Subject Description Form

Subject Code	AAE5205
Subject Title	Aircraft Engine Systems and Combustion
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To provide students with fundamental knowledge of advanced aircraft engine systems and combustion sciences and their applications in modern gas-turbine engines.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. obtain state-of-the-art knowledge in the areas of aircraft propulsion systems and combustion sciences; b. apply their knowledge, skills and hand-on experience to the design and analysis of aircraft propulsion and combustion systems; c. extend their knowledge of aeronautical engineering to different situations of engineering context and professional practice in propulsions and combustion systems; and d. recognize the need for and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	**Introduction to propulsion**: Fluid momentum; Reaction force; Rockets; Propellers; Turbojets; Turboprop; Turbofans. **Review of thermodynamics**: Mass, momentum and energy conservation laws; Thermal properties; First Law of Thermodynamics; *p*-*v*-*T* relation; Ideal gas model; Kelvin-Planck and Clausius statements; Reversible and irreversible processes; Carnot cycle; Clausius inequality; Entropy; Isentropic processes; Isentropic efficiencies; Brayton cycle. **Steady-state, one-dimensional (1-D), compressible flow**: Quasi-1-D flow of perfect gas; Isentropic and non-isentropic flow; Stagnation concept; Nozzle equations. **Propulsion basics**: Thrust equations; Thermal and propulsion efficiencies; Fuel consumption rate and specific thrust; Engine performance; Aircraft range. **Cycle analysis and engine performances**: Turbojet, turbofan, turboprop and turbo-shaft engines. **Subsystems –** Inlets; Turbomachinery: basics of compressors and turbines; Combustors; Nozzles. **Modern aircraft engines:** High-by-pass engines. **Introduction to Combustion**: Combustion modes and flame types; Stoichiometric and equivalence fuel-air ratio; Complete, lean & rich combustion; Elementary of chemical kinetics; Combustor types; Combustor design and flame-holders.

Teaching/Learning Methodology

The teaching and learning methods include lectures, homework assignment, test, and examination. Technical/practical examples and problems will be raised and discussed in class. Project is designed to evaluate the aircraft engine systems.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Project	25%	√	√	√	√
2. Homework assignment	25%	√	√	√	√
3. Final examination	50%	√	√	√	
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

$$0.5 \times \text{Continuous Assessment} + 0.5 \times \text{Final Examination}$$

The continuous assessment consists of project, homework assignments and tests. They are aimed at evaluating the progress of students' study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

The examination is used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	39 Hrs.
Other student study effort:	
▪ Self-Study	67 Hrs.
Total student study effort	106 Hrs.

Reading List and References	1. Thermodynamics: An Engineering Approach, 8th Edition, 2014, by Yunus A. Cengel and Michael A. Boles. McGraw-Hill Education 2. Fluid Mechanics: Fundamentals and Applications, 4th Edition, 2018. Cengel, Y. & Cimbala, J., McGraw-Hill Education 3. Elements of Propulsion: Gas Turbine and Rockets, 2nd Edition, 2006. Jack Mattingl., AIAA. 4. The Jet Engine, 5th Edition, Rolls Royce, WileyAircraft Engine Design, 3rd Edition, Mattingly, J., AIAA. 5. An Introduction to Combustion: Concepts and Applications, 4th Edition, 2021. Turns, S. et al., McGraw Hill. 6. A Gallery of Combustion and Fire, 1st Edition, 2020. Agarwal, A. et al., Cambridge University.

July 2023