Code No. : 3140

FACULTY OF ENGINEERING
B.E. 4/4 (Mech.) I Semester (Main) Examination, December 2010
THERMAL TURBO MACHINES

Time : 3 Hours] [Max. Marks : 75

*Note : Answer **all** questions from Part A. Answer **any five** questions from Part **B**.*

PART – A **(25 Marks)**

1. Show that the Mach angle is equal to $\text{Sin}^{-1}\left[\frac{1}{M}\right]$ where M is Mach number. 3

2. How does the molecular weight of a gas affect its speed of sound ? Why does Sonic Velocity have a higher value in liquids than in gases ? 3

3. In the Ray heigh line, show the region where cooling the fluid increases the temperature and heating the fluid decreases the temperature. Give the reason. 2

4. Write down the governing equations which satisfy the state before and after a normal shock. 2

5. What is fluid slip ? Define slip factor. Give three formulae to calculate the slip factor. 3

6. Why are longer blades used in air-craft compressors ? 2

7. In pressure compounded impulse turbine, the blade height has to be increased towards the low pressure side. Why ? 2

8. Differentiate between impulse and reaction turbines. 3

9. What are the advantages and disadvantages of Turbojet propulsion system ? 3

10. Define thrust power and propulsive power. 2

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PART – B (50 Marks)

11. Find the exit velocity and the throat and exit areas for a nozzle to pass 1 kg/sec of air from an inlet state of 1050 kPa, 160°C, negligible velocity to an exhaust pressure of 105 kPa. Nozzle efficiency is 88% and the discharge coefficient is unity.

12. a) What is Fanno flow ? Give examples.

    b) Air flows along a circular pipe with a diameter 50 mm. Assuming adiabatic and that Mach number at the entrance to the pipe is 0.2. Calculate the distance from the entrance of the pipe to the section in which the Mach number will be i) 1.0 ii) 0.6. Take friction factor = 0.00375 and ratio of specific heats for air = 1.4.

13. The pressure, temperature and velocity upstream of the shock are 75 kPa, 20°C and 0 m/sec. Downstream of the shock the pressure, temperature and velocity are 180 kPa, 97°C and 280 m/sec. Find the shock speed and the Mach number of the upstream flow relative to an observer moving with the shock.

14. An axial flow compressor of 50% reaction design has blades with inlet and outlet amples of 44° and 13° respectively. The compressor is to produce a pressure ratio of 5 : 1 with an over all is entropic efficiency of 87% when the inlet temperature is 290 K. The mean blade speed and axial velocity are constant throughout the compressor. Assuming a blade velocity of 180 m/sec and work input factor of 0.85. Find the number of stages required and the change of entropy.

15. a) What are the various sources of losses in steam turbines ?

    b) Derive the expression for maximum diagram efficiency of a reaction turbine.

16. The blade speed of a single ring of impulse blading is 300 m/sec and the nozzle angle is 20°. The isentropic heat drop is 473 KJ/Kg and the nozzle efficiency is 0.85. Given that the blade velocity coefficient is 0.7 and the blades are symmetrical, draw the velocity diagrams and calculate for a unit mass flow of steam

    a) Axial thrust on the blading b) Steam consumption per KW if the mechanical efficiency is 90% c) Diagram efficiency, stage efficiency and maximum blade efficiency d) energy loss in blade friction.

17. a) Explain the working of a solid propellant rocket with neat sketch.

    b) What is ramming effect ? With neat sketches distinguish clearly between Ram Jet and Pulse Jet.

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