Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEB08

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

B.Tech IV Semester End Examinations, April- 2020

Regulations: R18

AEROSPACE PROPULSION

(AERONAUTICAL 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

MODULE– I

1.	a)	What are the different types of gas turbine engine? Differentiate ramjet and turbojet engine.	**[7M]**
	b)	Derive the thrust equation with appropriate steps and label every nomenclature for the ideal turbojet engine.	**[7M]**
2.	a)	Illustrate the RAMJET engine and explain in brief the function of all the components associated.	**[7M]**
	b)	Air flows through a jet engine at the rate of 30 kg/s and the fuel flow rate is 1 kg/s. The exhaust gases leave the jet nozzle with a relative velocity of 610 m/s. Pressure equilibrium exists over the exit plane. Compute the velocity of the airplane if the thrust power is 1.12 × 106 W.	**[7M]**

MODULE – II

3.	a)	What are the major components of combustion chamber? Elaborate on each component and its importance in the combustion chamber	**[7M]**
	b)	What is the difference between annular and cannular type of combustion chamber and highlight with proper points.	**[7M]**
4.	a)	What is nacelle? Where is it found? Why is it used? Explain the subsonic inlet nomenclature with neat sketch.	**[7M]**
	b)	Write the advantages and disadvantages of the different types of combustion chamber and highlight its importance.	**[7M]**

MODULE – III

5. a) What is the maximum Mach number that can be attained by a convergent nozzle, and can it deliver and why? **[7M]**

   b) Is over-expanded operating condition possible for convergent nozzle? Justify your answer with suitable reasons. **[7M]**

6. a) Derive the equation for nozzle efficiency and explain in details the occurrence of the losses in nozzle. **[7M]**

   b) Write short notes:- **[7M]**
   1.thrust reversal
   2.need for thrust reversal

MODULE – IV

7. a) What is the difference between the axial and centrifugal compressor? Describe in brief the working of each compressor. **[7M]**

   b) The following data are suggested as a basis for the design of a single-sided centrifugal compressor: **[7M]**
   Power input factor c 1.04
   Slip factor s 0.9
   Rotational speed N 290 rev/s
   Overall diameter of impeller 0.5 m
   Eye tip diameter 0.3 m
   Eye root diameter 0.15 m
   Air mass flow m 9 kg/s
   Inlet stagnation temperature T01 295 K
   Inlet stagnation pressure p01 1.1 bar
   Isentropic efficiency hc 0.78.(a) determine the pressure ratio of the compressor and thepower required to drive it assuming that the velocity of the air at the inlet is axial; (b) to calculate the inlet angle of the impeller vanes at the root and tip radii of theeye, assuming that the axial inlet velocity is constant across the eye annulus.

8. a) What are the different types of diffusers used in a centrifugal compressor? Explain in brief about it illustrating the its importance. **[7M]**

   b) Derive the equation for the work done and the pressure rise across the centrifugal compressor with nomenclatures. **[7M]**

MODULE – V

9. a) What is the difference between axial flow and radial flow turbine? Describe in brief the working of each turbine. **[7M]**

   b) A multi-stage axial turbine is to be designed with impulse stages and is to operate with an inlet pressure and temperature of 6 bar and 900 K and outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85 %. All the stages are to have a nozzle outlet angle of 75oand equal inlet and outlet rotor blade angles. Mean blade speed is 250 m/s and the axial velocity is 150 m/s and is a constant across the turbine. Estimate the number for stages required for this turbine. **[7M]**

10. a) What is the reason for decrease in total pressure across turbine?Write different types of turbine blade cooling. **[7M]**

    b) Write short notes on flame stability problems in ramjet combustors.Write short notes on integral ram rocket engine **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Analyze parametric cyclic analysis, performance parameters, efficiency, and specific impulse of all air breathing engines.
II	Know the design and performance of subsonic and supersonic inlets, types of combustion chambers and factors affecting the combustors.
III	Discuss the types of nozzles, flow conditions in nozzles, interaction of nozzle flow with adjacent surfaces and thrust reversal.
IV	Explain different types of compressors and turbines, work done, velocity diagrams and stage efficiency calculations.

