NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA

Roll No._____

Subject: FLUID MACHINES

Code: MEPC210

Semester: B. Tech 4th (May 2025)

Branch: MECHNAICAL

Time: 3 Hours

Max. Marks: 50

Note:

I. Answer FIVE questions out of following. Marks allotted for each question are shown on the right hand margin.

II. Assume suitable value for the missing data, if any.

III. The Candidates before starting to write the solution, should please check the Question paper for any discrepancy, and also ensure that they have been delivered the question paper of right course no. and right subject title.

I (a)	A jet of water having a velocity of 42 m/s impinges without shock on a series of vanes moving at 14 m/s. The direction of motion of vanes is inclined at 20° to that of jet, the relative velocity at outlet is 0.9 of that at inlet and absolute velocity of water at exit is to be normal to the motion of vanes. Find (i) vane angles at entrance and exit (ii) work done on vanes per kg of water supplied by the jet (iii) hydraulic efficiency.	(5)
(b)	A boat moved by jet propulsion discharges water through a jet of area 0.02 m^2; the water being drawn from inlet openings facing the direction of motion. The total drag is estimated to be $20u^2$ N, where u is the speed of boat in m/s. If the boat moves at 90 $Kmph$, determine: (i) relative velocity of jet (ii) energy supplied by jet (iii) efficiency of propulsion. Take density of water as 1000 Kg/m^3.	(5)
II (a)	Explain with sketch the function a surge tank in a storage type power plant.	(3)
(b)	How does a Kaplan turbine differs from a propeller turbine?	(2)
(c)	The flow through a Pelton turbine is 1000 litres per minute under a head of 125 m. The buckets deflect the jet through 160°. Determine the power developed and the efficiency if the 10% friction loss occurs when fluid glides over the blades. Take C_v =0.98 & K_u =0.46.	(5)
	or	
	Describe in detail the main and operating characteristics of turbines	
III (a)	What are unit quantities? What are their importance? Also derive expressions for various unit quantities.	(5)
	or	
	Show that for a Francis turbine, the hydraulic efficiency is given by: $\eta_h = 1 - \frac{1}{1+2\cot\alpha_1(\cot\alpha_1 - \cot\beta_1)}$ Assume radial discharge at the outlet and constant velocity of flow. In the expressions α_1 and β_1 are the angles which the absolute and relative velocities at inlet make with the tangential velocity.	

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III (b)	Show by dimensional analysis that the power P developed by a hydraulic machine is given by : $P = \rho N^3 D^5 f\left(\frac{N^2 D^2}{gH}\right)$ where ρ is mass density of liquid, N is rotational speed, D is diameter of runner, H is the working head & g is gravitational acceleration.	(5)
IV (a)	Describe with sketch the different types of casings for centrifugal pumps.	(5)
(b)	Show that pressure head rise in the impeller of a centrifugal pump is given by: $H = (V_{f1}^2 + u_2^2 - V_{f2}^2 \operatorname{cosec}^2 \beta_2)/2g$ where V_{f1}, V_{f2} are the velocities of flow at the inlet and the outlet respectively, u_2 the vane velocity at the outlet and β_2 the vane angle at the outlet of the backward curved vanes. Neglect frictional and other losses in the impeller.	(5)
V (a)	Discuss the effect of piston acceleration in a reciprocating pump and derive the expression for accelerating head. What is the effect of accelerating head on indicator diagram?	(5)
	or	
	What is an air vessel? Why it is used in reciprocating pumps? Also find an expression for the rate of flow from and into an air vessel fitted to the delivery side of a single acting reciprocating pump.	
(b)	Explain with the help of a neat sketch the principle and working of a hydraulic ram.	