, rotor, stator, shaft, bearings, magnets, windings, electrical insulation, commutators, motor cooling, sensors).

Electric Motor Propulsion

Power electronics (switching devices, DC-DC converters, single-phase and multiple-phase DC-AC inverters, single-phase and multiple-phase AC-DC rectifiers). Motor control systems (control functions, speed control, torque control, position measurement, generator mode for energy recuperation, protection functions). Wiring of electric power storage, power electronics and electric motor. High energy and voltages risks, and associated safety procedures.

Assessment Breakdown

| | % |
|----------------------------------|--------|
| Continuous Assessment | 20.00% |
| Practical | 20.00% |
| End of Module Formal Examination | 60.00% |

Continuous Assessment

| Assessment Type | Assessment Description | Outcome addressed | % of total | Assessment Date |
|-----------------|---|-------------------|------------|-----------------|
| Written Report | Students will complete a written report where they will be required to perform some calculations. | 1,2,3,4 | 10.00 | Week 4 |
| Examination | A class test which may be administered on the college VLE. | 1,2 | 10.00 | Week 4 |

No Project

Practical

| Assessment Type | Assessment Description | Outcome addressed | % of total | Assessment Date |
|-----------------------------|---|-------------------|------------|-----------------|
| Practical/Skills Evaluation | A series of practical tasks relating to the performance of a propulsion system. | 1,2 | 10.00 | Every Week |
| Practical/Skills Evaluation | Will consist of a practical test in which students will be required to write software to analyse a propulsion system. | 1,2,3 | 10.00 | Week 12 |

| End of Module Formal Examination | | | | |
|----------------------------------|---|--------------------------|-------------------|------------------------|
| <i>Assessment Type</i> | <i>Assessment Description</i> | <i>Outcome addressed</i> | <i>% of total</i> | <i>Assessment Date</i> |
| Formal Exam | A formal written exam where students will be required to perform calculations relating to propulsion systems. | 1,2,3,4 | 60.00 | End-of-Semester |

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

Module Workload

| Workload: Full Time | | |
|----------------------------|--------------------|--|
| <i>Workload Type</i> | <i>Frequency</i> | <i>Average Weekly Learner Workload</i> |
| Lecture | 12 Weeks per Stage | 5.00 |
| Practicals | 12 Weeks per Stage | 4.00 |
| Independent Learning | 15 Weeks per Stage | 9.47 |
| Total Hours | | 250.00 |

Module Delivered In

| Programme Code | Programme | Semester | Delivery |
|----------------|---|----------|-----------|
| CW_EEACS_D | Bachelor of Engineering in Aircraft Systems | 5 | Mandatory |