Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE551

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

MODEL QUESTION PAPER - II

B. Tech VI Semester End Examinations (Regular), May – 2020
Regulations: R16
AEROSPACE PROPULSION AND COMBUSTION
(MECHANICAL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit All
Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. a) Draw and explain the functions of all the major components in turbojet engine. **[7M]**

   b) A turbojet engine is powering a fighter airplane. Its cruise altitude and Mach number are 10 km and 0.8, respectively. The exhaust gases leave the nozzle at a speed of 570 m/s and a pressure of0.67 bar. The exhaust nozzle is characterized by the ratio $Ae/\dot{m}a = 0.006 m^2 \cdot s/kg$. The fuel-to-air ratio is 0.02. It is required to calculate **[7M]**
   (a) The specific thrust ($T/\dot{m}a$).
   (b) The propulsive efficiency using the different expressions defined above.

2. a) Illustrate turbofan engine and explain the functions of all the components. **[7M]**

   b) Boeing 747 aircraft is powered by four CF-6 turbofan engines manufactured by General Electric Company. Each engine has the following data: **[7M]**
   Thrust force 24.0 kN
   Air mass flow rate 125 kg/s
   Bypass ratio 5.0
   Fuel mass flow rate 0.75 kg/s
   Operating Mach number 0.8
   Altitude 10 km
   Ambient temperature 223.2 K
   Ambient pressure 26.4 kPa
   Fuel heating value 42,800 kJ/kg
   If the thrust generated from the fan is 75% of the total thrust,
   determine
   (a) The jet velocities of the cold air and hot gases
   (b) The specific thrust
   (c) The thrust specific fuel consumption (TSFC)

UNIT – II

3. a) Write a brief note on performance characteristics of axial and centrifugal compressor. **[7M]**

   b) Write short notes on **[7M]**
   (a) Compressor stall (b) surge (c) rotating stall.

4. a) Explain in detail about scramjet engine with a neat sketch **[7M]**

   b) Explain different thrust agumentation methods for improving the thrust of an engine with a neat sketch. **[7M]**

UNIT – III

5.	a)	Explain the difference forces acting on a propeller with a neat sketch.	**[7M]**
	b)	Explain the nomenclature of a propeller with a neat diagram.	**[7M]**
6.	a)	Explain about various methods used for thrust reversal.	**[7M]**
	b)	Explain the relation between minimum area and external deceleration area	**[7M]**

UNIT – IV

7.	a)	Explain in detail about different flame holders used inside a combustion chamber with a neat diagram.	**[7M]**
	b)	Explain in brief different types of combustion chamber with neat sketch.	**[7M]**
8.	a)	With the help of neat diagram, explain the concept of combustion stability	**[7M]**
	b)	Write a brief notes on flame tube cooling with relevant diagrams.	**[7M]**

UNIT – V

9.	a)	Explain in brief about droplet combustion with a neat sketch.	**[7M]**
	b)	Explain laminar jet diffusion flame with a neat diagram	**[7M]**
10	a)	Illustrate the importance of using DNS and LES numerical techniques in improving the flame stabilization.	**[7M]**
	b)	Explain in detail the process of quenching and list its advantages over normal combustion process.	**[7M]**

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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

COURSE LEARNING OUTCOMES (CLOs):

S. No.	Description
AAE551.01	Apply knowledge and understand the essential facts, concepts and principles of thermodynamics.
AAE551.02	Understand the basic function of all aircraft engine components and how they work.
AAE551.03	Analyze classification of aircraft propulsion.
AAE551.04	Demonstrate different type's aircraft engine operating principle.
AAE551.05	Understand step by step procedure of engine parametric cycle analysis.
AAE551.06	Describe principle of operation of axial and centrifugal compressor.
AAE551.07	Understand different design of compressor and limitations of each method.
AAE551.08	Analyze performance characteristics of axial and centrifugal turbines.
AAE551.09	Analyze propeller performance and its types and explain their impact on engine performance.
AAE551.10	Describe operational modes of subsonic inlets and parameters influencing it.
AAE551.11	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.
AAE551.12	Understand different nozzle operating conditions for convergent nozzle
AAE551.13	Understand different nozzle operating conditions for convergent and divergent nozzle.
AAE551.14	Understand different types of combustion chamber and functions of all the components.
AAE551.15	Analyze combustion chamber performance and parameters influencing them.
AAE551.16	Describe the effect of flame tube cooling and its applications.
AAE551.17	Understand different types of premixed flames.

AAE551.18	Describe theory of droplet combustion and turbulent combustion.
AAE551.19	Analyze the numerical methods of LNS & DNS and explain the parameters influencing them.
AAE551.20	Understand different types of combustion chamber and functions of all the components.

MAPPING OF SEMESTER END EXAMINATIONS TO COURSE LEARNING OUTCOMES:

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AAE551.01	Apply knowledge and understand the essential facts, concepts and principles of thermodynamics.	CO 1	Understand
	b	AAE551.02	Understand step by step procedure of engine parametric cycle analysis.	CO 1	Understand
2	a	AAE551.03	Demonstrate different type's aircraft engine operating principle.	CO 1	Understand
	b	AAE551.04	Understand step by step procedure of engine parametric cycle analysis.	CO 1	Understand
3	a	AAE551.05	Describe principle of operation of axial and centrifugal compressor.	CO 2	Understand
	b	AAE551.06	Analyze performance characteristics of axial and centrifugal turbines.	CO 2	Remember
4	a	AAE551.07	Analyze performance characteristics of axial and centrifugal turbines.	CO 2	Remember
	b	AAE551.08	Understand step by step procedure of engine parametric cycle analysis.	CO 2	Remember
5	a	AAE551.09	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.	CO 3	Understand
	b	AAE551.10	Analyze propeller performance and its types and explain their impact on engine performance.	CO 3	Understand
6	a	AAE551.11	Describe operational modes of subsonic inlets and parameters influencing it.	CO 3	Remember
	b	AAE551.12	Describe operational modes of subsonic inlets and parameters influencing it.	CO 3	Remember
7	a	AAE551.13	Understand different types of combustion chamber and functions of all the components.	CO 4	Understand
	b	AAE551.14	Describe the effect of flame tube cooling and its applications.	CO 4	Remember
8	a	AAE551.15	Understand different types of combustion chamber and functions of all the components.	CO 4	Understand
	b	AAE551.16	Describe the effect of flame tube cooling and its applications.	CO 4	Remember
9	a	AAE551.17	Understand different types of premixed flames.	CO 5	Remember
	b	AAE551.18	Describe theory of droplet combustion and turbulent combustion.	CO 5	Understand
10	a	AAE551.19	Describe theory of droplet combustion and turbulent combustion.	CO 5	Remember
	b	AAE551.20	Analyze the numerical methods of LNS & DNS and explain the parameters influencing them.	CO 5	Remember

Signature of Course Coordinator **HOD, AE**