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10ME56

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Turbomachines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define Turbomachine. Differentiate between a turbomachine and positive displacement machine. **(08 Marks)**

b. Derive the equation for specific speed of pump. **(04 Marks)**

c. A turbine develops 10000 kw , under a head of 25m at 135 rpm. What is the specific speed? What would be its normal speed and output under a head of 20 meters? **(08 Marks)**

2 a. What is Reheat factor? Show that the reheat factor is greater then unity in a multistage turbine. **(10 Marks)**

b. A low pressure compressor develop a pressure of 1200 mm of meter. If the initial and find state of air use $P_1 = 1.02$ bar , $T_1 = 27^0C$, $T_2 = 42^0C$. Determine the compressor and infinitesimal stage efficiencies. **(10 Marks)**

3 a. Derive alternate form of Euler's turbine equation and explain the significance of each energy component. **(10 Marks)**

b. Identify turbines and compressor from the following data for various machines :

i) $u_1 = u_2 = 50$m/sec $Vn_1 = 4$m/sec ; $Vn_2 = 5$m/sec.

ii) $vn_1 = vn_2 = 12$m/sec $u_1 = 102$ m/sec ; $u_2 = 118$ m/sec.

iii) $Ho_2 - Ho_1 = -4$ kJ/kg.

iv) $Po_2 - Po_1 = 37.5$ mm of W.G. **(10 Marks)**

4 a. For the power generating machine show that $R = \frac{2 + \cot\beta_2}{4}$ with usual notation and show the effect of discharge angle and energy transfer and degree of reaction. **(10 Marks)**

b. A jet of water having a velocity of number, Impinges on a series of vanes moving with a velocity of number. The jet makes an angle of 30^0 to the direction of motion of vanes when entering and leaves at an angle of 120^0. Draw the velocity triangle at inlet and outlet and find the angle of vane tips so that water enters and leaves without stock. **(10 Marks)**

PART – B

5 a. What is the need of compounding? Explain any two methods with sketch, showing variation of velocity and pressure. **(10 Marks)**

b. The rotor of an impulse turbine is 60cm diameter and runs at 9600 rpm. The nozzle are at 20^0 to the plane of the wheel and the steam leaves them at 600 meter. The blades outlet angle are 30^0 and the friction factor is 0.8. Calculate the power developed per kg of steam per second and the diagram efficiency. **(10 Marks)**

6 a. With neat sketch, explain the working principle of transic turbine. State the importance of draft tube. **(10 Marks)**

b. It is desired to produce 1500 kw of power at a head of 200m. Assuming an overall efficiency of turbine to be 0.80. Find what will be the required size of jet, the diameter of runner and its speed. Assume Cv = 0.98 , Jet ratio = 12 , φ = 0.45. **(10 Marks)**

7 a. Obtain an expression for the minimum starting speed of a centrifugal pump and give a brief ideal about cavitation. **(10 Marks)**

b. A centrifugal pump with 1.2m diameter runs at 200 rpm and pumps 1.88 m^3/s. The average lift being 6m. The angle which the vane make at exit with the tengent to the impeller is 26^0 and the radial velocity is 2.5m/sec. Determine the manometric efficiency and the least speed to start pumping if the inner diameter of the impeller is 0.6m. **(10 Marks)**

8 a. What is the function diffuser? Name different types of diffuser used in centrifugal compressor and explain them with simple sketches. **(10 Marks)**

b. A centrifugal compressor runs at a speed of 15000 rpm and delivers 30kg/sec of air. The exit diameter is 70cm relative velocity at exit is 100m/sec at an exit angle of 75^0. Assume axial inlet and inlet temperature is 300K, inlet total pressure = 1 bar. Determine

i) Power required to drive compressor.
ii) Work done.
iii) Ideal head developed.
iv) Total exit pressure. **(10 Marks)**

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