Code No. 6432 / N

FACULTY OF ENGINEERING

B.E. 4/4 (Mech.) I-Semester (New) (Main) Examination, November 2013

Subject : Thermal Turbo Machines

Time : 3 Hours **Max. Marks: 75**

Note: Answer all questions of Part - A and answer any five questions from Part-B. Answer to the questions of Part - A must be at one place and in the same order as they occur in the question. Missing data, if any may suitably be assumed.

PART – A (25 Marks)

1. List various regimes of compressible flow based on Mach Number. (3)
2. Write the expression for the ratio of stagnation and static density in terms of Mach No. for a compressible fluid flow. (2)
3. Define oblique shock wave. (3)
4. Show Fanno Line on T-s diagram. (2)
5. Differentiate reciprocating and rotodynamic compressors. (3)
6. Explain surging phenomena in axial flow compressors. (2)
7. Explain the variation of pressure, velocity and specific density in pressure compounding of steam turbines with neat sketch. (3)
8. Draw velocity triangle for 50% reaction steam turbine. (2)
9. List the merits of open cycle gas turbine over closed cycle configuration. (3)
10. Define propulsive efficiency for a Jet engine. (2)

PART – B (50 Marks)

11. In a supersonic wind tunnel nozzle, for conducting an experiment a test section ith M = 5 is to be designed whose throat area is 0.4 m^2. The air enters the nozzle from a reservoir at 1 bar and 50^oC. Assuming isentropic flow, find (i) Mass flow rate required (ii) Test section area and (iii) Air properties at test section. (10)

12. A normal shock occurs in air flow passing through a constant cross sectional area passage at a section after which the mach no. if found to be 0.68. If the pressure and temperature before the shock are 1 bar and 900 ^oK, find (i) pressure, temperature after the shock (ii) flow and accoustic velocities before and after the shock (iii) change in Stagnation pressure and temperatures across the shock. (10)

13. (a) Obtain Euler's equation for energy transfer in a turbo machine. (5)
    (b) Discuss the classification of rotodynamic compressors. (5)

14. In a single stage impulse turbine, the nozzle angle is 30^o to the tangential direction and the blade speed is 210 m/s. The steam speed at inlet is 550 m/s. Blade friction coefficient is 0.85 (i.e. Vr2 / Vr1 = 0.85). Assuming axial exit and flow rate of 700 kg /hr, determine the blade angles and power developed by the turbine. Also find the absolute velocity of steam at exit. (10)

15. A Gas Turbine unit takes in air at 15^oC and one atmospheric pressure and the compression ratio is 9/1. The HP turbine drives the compressor and the generator is run by LP turbine. The isentropic efficiencies of the compressor, HP and LP turbines are 0.75, 0.8 and 0.82 respectively. The maximum cycle temperature is 600^oC. For the compression process, take Cp = 1005 J/Kg - ^oK and γ = 1.4 ; For the combustion and expansion processes take Cp =1150 J/Kg-^oK and γ = 1.333. Neglecting the mass of fuel, calculate (i) Pressure and (ii) Temperature of the gases entering the power turbine, (iii) The net power developed per unit Kg/s mass flow rate (i) Work ratio and (v) Cycle efficiency of the unit. (10)

16. (a) Explain the nature of accelerating and decelerating passage for subsonic and supersonic flows. (5)
    (b) Explain the effect of outlet blade angle on performance of centrifugal compressor. (5)

17. (a) Explain reheating cycle in gas turbines. (5)
    (b) Explain the working principle of Ramjet engine. (5)

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