337552(37)

B. E. (Fifth Semester) Examination, April-May 2019

(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 & carry equal 2 marks. Solve any* ***two*** *parts from (b), (c) and (d) are carry equal 7 marks. Use of Steam table and Mollier chart is permitted.*

1. (a) Classify steam turbine on the basis of principle of operation.

(b) Explain pressure compunded impulse turbine with neat sketches.

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

(d) The mean diameter of the blades of an impulse turbine with a single row wheel is 105 cm and the speed is 3000 rpm. The nozzle angle is 18°, the ratio of blade velocity to steam velocity is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet blade angle. The steam flow is 8 kg/s. Draw the velocity diagram for the blades and calculate the following :

(i) Tangential thrust on the blade;

(ii) Axial thrust on the blade;

(iii) Resultant thrust on the blades ;

(iv) Power developed by the blades;

(v) Blade efficiency

2. (a) Show isentropic heat drop in the fixed and the moving blades in h-s diagram.

(b) Define the following terms :

(i) Regulating value losses with h-s diagram

(ii) Moving blade losses

(c) Derive an expression for Gross stage efficiency in a 50% reaction turbine :

$$(\eta_{gs})_{max} = \frac{\eta_n \cdot \cos^2 \alpha_1}{1 - \phi(1 - \cos^2 \alpha_1)}$$

(d) The total tangential force on one ring of parson's turbine is 1200 N, when the blade speed is 100 m/s. The mass flow rate is 8 kg/s. The blade outlet angle is 20°. Determine the steam velocity at outlet form the blades. If the friction losses which would occur with pure impulse are 25% of the kinetic energy corresponding to relative velocity at entry to each ring of blades and if the expansion losses ar 10% of the heat drops in the blade, determine the heat drop per stage and stage efficiency.

3. (a) Define the term 'state point locus'.

(b) Explain throttle governing with neat sketch.

(c) Explain internal and other efficiency and develop the relation between stage efficiency, internal efficiency and reheat factor.

(d) Superheated steam is expanded from a pressure of 20 bar to 0.1 bar in a turbine. The initial temprature of the steam is 350°C. At a pressure of 1.6 bar the steam is found to be just dry and saturated and at 0.1 bar it is 10% wet. Sketch T-s and h-s diagrams showing the condition curve and calculate :

(i) the total enthalpy drop with isentropic expansion between the initial state and final pressure,

(ii) the actual enthalpy drop, and

(iii) the percentage increase in volume of steam at the exhaust due to losses.

4. (a) Give the reason of deviation of actual gas turbine cycle from theoritical cycle.

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

(c) Explain methods for improvement of thermal efficiency of open cycle gas turbine plant.

(d) The following particulars relate to closed cycle gas turbine using air as the working medium :

Atmospheric temperature = 26°C, Maximum temperature = 870°C, Initial pressure at compressor = 1 bar, find pressure of compressor = 5 bar, turbine efficiency = 0.84, Compressor efficiency = 0.8, Calorific value of fuel = 41840 kJ/kg, Heater Loss = 10% heating value, C_p = 1.005 kJ/kg, γ = 1·4.

Calculate :

(i) Compressor work

(ii) heat supplied

(iii) turbine work

(iv) net work

(v) fuel - air ratio

(vi) thermal efficiency

(vii) air rate

(viii) work ratio

(ix) specific fuel consumptions.

5. (a) Write the Euler's equation.

(b) Compare centifugal and axial flow compressors in different parameters.

(c) With neat sketch explain the working of a centifugal compressor.

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