Subject Description Form

Subject Code	ME47007
Subject Title	Aircraft and Spacecraft Propulsion
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME34002 Engineering Thermodynamics; and ME34004 Fluid Mechanics
Objectives	1. To provide students with the basic knowledge relevant to propulsion systems of aircraft and spacecraft. 2. To provide students with knowledge and applications of thermodynamic cycles in propulsion systems of aircraft and spacecraft and the chemistry and thermodynamics of combustion.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand basic knowledge of modern propulsion systems used in today's aircraft and spacecraft, such as turbojet, turbofan and rocket propulsion. b. Obtain state-of-the-art knowledge in the area of advanced aerodynamics and thermodynamics related to modern propulsion systems in aircraft and spacecraft. c. Apply their knowledge, skills and hand-on experience to the design and analysis of propulsion systems in aircraft and spacecraft. d. Extend their knowledge of mechanical engineering to different situations of engineering context and professional practice in turbomachinery.
Subject Synopsis/ Indicative Syllabus	***Basic Knowledge of Compressible Flows and Thermodynamics*** **-** Conservation laws including continuity equation, momentum equation and energy equation. Brief review of thermodynamics. Isentropic and polytropic processes, stagnation concept. Speed of sound and Mach number. Quasi-one-dimensional flows, including compressible flows with friction and heat and nozzle flows. ***Introduction to Propulsion Systems of Aircraft*** **-** Thrust and drag. Engine stall. Ramjet, turbojet, turbofan, turboprop, turbo-shaft engines, and new types of engines. Engine maintenance. Engine airworthiness. ***Basic Components of Aircraft Gas-turbine Engine*** **-** Inlets. Compressor. Combustion chambers and afterburners. Turbine and nozzles. ***Cycle Analysis and Performance*** **-** Thrust equations. Engine performance parameters. Thermal and propulsion efficiencies. Fuel consumption rate and specific thrust. Basic considerations in the analysis of jet propulsion. Inter-cooling. Reheating. Regeneration. Cycle analysis. Modifications to turbojet engines. Gas turbine design. ***Turbomachinery*** **-** Basics of compressors and turbines. ***Introduction to Propulsion Systems of Spacecraft*** **-** Chemical rockets. Spacecraft propulsion. Electric propulsion. Rocket thrust. High-speed Airbreathing engines. Hypersonic propulsion.

Teaching/Learning Methodology

Lectures are used to deliver the fundamental knowledge in relation to propulsion systems of aircraft and spacecraft (outcomes a to d).

Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to d).

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

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	50%	√	√	√	√
2. Assignments including Tests	30%	√	√	√	√
3. Experiment	20%	√	√	√	√
Total	100%				

Overall Assessment:

$0.50 \times$ End of Subject Examination + $0.50 \times$ Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignments, closed-book tests and group experiment. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus. Continuous assessment will also be used to assess the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfill the requirements of being space engineers.

All assigned homework inclusive of any computer problems should be worked independently. It is the students' responsibilities to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a zero score will be assigned.

Student Study Effort Expected

Class contact:	
▪ Lecture	33 Hrs.
▪ Tutorial/Lab.	6 Hrs.
Other student study effort:	
▪ Assignments	36 Hrs.
▪ Self-study	40 Hrs.
Total student study effort	115 Hrs.

Reading List and References

1. S. Farokhi. Aircraft Propulsion, Wiley, latest edition.
2. Hill P. and Peterson C., *Mechanics and Thermodynamics of Propulsion*. Addison Wesley, latest edition.
3. Sutton G. P., Biblarz O., *Rocket Propulsion Elements*, John Wiley & Sons, Inc., latest edition.
4. P. Fortescue, *et al.* Spacecraft Systems Engineering, Wiley, latest edition.