CBCS SCHEME

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18AE43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the principles of aircraft propulsion. Write about different types of aircraft power plants. **(10 Marks)**

b. Explain the working principle of Four-Stroke SI engine. **(10 Marks)**

OR

2 a. Explain the working principle of simple Jet engine with the help of PV and T-S diagram. Also derive the expression for net work output and efficiency. **(12 Marks)**

b. Write the advantage of Gas turbine engines over the reciprocating engines. **(08 Marks)**

Module-2

3 a. Write about types of propeller used in aircrafts, with suitable diagram. **(08 Marks)**

b. Derive an expression for momentum theory for propeller with assumptions made. **(12 Marks)**

OR

4 a. Explain the methods of thrust augmentation. **(10 Marks)**

b. Define thrust and derive the equation of thrust for a propulsive device. **(10 Marks)**

Module-3

5 a. Consider for a Gas turbine engine, air flowing in a duct has a velocity of 300m/s, pressure 1-bar and temperature 290K.
Determine :
i) Stagnation pressure and temperature
ii) Velocity of sound at stagnation condition
iii) Velocity of sound at dynamic condition
iv) Stagnation pressure assuming constant density. **(10 Marks)**

b. Explain the modes of Inlet operation with the formation of shocks at supersonic inlets with neat sketch. **(10 Marks)**

OR

6 a. What is thrust reversal and explain the methods for thrust reversal. **(10 Marks)**

b. Discuss about losses in the nozzles. **(10 Marks)**

Module-4

7 a. Explain the principle and operation of centrifugal compressor with h-s diagram. **(10 Marks)**

b. A centrifugal compressor running at a speed of 11,500rev/min with Inlet total heat temperature of 21°C has Inlet and outlet total head of pressure as 1-bar and 4-bar respectively. The diameter of Impeller is 75cm and slip factor is 0.92. Determine the compressor efficiency. **(10 Marks)**

OR

8 a. Obtain the expression for degree of reaction for an axial flow compressor. **(10 Marks)**

b. An axial flow compressor working with air as fluid is having 50% reaction design has blades with Inlet and outlet angles of 45° and 10° respectively. The compressor is to produce a pressure ration of 6 : 1 with an overall isentropic efficiency of 0.85 when inlet static temperature is out of the compressor. Assuming a value of 200m/s for blade speed, find the number of stages required. If the work done factor is :
i) Unity ii) 0.87 for all stages. **(10 Marks)**

Module-5

9 a. Discuss the types of combustion chamber used in gas turbine engines with sketch. Also discuss about its advantages and disadvantages. **(10 Marks)**

b. Discuss the various turbine cooling methods used for gas turbine engine. **(10 Marks)**

OR

10 a. Discuss about losses in radial turbine and write the expression for blade efficiency. **(10 Marks)**

b. In an impulse turbine stage the gas at 7 bars and 300°C expands to 3 bars. The nozzle angle is 70° with reference to the exit direction. The rotor blades have equal inlet and outlet angle and the stage operates with optimum blade speed ratio. Assuming that the isentropic efficiency of nozzle is 0.9 and the velocity at entry to the stage is negligible. Deduce the blade angle used and the mass flow required for this stage to produce 75KW. Take $C_p = 1.15$ kJ/kg K. **(10 Marks)**

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