AIRCRAFT PROPULSION

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC07	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Knowledge of Engineering Thermodynamics

I. COURSE OVERVIEW:

An aerospace propulsion system is a machine that produces thrust to push an aircraft forward. This course introduces various aircraft propulsion systems, and their performance analysis. The course discusses the operating principles of the aircraft engine's major components such as inlets, compressors, turbines, and nozzles. The design parameters, performance characteristics, and the factors influencing them are also addressed. This course is a prerequisite to the next level course, Turbomachinery.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of air-breathing propulsion system, their operating principles, and function of an individual component.
II. The geometry off low inlets, combustion chambers, and factors affecting their performance.
III. The establishment of flow through various inlets and nozzles under different operating conditions.
IV. The operating principles of various compressors, turbines and performance characteristics under different flight conditions.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Compare** the operating principles of various gas turbine engines and their components for selecting the suitable engine as per the mission requirements.	Understand
CO 2	**Utilize** the thrust equation and engine cycle analysis for achieving the required performance.	Apply
CO 3	**Apply** the knowledge of flow through various inlets, and nozzles under various operating conditions for selecting the suitable inlets and nozzle as per the mission requirement.	Apply
CO 4	**Compare** the different types of combustion chambers for identifying the design variables affecting their performance.	Understand
CO 5	**Make use of** the performance characteristics and efficiencies of different compressors and turbines for identifying a suitable combination.	Apply
CO 6	**Identify** the important design performance parameters of ramjet engine towards developing optimized ramjet engine.	Apply

IV. SYLLABUS:

MODULE-I: AIR-BREATHING ENGINES(09)

Classification, operational envelopes; Description and function of gas generator, turbojet, turbofan, turboprop, turbo shaft, ramjet, scramjet, turbojet/ramjet combined cycle engine, thrust equation; Engine performance parameters, specific thrust, specific fuel consumption and specific impulse, thermal efficiency, propulsive efficiency, engine overall efficiency and its impact on aircraft range and endurance; Ideal cycle analysis , a turbojet, turbojet with afterburner, turbofan engine.

MODULE –II: INLETS AND COMBUSTION CHAMBERS(09)

Internal flow and stall in subsonic inlets, relation between minimum area ratio and external deceleration ratio, diffuser performance, supersonic inlets, operating conditions of supersonic inlet, starting problem on supersonic inlets, shock swallowing by area variation; Classification of combustion chambers, Combustion mechanism and important combustion parameters. Pressure losses; combustion efficiency; combustion intensity. Factors affecting combustion chamber design, and operation, flame stabilization

MODULE –III: NOZZLES(09)

heory of flow in isentropic nozzles, nozzles and choking, nozzle throat conditions, nozzle efficiency, losses in nozzles.

Over expanded and under expanded nozzles, Nozzle design considerations: fixed and variable geometry nozzles, thrust vectoring, thrust reversal.

MODULE –IV: COMPRESSORS(09)

Principle of operation of centrifugal compressor and axial flow compressor, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant reaction designs of axial flow compressor, performance characteristics of centrifugal and axial flow compressors, stage efficiency calculations, cascade testing.

MODULE –V: TURBINES(09)

Principle of operation of axial flow turbines, limitations of radial flow turbines, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant angle designs, performance characteristics, turbine blade cooling.

V. TEXT BOOKS:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison Wesley Longman INC, 1999.
2. Mattingly J.D., "Elements of Propulsion: Gas Turbines and Rocket", AIAA, 1991.

VI. REFERENCE BOOKS:

1. Cohen, H.Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.

VII. WEB REFERENCES:

1. https://nptel.ac.in/courses/101101002/
2. https://nptel.ac.in/courses/112106073/

VIII. E-TEXT BOOKS:

1. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html
2. https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems
3. https://www.crcpress.com/Aircraft-Propulsion-and-Gas-Turbine-Engines/ElSayed/p/book/9780849391965