

## AEROSPACE PROPULSION

<b>IV Semester: AE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
AAEB08	Core	3	1	-	4	30	70	100
		<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>		<b>Total Classes: 60</b>

### 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, Turbo machinery.

### II. OBJECTIVES:

The course should enable the students to:

- I The fundamentals of air-breathing propulsion system, their operating principles, and function of an individual component.
- II The geometry of flow 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:

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|------|--|------------|
| 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 nozzles 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:

<b>MODULE -I</b>	<b>AIR-BREATHING ENGINES</b>	<b>Classes: 10</b>
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; Parametric cycle analysis a, turbojet, turbojet with afterburner, turbofan engine, turboprop engine.		
<b>MODULE -II</b>	<b>INLETS AND COMBUSTION CHAMBERS</b>	<b>Classes: 10</b>
Internal flow and stall in subsonic inlets, relation between minimum area ratio and eternal 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.		
<b>MODULE -III</b>	<b>NOZZLES</b>	<b>Classes: 08</b>
Theory 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.		
<b>MODULE -IV</b>	<b>COMPRESSORS</b>	<b>Classes: 09</b>
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.		
<b>MODULE -V</b>	<b>TURBINES</b>	<b>Classes: 08</b>
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, sample ramjet design calculations, flame stability problems in ramjet combustors, integral ram rockets.		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>Hill, P.G. &amp; Peterson, C.R. "Mechanics &amp; Thermodynamics of Propulsion" Addison Wesley Longman INC, 1999.</li> <li>Mattingly J.D., "Elements of Propulsion: Gas Turbines and Rocket", AIAA, 1991.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Cohen, H.Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.</li> <li>Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li><a href="https://nptel.ac.in/courses/101101002/">https://nptel.ac.in/courses/101101002/</a></li> <li><a href="https://nptel.ac.in/courses/112106073/">https://nptel.ac.in/courses/112106073/</a></li> </ol>		
<b>E-Text Books:</b>		
<ol style="list-style-type: none"> <li><a href="https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html">https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html</a></li> <li><a href="https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems">https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems</a></li> <li><a href="https://www.crcpress.com/Aircraft-Propulsion-and-Gas-Turbine-Engines/ElSayed/p/book/9780849391965">https://www.crcpress.com/Aircraft-Propulsion-and-Gas-Turbine-Engines/ElSayed/p/book/9780849391965</a></li> </ol>		
<b>Course Home Page:</b>		