9/11/13.

(8)

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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV / DEC .

MECHANICAL ENGINEERING BRANCH

FIFTH Semester

ME 333 / ME 371/ ME 9026 GAS DYNAMICS & JET PROPULSION

(Regulations 2002/2004/2008)

(Use of Gas tables permitted)

Time: 3 Hours Answer ALL Questions Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Write down the adiabatic energy equation. Give its significance.
2. Draw the geometry of a duct for accelerating a sub-sonic flow to M=1.
3. Define an oblique shock.
4. State the advantages of a shock wave.
5. Sketch Fanno flow on a T-s diagram.
6. List out the assumptions used in Rayleigh flow.
7. Define propulsive efficiency.
8. Define bypass ratio for a turbofan engine.
9. What do you understand by specific impulse?
10. Define escape velocity.

Part – B (5 x 16 = 80 marks)

11. A stream of air flows in a duct of 50 mm diameter at the rate of 1 kg/s. The stagnation temperature is 45°C. At one section of the duct the static pressure is 40 kPa. Calculate the Mach no., velocity and stagnation pressure in this section. State the assumptions made.

12. a) A CD nozzle operates at off-design condition while conducting air from a high pressure tank from a large container. A normal shock occurs in the divergent part of the nozzle at a section where cross-sectional area is 25 cm^2. If the stagnation pressure and temperature at the inlet of the nozzle are 2.1 bar and 40°C respectively, and the throat area is 15 cm^2 and the exit area is 30 cm^2 estimate the exit Mach no., and exit pressure.

(OR)

b) Derive the Prandtl-Meyer relation for flow through a normal shock wave. Also discuss the significance of Rankine-Hugoniot equation. (12+4)

13. a) Air at P_0=8 bar, T_0= 450 K is supplied to a 50 mm diameter pipe. The friction factor for the pipe surface is 0.002. The inlet Mach number is 2.5 and it is changed to 1.0 at the exit determine the (i) Length of the pipe (ii) Mass flow rate of air.

(OR)

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b) Air at 250 K and 1.0 bar is moving at 100 m/s towards the entrance of a combustion chamber. Determine the exit conditions if 300 kJ/kg of heat is added to the flow during the combustion process.

14. a) Explain with a neat schematic the various types of aircraft engines used for passenger transport along with their merits.

(OR)

b) Derive an expression for the thrust equation of a turbo jet engine. Also write down the relation for thrust power and overall efficiency of a jet engine. (10+3+3)

15. a) What is a chemical rocket engine? How it is classified? Also obtain the expressions for propulsive, thermal and overall efficiency of chemical rocket engine. (3+3+10)

(OR)

b) Calculate thrust, specific impulse, propulsive, thermal, and overall efficiencies of a rocket engine from the following data:
Effective jet velocity : 1350 m/s, Flight to jet speed ratio: 0.80,Oxidizer flow rate : 2.5 kg/s, and Fuel flow rate : 1.0 kg/s