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B. E. (Fifth Semester) Examination,
April-May/Nov.-Dec. 2020

(New Scheme)

(Mech. Engg. Branch)

TURBO MACHINERY

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt all questions. Part (a) of each question is compulsory are 2 marks. Solve any* ***two*** *parts from (b), (c) and (d) are 7 marks. Use of Steam table.*

Unit-I

1. (a) Define compounding of impulse turbine?

(b) Explain velocity compounded impulse turbine with neat sketches.

(c) What is the condition for maximum blade efficiency in a single stage impulse turbine?

(d) The isentropic heat drop in given stage of a multi stage impulse turbine is 33.5 kJ/kg of steam. The nozzle outlet angle is 20°. The efficiency of the nozzle is 92%. The mean diameter of the blade is 95·5 cm and the revolution per minute is 3000. The carry over factor is 0·88. Blades are equiangular with a velocity coefficient of 0·87. Calculate steam velocity at the outlet of the nozzle, blade angles and gross stage efficiency.

Unit-II

2. (a) Define Degree of Reaction?

(b) Prove that :

$$(\eta_b)_{max} = \frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}$$

(c) Explain :

(i) Regulating valve losses with h-s diagram

(ii) Moving blade losses

(iii) Disk friction losses

(d) Steam flows into the nozzles of an impulse reaction turbine stage from the blades of the proceeding stage with a velocity of 100 m/s and issue from the nozzles with a velocity of 325 m/s at an angle of 20° to the wheel plane. Calculate the gross stage efficiency for the following data : mean blade velocity - 180 m/s, Expansion efficiency for nozzle and blade = 0·9, Carry over factor for nozzle and blade = 0·75, Degree of reaction = 0·26, Blade outlet angle = 28°.

Unit-III

3. (a) Define State Point Locus?

(b) Explain Nozzle control Governing with neat sketch.

(c) Define internal efficiency, Stage efficiency and Reheat factor, Derive the relationship between them.

(d) An impulse turbine installation consisting of H.P. I.P. & L.P. turbines is required to work with initial steam conditions of 17 bar with 120°C of superheat and a condenser pressure of 0·07 bar. Allowing a reheat factor of 1·05 and a loss of available heat of 6 kJ/kg. Steam determine the heat units to be allowed to each turbine in order that the H.P. and I.P may each develop $1/4^{th}$ of the total power. Assume stage efficiency of 0·77, 0·75 and 0·72 in the H.P. I.P. and L.P. respectively.

Unit-IV

4. (a) Write application of Gas Turbine?

(b) Derive an expression for the optimum pressure ratio giving maximum specific output in simple cycle gas turbine.

(c) Draw the schematic and T-S diagram of gas turbine plant with regeneration.

(d) An open gas turbine plant works between the fixed absolute temp. limits 300 K and 1500 K, the

absolute pressure limits being 1 bar and 14 bar. The isentorpic efficiency of compressor is 0.85 and that of turbine is 0.86. Estimate the actual thermal efficiency of the plant and the power developed. The calorific value of fuel is 42000 kJ/kg. Assume combustion efficiency = 0.99, mechanical efficiency = 0.98 for whole assembly, generator effieicny = 0.985 and mass flow rate of air = 500 kg/s.

Unit-V

5. (a) Define Slip factor?

(b) Explain working of centrifugal compressor with neat sketch.

(c) Discuss surging, choking and stalling phenomena in compressor.

(d) An axial flow compressor is required to deliver air at the rate of 50 kg/s and provide a total pressure ratio of 5:1, the inlet stagnation condition being 288 K and 1 bar. The isentropic efficiency is 86%. The compressor shall have 10 stages with equal rise in total temperature in each stage. The axial velocity of flow is 150 m/s and the blade speed is kept as 200 m/s to minimize noise generation. The stage degree of reaction at mean blade height is 50%. Assuming work done factor as 0.86, Calculate all the fluid angles of the first stage. Also calculate the tip and hub diameter if hub-diameter ratio is 0.8. Determine the speed in rpm.