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Paper Code : PC-AUE 402/PC-ME402 Fluid Mechanics & Fluid Machines

UPID : 004422

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (I) What is the dimension of torque?
- (II) Define hydraulic efficiency of a hydraulic turbine.
- (III) What is surge tank?
- (IV) What is fluids?
- (V) What is minor energy losses in pipes flow ?
- (VI) What is dimension of power?
- (VII) What do you understand by the term boundary layer?
- (VIII) What is the dimension of surface tension?
- (IX) Explain impulse turbine.
- (X) What are the main parts of centrifugal pump?
- (XI) What is kinetic head?
- (XII) what is critical Depth (h_c) for flow in open canals?

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Water is flowing through a pipe of diameter 5 cm under a pressure of 29.43 N/cm^2 (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross section , which is 5 m above the datum line. [5]
3. State Bernoulli's theorem for steady flow of an incompressible fluid with assumptions. [5]
4. Find the kinematic viscosity of an oil having density 981 kg/m^3 . The shear stress at a point in the oil is 0.2452 N/m^2 and velocity gradient at that point is 0.2 per second. [5]
5. An oil of sp. Gr. 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres per second. Find the head loss due to friction and power required to maintain the flow for a length of 1000m. Take, $f = \text{co-efficient of friction} = 0.0048$. [5]
6. A Kaplan turbine delivers 10 MW under a head of 25 m. The hub and tip diameters are 1.2 m and 3 m. Hydraulic and overall efficiencies are 0.90 and 0.85. If both velocity triangles are right angled triangles, determine the speed, guide blade outlet angle and blade outlet angle. [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) A plate having an area of 0.6 m^2 is sliding down the inclined plate at 30° to the horizontal with a velocity of 0.36 m/s. There is a cushion of fluid 1.8 mm thick between the plane and the plate. Find the viscosity of the fluid if the weight of the plate is 280 N. [10]
(b) What do you mean by capillarity? [5]
8. (a) The discharge Q through an orifice depends on the pressure P , the density of fluid ρ and the diameter of the orifice d . [10]
Determine a general formula for the discharge using Buckingham – Ham π -theorem.
(b) What do you mean by Dimensional Homogeneity? [5]
9. (a) The space between two square flat parallel plates is filled with oil. Each side of the plate is 720 mm. The thickness of the oil film is 15 mm. The upper plate, which moves at 3 m/s requires a force of 120 N to maintain the speed. Determine [10]
(i) The dynamic viscosity of the oil
(ii) The kinematic viscosity of oil if the specific gravity of oil is 0.95

- (b) Write the unit of Kinematic viscosity and dynamic viscosity. [5]
10. (a) Two pipes are connected in parallel between two reservoirs that have difference in levels of 3.5 m. [7]
The length, the diameter, and friction factor ($4f$) are 2400 m, 1.2 m, and 0.026 for the first pipe and 2400 m, 1 m, and 0.019 for the second pipe.
Calculate the total discharge between the two reservoirs
- (b) A tank transmits 100 L/s of water to point C where the pressure is maintained at 1.5 kg/cm². The [8]
first part AB of the pipeline is 50 cm diameter and 2.5 km long, and the second part BC is 25 cm diameter and 1.5 km long. 63
The friction coefficient is 0.005 and minor losses are ignored.
Assuming level at C is (0.0); find the water level (L) in the tank?
11. (a) A model for a spillway must be built in a laboratory where the maximum capacity of the pump is 9 [10]
m³. The prototype has 300 m³ maximum discharge and 5 m head on the crest.
- Determine the scale ratio for the model? 75
 - Calculate the head on the crest of the model?
 - Find the time in model corresponding to 36 hours in prototype?
 - Determine the loss of power in prototype corresponding to observed 0.05 HP in model?
- (b) What do you mean by kinematic and dynamic similarity? [5]

*** END OF PAPER ***