Hall Ticket No | | | | | | | | | | | Question Paper Code:AAEC07

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022
Regulation:UG20

AIRCRAFT PROPULSION

Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) With aid of neat sketch, explain the working principle of ramjet engine and mention some of its limitations. [BL: Understand| CO: 1|Marks: 7]

   (b) A turbojet power plant uses aviation kerosene having a calorific value of 43 MJ/kg. The fuel consumption is 0.18 kg per hour per N of thrust, when the thrust is 9 kN. The aircraft velocity is 500 m/s the mass of air passing through the compressor is 27 kg/s. Calculate the air-fuel ratio and overall efficiency. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Illustrate different types of combustion chamber and distribution of flow through the combustors. [BL: Understand| CO: 2|Marks: 7]

   (b) Elucidate the modes of inlet operation in supersonic inlets and how the shock waves are playing a crucial role in it with useful sketch? [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Describe the methods of thrust reversal for propeller and jet engine aircrafts. [BL: Understand| CO: 3|Marks: 7]

   (b) Consider a C-D nozzle for aircraft propulsion, give the criteria for optimum expansion,under expansion and over exansion. [BL: Apply| CO: 3|Marks: 7]

4. (a) With help of suitable plot, explain the isentropic flow through C-D nozzles and explain the condition for generation of supersonic flow at nozzel exit. [BL: Understand| CO: 4|Marks: 7]

   (b) Obtain a relation for area ratio-Mach number for nozzles with help of continuity equation. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) With help of velocity triangle,explain the flow through inducer section of centrifugal compressor. [BL: Understand| CO: 5|Marks: 7]

   (b) A centrifugal compressor has to deliver 35 kg of air per sec. Theimpeller is 76 cm diameter revolving at 11,500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2:1, estimate the probable axial width of the impeller at the impeller tip if the radial velocity is 120 m/s. The inlet conditions are 1 bar and 47 °C. [BL: Apply| CO: 5|Marks: 7]

6. (a) Explicate the primary and secondary losses occur across the axial flow compressor.
[BL: Understand| CO: 5|Marks: 7]

(b) An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45 deg and10 deg respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is 37deg C. The blade speed and axial velocity are constant throughout the compressor. Assuming a value of 200 m/s for blade speed, find the number of stages required if the work done factor is unity . [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) How do you differentiate the impulse and reaction turbine? Explain the operating principle of axial flow turbine. [BL: Understand| CO: 6|Marks: 7]

(b) A multistage gas 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 an outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 75 deg and equal outlet and inlet blade angles. Mean blade speedof 250 m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages required. Assume Cp = 1.15 kJ/kg K,γ = 1.333 and optimum blade speed ratio. [BL: Apply| CO: 6|Marks: 7]

8. (a) What is the need for turbine blade cooling? Describe the turbine blade cooling techniques adopted for gas turbine engines. [BL: Understand| CO: 6|Marks: 7]

(b) Derive an expression for degree of reaction for axial flow turbine in terms of design parameters.
[BL: Apply| CO: 6|Marks: 7]

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