INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

AIRCRAFT PROPULSION AND TURBO MACHINERY								
IV Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED07	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Thermodynamics and Heat Transfer								

I. COURSE OVERVIEW:
An aircraft 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.

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 will 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.
CO 2 Utilize the thrust equation and engine cycle analysis for achieving the required performance.
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.
CO 4 Compare the different types of combustion chambers for identifying the design variables affecting their performance.
CO 5 Summarize the operating principles of various compressors, turbines for their suitable selection.
CO 6 Make use of the performance characteristics and efficiencies of different compressors and turbines for identifying a suitable combination.

IV. COURSE CONTENT:

MODULE-I: AEROSPACE ENGINES CLASSIFICATION AND THERMODYNAMIC CYCLE ANALYSIS (10)

Description and function of gas generator, Classifications of Aerospace Engines-Turbo jet Engines, Turboprop, Turboshaft, Turbo fan Engines, Propfan Engines Advanced Ducted Fan, Classification of Jet Engines-Ramjet, Pulsejet, Scramjet, Turboramjet, Turbo rocket -Thrust Equation, FactorsAffectingThrust

Jet Nozzle Air Speed Mass Air Flow Altitude, Ram Effect, Ideal cycle analysis- turbo jet, turbofan, real cycle analysis- turbojet, Engine Performance Parameters Propulsive Efficiency Thermal Efficiency Propeller Efficiency Overall Efficiency Take off Thrust Specific Fuel Consumption, Aircraft Range, Endurance Factor Specific Impulse.

MODULE –II: INLETS AND COMBUSTION CHAMBERS (10)

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, Supersonic Combustion Chamber Combustion Process Chemistry of Combustion, important combustion parameters. Pressure losses; combustion efficiency; combustion intensity. Factors affecting combustion chamber design, and operation, flame stabilization, Cooling, Material, Aircraft Fuels, Emissions and Pollutants.

MODULE –III: NOZZLES (09)

Governing Equations, 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, after burning nozzles, thrust vectoring, thrust reversal Classification of Thrust Reverser Systems.

MODULE –IV: COMPRESSORS (10)

Principle of operation of centrifugal compressor and axial flow compressor, work done and pressure rise, types of velocity triangles, degree of reaction, free vortex and constant reaction designs of axial flow compressor, Basic design parameters , Centrifugal Stress, Tip Mach number, fluid deflection, design process for compressor, Blade design, Cascade measurements-ChoosingtheTypeofAirfoil, Stage performance Blade Efficiency and Stage Efficiency, performance characteristics of centrifugal and axial flow compressors-single stage, multistage compressor, Stall and Surge, Surge Control Methods Multi spool compressor ,variable vanes, air bleed.

MODULE –V: TURBINES (09)

Principle of operation of axial flow turbines, comparison of axial flow compressors and turbines, limitations of radial flow turbines, work done and pressure rise, velocity triangles, degree of reaction, free vortex and constant angle designs, preliminary design- main design step, aerodynamics design performance characteristics, losses and efficiency, profile loss, annulus loss secondary flow loss, tip clearance loss, 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. ELECTRONICS RESOURCES:

1. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1118806778.html
2. https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems

VIII. MATERIALS ONLINE

1. Course template

2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation