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10AE55

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Aircraft Propulsion

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Give the general classifications of power plants used in aircraft. **(06 Marks)**

b. Derive the general heat conduction equation in Cartesian co – ordinates. **(08 Marks)**

c. A wall of cold room is composed of three layers. The outer layer is brick 20cm thick, middle layer is cork 10cm thick, the inside layer is cement 5cm thick. The temperature of the outside air is 25°C and that on the inside air is -20°C. The film co efficient for outside air and brick is 45.4W/m^{2}K and for inside air and cement is 17W/m^{2}K. Find
i) Thermal Resistance for unit area ii) Heat flow rate for unit area. **(06 Marks)**

2 a. Derive the thrust equation of a gas turbine engine and also write down the thrust and equations for turbojet, turbo prop and turbo fan engine. **(10 Marks)**

b. Air enters a turbojet engine at a rate of 12×10^4 Kg/h at 15°C and 1.03 bar and is compressed adiabatically to 182°C and four times the pressure. Products of combustion enter the turbine at 815°C and leave it at 650°C to enter the nozzle. Calculate the isentropic efficiency of the compressor, the power required to drive the compressor, the exit speed of gasses and thrust developed when flying at 800km/h. Assume the isentropic efficiency of turbine is same as that of the compressor. **(10 Marks)**

3 a. Explain with a neat sketch the operation of subsonic inlet under various flow speed condition. **(08 Marks)**

b. List down the major design requirement of an aircraft inlet which provides an optimum performance. **(04 Marks)**

c. Describe briefly about the starting problem in supersonic inlets and explain the phenomenon of shock swallowing. **(08 Marks)**

4 a. With a neat sketch, explain the working of an aircraft combustion chamber. **(10 Marks)**

b. Explain the working of a convergent nozzle and plot the variation of mass flow rate and pressure ratio occurring in the convergent nozzle. **(10 Marks)**

PART – B

5 a. Define degree of reaction of an axial flow compressor and obtain an expression for 50% degree of reaction. **(10 Marks)**

b. A centrifugal compressor compresses 30Kg of air per second at a rotational speed of 15000RPM. The air enters the compressor axially, and the conditions at the exit sections are radius = 0.3m, relative velocity of air at the tip = 100m/s at an angle of 80° with respect to the plane of rotation.
Take P_{01}= 1 bar and T_{01} = 300K
Find the torque and power required to drive the compressor and also the head developed. **(10 Marks)**

6 a. With the help of a neat sketch, explain the working of an impulse turbine and show the variation of pressure and velocity of the fluid passing through it. **(10 Marks)**

b. In a single – stage impulse turbine, nozzle discharges the fluid on to the blades at an angle of 65° to the axial direction and the fluid leaves the blade with an absolute velocity of 300m/s at an angle of 30° to the axial direction. If the blades have equal inlet and outlet angles and there is no axial thrust, estimate the blade angle and power developed. **(10 Marks)**

7 a. Explain subcritical, critical and supercritical operation of a ramjet engine. **(06 Marks)**

b. With suitable graph, explain the performance characteristics of a ramjet engine. Also bring out the advantages and disadvantages of it. **(14 Marks)**

8 a Draw a schematic diagram of a liquid propellant rocket with turbo pump feed system and explain its operation. **(10 Marks)**

b. A rocket flies at 10080 kmph with an exhaust jet velocity of 1400m/s and propellant flow rate of 5Kg/s. If the heat of reaction of the propellant is 6500kJ/kg of the propellant mixture, determine the

i) Propulsive efficiency and propulsive power
ii) Engine output and thermal efficiency
iii) Overall efficiency **(10 Marks)**

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