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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 than unity in a multistage turbine. (10 Marks)  
b. A low pressure compressor develop a pressure of 1200 mm of meter. If the initial and final state of air use  $P_1 = 1.02 \text{ bar}$  ,  $T_1 = 27^\circ\text{C}$  ,  $T_2 = 42^\circ\text{C}$ . 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)  $u_1 = u_2 = 50 \text{ m/sec}$  ;  $V_{n1} = 4 \text{ m/sec}$  ;  $V_{n2} = 5 \text{ m/sec}$ .  
ii)  $v_{n1} = v_{n2} = 12 \text{ m/sec}$  ;  $u_1 = 102 \text{ m/sec}$  ;  $u_2 = 118 \text{ m/sec}$ .  
iii)  $H_{02} - H_{01} = -4 \text{ kJ/kg}$ .  
iv)  $P_{02} - P_{01} = 37.5 \text{ mm of W.G.}$  (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  $30^\circ$  to the direction of motion of vanes when entering and leaves at an angle of  $120^\circ$ . 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  $20^\circ$  to the plane of the wheel and the steam leaves them at 600 meter. The blades outlet angle are  $30^\circ$  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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.





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- 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  $C_v = 0.98$ , Jet ratio = 12,  $\phi = 0.45$ . (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  $1.88 \text{ m}^3/\text{s}$ . The average lift being 6m. The angle which the vane make at exit with the tangent to the impeller is  $26^\circ$  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  $75^\circ$ . 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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