AEROSPACE PROPULSION AND COMBUSTION

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

COURSE OBJECTIVES:

I. Demonstrate with an overview of various aerospace propulsion systems and a sound foundation in the fundamentals of thermodynamics.
II. Distinguish the elementary principles of thermodynamic cycles as applied to propulsion analysis.
III. Prioritize an introduction to combustion& gas kinetic theory.
IV. Discover the knowledge of working knowledge of and the tools to measure various flight propulsion systems such as turbojets, turbofans, ramjets, rockets, air turbo-rockets and nuclear/electric propulsion systems.

COURSE OUTCOMES (COs):

CO 1: Gain knowledge about power plants and aircraft engines performance
CO 2: Assess the importance of various types engine components used in the aircraft
CO 3: Obtain an insight in the concept of propellers, inlets and various nozzles in aircraft
CO 4: Assess the significance of combustion inside the engines and its performance
CO 5: Estimate the flammability limits, premixed flames and their significance in the combustion zone

COURSE LEARNING OUTCOMES (CLOs):

1. Apply knowledge and understand the essential facts, concepts and principles of
2. Understand the basic function of all aircraft engine components and how they work.Analyze the engine performance parameters and parameters influencing them..
3. Analyze classification of aircraft propulsion.Demonstrate different types aircraft engine operating principle.
4. Demonstrate different type's aircraft engine operating principle.Understand steps involved in performance analysis of all aircraft engine.
5. Understand step by step procedure of engine parametric cycle analysis.Analyze diffuser performance, losses in it and their impact on engine performance.
6. Describe principle of operation of axial and centrifugal compressor.Understand different types of combustion chamber and functions of all the components.
7. Understand different design of compressor and limitations of each method.Describe theory of flow in isentropic nozzle and physics behind nozzle operation.
8. Analyze performance characteristics of axial and centrifugal turbines.Describe principle of operation of axial and centrifugal compressor.
9. Analyze propeller performance and its types and explain their impact on engine performance.Analyze performance characteristics of axial and centrifugal compressor.
10. Describe operational modes of subsonic inlets and parameters influencing it.
11. Describe theory of flow in isentropic nozzle and physics behind nozzle operation.
12. Understand different nozzle operating conditions for convergent and divergent nozzle.
13. Understand different types of combustion chamber and functions of all the components.
14. Describe the effect of operating variables on performance.

15. Analyze combustion chamber performance and parameters influencing them.
16. Describe the effect of flame tube cooling and its applications.
17. Understand different types of premixed flames.
18. Explain the significance of flammability limits during combustion process.
19. Describe theory of droplet combustion and turbulent combustion.
20. Analyze the numerical methods of LNS & DNS and explain the parameters influencing them.

Unit-I	**ELEMENTS OF AIRCRAFT PROPULSION**	**Classes: 10**

Classification of power plants, methods of aircraft propulsion, propulsive efficiency, specific fuel consumption, thrust and power, factors affecting thrust and power, illustration of working of gas turbine engine, characteristics of turboprop, turbofan and turbojet engines and performance.

Unit -II	**COMPONENTS OF JET ENGINES**	**Classes: 08**

Ram jet, scram jet engines construction and nomenclature, theory and performance, methods of thrust augmentation, atmospheric properties, introduction to compressors, turbines, combustors and after burners for aircraft engines.

Unit-III	**INLETS, NOZZLES AND PROPERLLER THEROY**	**Classes: 10**

Propeller performance parameters, negative thrust, prop fans, ducted propellers, propeller noise, propeller selection, propeller charts. Subsonic and supersonic inlets, relation between minimum area ratio and external deceleration ratio.

Starting problem in supersonic inlets, modes of inlet operation, jet nozzle, efficiencies, over expanded, under and optimum expansion in nozzles, thrust reversal.

Unit-IV	**THERMODYNAMICS OF REACTING SYSTEMS**	**Classes: 09**

Classification of combustion chambers, combustion chamber performance, flame tube cooling, flame stabilization, effect of operating variables on performance.

Unit-V	**PREMIXED FLAMES**	**Classes: 08**

Rankine hugoniot relations, theories of laminar premixed flame propagation, quenching and flammability limits; Diffusion flames: Burke-Schumann theory, laminar jet diffusion flame, droplet combustion, turbulent combustion, closure problem, premixed and non-premixed turbulent combustion, introduction to DNS and LES.

Text Books:

1. Stephen R. Turns, “An Introduction to Combustion”, McGraw-Hill, 3rd Edition, 2012.
2. Thomas A. Ward. “Aerospace Propulsion Systems”, John Wiley and Sons, 1st Edition, 2010..

Reference Books:

1. M. H. Sadd, “Elasticity: Theory, Applications, and Numerics”, Academic Press, 2nd Edition, 2009.
2. R. G. Budynas “Advanced Strength and Applied Stress Analysis”, McGraw-Hill, 2nd Edition, 1999.
3. A.P. Boresi, R.J. Schmidt, “Advanced Mechanics of Materials”, John Willey & Sons, 5th Edition, 2003.

Web References:
1. https://www.nptel.ac.in/courses/101101002/ 2. https://www.en.wikipedia.org/wiki/Airbreathing_jet_engine 3. https://www.en.wikipedia.org/wiki/Combustor **4.** https://www.aero.iisc.ernet.in/page/propulsion
E-Text Books:
1. https://www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118307984.html 2. https://www.sciencedirect.com/science/book/9781856179126 3. https://www.books.google.co.in/books?id=iUuPAQAAQBAJ&source=gbs_similarbooks