COURSE OUTCOMES (COs):

CO 1	Gain knowledge about the various types of gas turbine engine basic function and their performance analysis
CO 2	Understand the various inlets and combustion chamber performance parameters affecting it
CO 3	Gain knowledge about theory of flow through isentropic convergent, convergent-divergent nozzles and their operating conditions
CO 4	Understand basic principle operations of axial and centrifugal compressors, and their design
CO 5	Understand basic principle operations of axial and radial turbine, and their design.

COURSE LEARNING OUTCOMES (CLOs):

AAEB08.01	Apply knowledge and understand the essential facts, concepts and principles of thermodynamics.
AAEB08.02	Understand the basic function of all aircraft engine components and how they work.
AAEB08.03	Analyze the engine performance parameters and parameters influencing them.
AAEB08.04	Understand the impact of performance parameters on endurance and range how they affect the aircraft performance.
AAEB08.05	Demonstrate different type's aircraft engine operating principle.
AAEB08.06	Understand step by step procedure of engine parametric cycle analysis.
AAEB08.07	Understand steps involved in performance analysis of all aircraft engine.
AAEB08.08	Describe operational modes of subsonic inlets and parameters influencing it.
AAEB08.09	Analyze diffuser performance, losses in it and their impact on engine performance.
AAEB08.10	Describe supersonic inlets, starting problem in it and their operating modes.
AAEB08.11	Understand different types of combustion chamber and functions of all the components.

AAEB08.12	Analyze combustion chamber performance and parameters influencing them.
AAEB08.13	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.
AAEB08.14	Understand different nozzle operating conditions for convergent and divergent nozzle.
AAEB08.15	Describe principle of operation of axial and centrifugal compressor.
AAEB08.16	Understand different design of compressor and limitations of each method.
AAEB08.17	Analyze performance characteristics of axial and centrifugal compressor.
AAEB08.18	Describe principle of operation of centrifugal and axial flow turbine.
AAEB08.19	Understand different design of axial and centrifugal turbine.
AAEB08.20	Design of ramjet engine and steps involved in it.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AAEB08.02	Understand the basic function of all aircraft engine components and how they work.	CO 1	Remember
	b	AAEB08.03	Analyze the engine performance parameters and parameters influencing them.	CO 1	Remember
2	a	AAEB08.01	Apply knowledge and understand the essential facts, concepts and principles of thermodynamics.	CO 1	Understand
	b	AAEB08.06	Understand step by step procedure of engine parametric cycle analysis.	CO 1	Understand
3	a	AAEB08.12	Describe operational modes of subsonic inlets and parameters influencing it.	CO 2	Understand
	b	AAEB08.11	Analyze combustion chamber performance and parameters influencing them.	CO 2	Remember
4	a	AAEB08.10	Describe supersonic inlets, starting problem in it and their operating modes.	CO 2	Remember
	b	AAEB08.11	Understand different types of combustion chamber and functions of all the components.	CO 2	Remember
5	a	AAEB08.14	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.	CO 3	Remember
	b	AAEB08.13	Understand different nozzle operating conditions for convergent and divergent nozzle.	CO 3	Understand
6	a	AAEB08.13	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.	CO 3	Understand
	b	AAEB08.13	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.	CO 3	Understand
7	a	AAEB08.15	Describe principle of operation of axial and centrifugal compressor.	CO 4	Remember
	b	AAEB08.16	Understand different design of compressor and limitations of each method.	CO 4	Remember
8	a	AAEB08.15	Describe principle of operation of axial and centrifugal compressor.	CO 4	Remember
	b	AAEB08.16	Analyze performance characteristics of axial and centrifugal compressor.	CO 4	Remember
9	a	AAEB08.18	Describe principle of operation of centrifugal and axial flow turbine.	CO 5	Remember
	b	AAEB08.20	Design of ramjet engine and steps involved in it.	CO 5	Remember

10	a	AAEB08.19	Describe principle of operation of centrifugal and axial flow turbine.	CO 5	Understand
	b	AAEB08.20	Design of ramjet engine and steps involved in it.	CO 5	Remember

Signature of Course Coordinator **HOD, AE**