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F-ME-552

B. E. (Fifth Semester) Examination, 2016

(New Course)

(Mechanical Engg. Branch)

TURBO MACHINERY

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *All questions are compulsory. Part (a) of each question is compulsory. Steam table is allowed in the examination hall. Assume suitable data if required.*

Unit-I

1. (a) Write working principle of impulse turbine. 2

(b) In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 80 cm and the speed of rotation is 3000 rpm.

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The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20°. The rotor blades are equiangular and due to friction in the blade channels the relative velocity of steam at outlet from the blades is 0.86 times the relative velocity of the steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 140 N. 14

Or

(c) A velocity compounded impulse wheel has two rows of moving blades with a mean diameter of 70 cm. The speed of rotation is 3000 rpm, the nozzle angle is 16°, and the estimated steam velocity at the nozzle outlet is 610 m/s. The mass of steam passing through the blades per second is 6·5 kg.

Assuming K = 0.872 and that the outlet angles of the blades are (i) first row of moving blades 18° (ii) intermediate guide blades 22° (iii) second row of moving blades 38°, draw the velocity diagrams and calculate (i) Blade inlet angles (ii) power developed in each row of blades (iii) Efficiency of the wheel as a whole. 14

Unit-II

2. (a) Define degree of reaction. 2

(b) The outlet angle of the blade of person's turbine is 30° and the axial velocity of flow of steam is 0.5 times the mean blade velocity. Draw the velocity diagram for a stage consisting of one fixed and one moving row of blades, given that the mean diameter is 70cm and the speed of rotation is 3000 rpm. Calculate the inlet angle of blades if the steam is to enter the blade channels without shock. If the blade height be 6·4 cm, the mean pressure 5·5 bar, the steam dry and sturated, find the power developed in the stage. 14

Or

(c) (i) How does the losses in steam turbines are classified. Explain in brief.

(ii) How the moving blade of reaction turbine is different from impulse turbine. 14

Unit-III

3. (a) Define reheat factor. 2

(b) (i) What do you mean by governing of steam turbine? Explain by pass governing with neat sketch.

(ii) Make comparison between nozzle and throttle control governing. 14

Or

(c) In a four stage pressure compounded impulse turbine steam is at a pressure of 23 bar and superheated to a temperature of 145°C. The exhaust pressure is 0·07 bar and the overall turbine efficiency is 0.72. Assuming that the work is shared qually between the stages and the condition line is straight, estimate the stage pressures, the efficiency of each stage and the reheat factor. 14

Unit-IV

4. (a) Define work ratio and explain its physical significance. 2

(b) An open gas turbine plant works between the fixed absolute temperature limits 300K and 1500K, the absolute pressure limits being 1 bar and 14 bar. The isentropic efficiency of compressor is 0·85 and that of turbine is 0.86. Estimate the actual thermal efficiency of the plant and the ower developed. The calorific value of fuel is 4200 kj/kg. 14
Assume mass flow rate of air = 500 kg/s.

Or

(c) (i) Derive an expression for the optimum pressure ratio for maximum specific output in ideal simple gas turbine cycle.

(iv) Width of impeller at inlet

(v) Impeller blade angle at inlet 14

Or

(c) (i) Discuss surging, chocking and stalling phenomenon.

(ii) Compare centrifugal and axial compressor. 14

(ii) Write the effect of reheat and intercooling on following

1. **Compressor work**
2. **Turbine work**
3. **Heat addition**
4. **Heat rejection**
5. **Thermal efficiency** 14

Unit-V

5. (a) Define slip factor. 2

(b) A centrifugal compressor running at 9000 rpm delivers 600 m^3/min of free air.

The air is compressed from 1 bar and 20°C to a pressure ratio of 4 with an isentropic efficiency of 0·82. Blades are radial at outlet of impeller and the flow velocity of 62 m/s may be assumed throughout constant. The outer radius of impeller is twice the inner and the slip factor may be assumed as 0·9. Calculate the following :

(i) Final temperature of air

(ii) Theoretical power

(iii) impeller diameters at inlet and outlet