CBCS Scheme

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15AE43

Fourth Semester B.E. Degree Examination, June/July 2017
Aircraft Propulsion

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define and explain, mach number, Raynold's number. Compressible flow and incompressible flow. **(06 Marks)**

b. Explain with neat diagrams the working principle of four stroke CI engine. **(10 Marks)**

OR

2 a. What is meant by Boundary layer? Explain Boundary layer separation with figure. **(08 Marks)**

b. Explain with principle of aircraft propulsion with example. **(08 Marks)**

Module-2

3 a. Describe the types of propellers used for aircraft. And explain what is propeller thrust and momentum thrust with equations. **(04 Marks)**

b. Explain with neat sketches the performance characteristics' of Turbojet, Turboprop and Turbofan engines. **(12 Marks)**

OR

4 a. What is thrust? Derive an equation of thrust for a propulsive device and explain the factors affecting thrust. **(10 Marks)**

b. Define with relevant equations i) thrust power ii) propulsive efficiency. **(06 Marks)**

Module-3

5 a. Bring out the different types of inlets used for gas turbines engines and explain with neat diagram Bell mouth shape inlet. **(04 Marks)**

b. Explain the theory of isentropic flow through a convergent nozzle. **(06 Marks)**

c. Air flowing in a duct has a velocity of 300m/s pressure 1.0 bar and temperature 290K. Taking v =14 and R = 287 J/kg-K. Determine :
   i) Stagnation pressure and temperature
   ii) Velocity of sound in the dynamic and stagnation condition
   iii) Stagnation pressure assuming constant density. **(06 Marks)**

OR

6 a. What are over expanded and under expanded nozzle? Explain. **(02 Marks)**

b. What do you mean by thrust Reversal? Explain the types of thrust reversals with figures. **(06 Marks)**

c. A supersonic wind tunnel setting chamber expands air or Freon – 21 through a nozzle from a pressure of 10 bar to 4 bar in the test section. Calculate the stagnation temperature to be maintained in the settling chamber to obtain a velocity of 500 m/s in the test section for
   i) Air, $C_p = 1.025$ kJ/kg K, $C_v = 0.735$ kJ/kg K
   ii) $F_7 21$, $C_p = 0.785$ kJ/kg K, $C_v = 0.67$ kJ/kg K.
   What is the test section mach number in each case? **(08 Marks)**

Module-4

7 a. Explain the principle of operation of centrifugal compressors. **(08 Marks)**

b. A centrifugal compressor has to deliver 35kg of air per sec. the impeller is 76cm 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. **(08 Marks)**

OR

8 a. Explain the performance characteristics of axial flow compressor. **(06 Marks)**

b. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45° and 10° 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 out the compressor. Assuming a value of 200 m/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. Describe the process of combustion in a gas turbine and explain classification of combustion chamber with neat diagrams. **(10 Marks)**

b. Explain the effect of operating variables on Burns performance. **(06 Marks)**

OR

10 a. With neat diagram explain :

i) Single stages Turbines

ii) Multistage Turbines. **(06 Marks)**

b. Gas at 7 bar and 300°C expands to 3 bar in an impulse turbine stage. 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 the nozzles is 0.9 and that 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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