COURSE CODE	COURSE TITLE	L	T	P	C
1151AE108	AIRCRAFT GAS TURBINE PROPULSION	2	2	0	3

Course Category:

Programme core

a. Preamble :

This provides the descriptive knowledge towards concept of air breathing engine such as gas turbine engine and its practical applications. This subject also links with some of the other basic prerequisite courses such as Aero Engineering Thermodynamics, Fluid Mechanics and rockets and missiles. This course provides experimental approach to the students to investigate gas turbines.

b. Prerequisite Courses:

- Aero Engineering Thermodynamics

c. Related Courses:

- Rocket and space propulsion
- Ramjet and Scramjet Propulsion
- Combustion in Jet and Rocket Engines

d. Course Educational Objectives:

- To understand and analyse the gas turbine engine and its components.
- To realize and analyse the thermodynamics of various component of a gas turbine engine.
- To synthesize and recognize how the engine integrates into an aircraft system and how to link the engine requirements to an aircraft's mission requirements

e. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the working concept of various types of gas turbine engines	K2
CO2	Differentiate between a subsonic and a supersonic inlet and further relate it to aerospace applications	K4
CO3	Analyze the working concept of various types of compressor	K4
CO4	Examine the suitability of the combustion chamber & nozzle for a given gas turbine engine	K4
CO5	Illustrate the operational and designing concepts of gas turbine blade and estimate performance of turbines	K4,

f. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**H**			**H**			**M**	**H**				
CO2	**H**			**H**			**M**	**H**				
CO3	**H**			**H**			**M**	**H**				
CO4	**H**			**H**			**M**	**H**				
CO5	**H**			**H**			**M**	**H**				

H High; M-Medium; L-Low

g. Course Contents:

UNIT I - FUNDAMENTALS OF GAS TURBINE ENGINES L - 6 T - 6

Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature of air entering through gas turbine engines – Methods of thrust augmentation – Characteristics of turbojet, turboprop, turbofan, turbo shaft and ramjet – Performance Characteristics-Materials for gas turbine engines.

UNIT II - SUBSONIC AND SUPERSONIC INLETS L - 6 T - 6

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and external deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Models of inlet operation.

UNIT III – COMPRESSORS L - 6 T - 6

Principle of operation of axial and centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

UNIT IV - COMBUSTION CHAMBERS AND NOZZLES L - 6 T - 6

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – simplex and Duplex type of Burners. Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust Reversal-Numerical problems

UNIT V - GAS TURBINES L - 6 T - 6

Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementary theory – Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance – Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling – Matching of turbine and compressor – Numerical problems.

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Total Periods: 30+30= 60

h. Learning Resources

i. Text Books:

1. Hill, P.G. & Peterson, C.R., Mechanics and Thermodynamics of Propulsion, Pearson India, 2nd Edition 2009.
2. Jack Mattingly, Elements of Gas Turbine Propulsion, Tata McGraw Hill Education (India) Pvt Ltd, 1st Edition, 2005

ii. References:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, HIH and Straznicky, Gas Turbine Theory, Sixth Edition, Pearson Further Education, 2009
2. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, Taylor & Francis Group, 1st Edition, CRC press, 2008
3. Ganesan V, Gas Turbines, 3rd Edition, Tata McGraw-Hill Education (India) Pvt Ltd, Delhi, 2010

4. Saeed Farokhi, Aircraft Propulsion, John Wiley & Sons Inc; 1st edition (2008)
5. Rolls Royce Jet Engine – Technical Publications Department, Rolls-Royce Plc, Derby, England, Fifth Edition – 1996.