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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Mechanical Engineering

Semester End Examination; Feb. - 2021

Turbomachines

Time: 3 hrs *Max. Marks: 100*

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*
II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for Maximum of* ***18 marks*** *from each unit.*

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	Define a "Turbomachine".	2
b.	Write the components of the pelton wheel turbine.	2
c.	What is the function of Draft tube?	2
d.	Define the diagram efficiency of a steam turbine.	2
e.	What is Cavitution?	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	Difference between positive displacement machine and turbo machine.	9
b.	At a 50% reaction stage axial flow turbine, the mean blade diameter is 60 cm. The maximum utilization factor is 0.9 steam flow rate is 10 kg/s. Calculate the inlet and outlet absolute velocities and power developed, if the speed is 2000 rpm.	9
c.	Draw the velocity triangle at inlet and outlet of an axial flow turbine when? i) $R = 0$ ii) $R = 0.5$ iii) $R = 1$ Discuss the energy transfer in these cases.	9
	UNIT - II	**18**
2 a.	With neat sketch, explain the working principle of pelton turbine.	9
b.	A pelton wheel is to be designed for a head of 60 m, when running at 200 rpm. The pelton wheel developed 95.55 kW. The velocity of bucket is 0.45 times the velocity of the jet, overall efficiency is 0.85, and coefficient of velocity is equal to 0.98. Find the diameter of jet, diameter of the wheel and bucket on the wheel.	9
c.	Show that for maximum utilization the speed of the wheel is equal to half of speed of jet.	9
	UNIT - III	**18**
3 a.	Sketch a Francis turbine and explain its working.	9
b.	The inlet and outlet diameter of an outward flow turbine are 1.2 m and 1.5 m respectively. The wheel has a speed of 300 rpm, while working under a head of 45 m. The quantity of water passing through the wheel is 5 m^3/s of $\eta_H = 0.90$ and breadth of the wheel is 0.3 m, find the angles of the blades and guide vanes.	9
c.	A Kaplan turbine produces 58.800 kW under a head of 25 m, which has overall efficiency of 90%. Taking the value of speed ratio $\phi = 1.6$, flow ratio $\psi = 0.5$ and the hub diameter = 0.35 times the outer diameter. Find the diameter and the speed of the turbine.	9

Contd….2

UNIT - IV **18**

4 a. Why compounding of steam turbine necessary? Describe the velocity compounding of steam turbine with neat sketch. 9

b. Steam issuing from a nozzle to a De-Laval turbine with a velocity of 1000 m/s. The nozzle is 20°, the mean blade speed is 400 m/s. The blades are symmetrical, the mass flow rate = 1000 kg/hr, friction factor = 0.8, nozzle efficiency = 0.95. Calculate;

i) The blade angles

ii) Axial thrust 9

iii) Work done per kg of steam

iv) power developed

v) Blade efficiency

vi) Stage efficiency

c. With the usual notation, prove that the maximum blade efficiency $\eta_{b,\max} = \frac{cos^2 d_1(1+C_b K)}{2}$. 9

UNIT - V **18**

5 a. Define the following terms as referred to the centrifugal pump:

i) Suction head

ii) Static head

iii) Manometric efficiency 9

iv) Hydraulic efficiency

v) Mechanical efficiency

vi) Overall efficiency

b. A centrifugal pump with 1.2 m diameter runs at 200 rpm and pumps 1880 lit/s, the average lift being 6 m. The angle which the vanes make at exit the tangent to the impeller in 26° and radial velocity of flow is 2.5 m/s. Determine the Manometric efficiency and the least speed to start pumping against a head of 6 m, inner diameter of impeller being 0.6 m. 9

c. Show that the pressure rise in the impeller of a centrifugal pump, when the frictional and other losses in the impeller are neglected is given by,

$$\Delta p = \frac{\rho}{2}[V_{f_1}^2 + U_2^2 - V_{f_2}^2 \cos ec^2 \beta_2]$$ 9

Where V_{f_1} and V_{f_2} are the flow velocities at inlet and outlet of the impeller U_2 = tangential speed of impeller at exit, β_2 = exit blade angle.

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