# ELEC H3604: Electrical Propulsion

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| **Module Title:** | Electrical Propulsion |
| **Language of Instruction:** | English |

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| **Credits:** | 10 |

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| **NFQ Level:** | 7 |

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| **Module Delivered In** | 1 programme(s) |

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| **Teaching & Learning Strategies:** | Teaching will be conducted through lectures, practicals and problem-based learning. The Institute VLE will be used to evaluate the student's understanding of the basic concepts during each section, including using class tests. The practical sessions will be used to support the theory. |

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| **Module Aim:** | To provide students with an understanding of how propulsion systems can implement in the age of "more electric aircraft". |

| **Learning Outcomes** | |
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| *On successful completion of this module the learner should be able to:* | |
| LO1 | Apply the fundamental principles of electrical power generation, distribution, protection and utilization on board aircraft. |
| LO2 | Use computer based engineering tools to evaluate electronically controlled electrical and electronic propulsion systems for aircraft. |
| LO3 | Perform calculations relating to the peformance of air breathing aerospace propulsion systems. |
| LO4 | Develop knowledge and calculate performance of different stages of propulsion systems. |

| **Pre-requisite learning** |
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| ***Module Recommendations***<br>*This is prior learning (or a practical skill) that is recommended before enrolment in this module.* |
| No recommendations listed |
| ***Incompatible Modules***<br>*These are modules which have learning outcomes that are too similar to the learning outcomes of this module.* |
| No incompatible modules listed |
| ***Co-requisite Modules*** |
| No Co-requisite modules listed |
| ***Requirements***<br>*This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.* |
| No requirements listed |

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## Module Content & Assessment

| Indicative Content |
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| **Avionic Fundamentals Review**<br>AC theory, transformers, relays, contactors, RLC Circuits, power factor, power factor correction, J-notation, polar form, transistors as a switch, pulse code modulation. |
| **Electrical Power**<br>Batteries (installation and operation, new battery technology, UAV batteries), DC power generation, AC power generation, emergency power generation, voltage regulation, frequency regulation, power distribution and utilization, circuit protection, external / ground power. |
| **Electrical Motor Propulsion**<br>Power electronics (switching devices, DC–DC converters, single-phase and multiple-phase DC–AC inverters, single-phase and multiplephase 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. |
| **Electric Motor Propulsion**<br>Construction of rotating electric machines (outrunner, inrunner, rotor, stator, shaft, bearings, magnets, windings, electrical insulation, commutators, motor cooling, sensors). Induction, reluctance, brushless dc, series, shunt motors. |
| **Introduction to Thermodynamics**<br>Review of conservation equations: mass, momentum and energy, thermodynamics, compressible flow, Introduction: air-breathing, first Law of thermodynamics, specific heat capacity, ratio of specific heat capacities, closed systems, open system, steady state energy equation, enthalpy. |
| **Propulsion Thermodynamics**<br>Second Law of thermodynamics, entropy, T-S Diagrams, Otto Cycle, Diesel Cycle, Brayton Cycle, Mean effective pressure, cycle efficiency, PV diagrams. |
| **Combustion**<br>Combustion: stoichiometry, thermochemistry, Fuels, premixed, non-premixed flames, adiabatic flame temperature, experimental and numerical methods in combustion, flammability and stability limits. |
| **Froude Momentum**<br>Froude momentum theory, in-flow, thrust. |
| **Torsion of Shafts**<br>2nd Polar Moment, Torque, Power, Shear, Moment of Inertia, Radius of Gyration. |
| **Balancing of Rotating Masses**<br>Static Balancing and Dynamic Balancing, both numerically and graphically. |
| **Vibration**<br>Whirl Speed, Torsional Vibration, Rayleigh method, Dunkerley's method. |

| Assessment Breakdown | % |
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| 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 | n/a | 1,3,4 | 10.00 | Week 8 |
| Examination | n/a | 1,3,4 | 10.00 | Week 5 |

No Project

**Practical**

| *Assessment Type* | *Assessment Description* | *Outcome addressed* | *% of total* | *Assessment Date* |
|---|---|---|---|---|
| Practical/Skills Evaluation | Completion of assigned practical tasks. | 1,2,3,4 | 20.00 | Every Week |

**End of Module Formal Examination**

| *Assessment Type* | *Assessment Description* | *Outcome addressed* | *% of total* | *Assessment Date* |
|---|---|---|---|---|
| Formal Exam | A formal envigilated exam at the end of the semester. | 1,3,4 | 60.00 | End-of-Semester |

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

# ELEC H3604: Electrical Propulsion

## Module Workload

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

## Module Delivered In

| Programme Code | Programme | Semester | Delivery |
|---|---|---|---|
| CW_EEAER_B | Bachelor of Engineering (Honours) in Aerospace Engineering | 5 | Mandatory |