मठ - 001

Fluid Mechanics
(123101)

P. Pages : 3

Time : Three Hours

Max. Marks : 80

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Assume suitable data wherever necessary.
5. Figures to right indicate full marks.
6. Use of non programmable calculator is allowed.
7. Attempt **any two** sub questions from each unit.

UNIT - I

1. a) The space between two square flat parallel plates is filled with oil. Each side of plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine :
   i) The dynamic viscosity of the oil in poise.
   ii) The kinematic viscosity of oil in strokes if specific gravity of oil is 0.95.   8

   b) A roller gate of cylindrical form 3 m in diameter has a span of 10 m. Find magnitude and direction of resultant force acting on the gate, when it is placed on the dam and water level is such that it is going to spill.   8

   c) Define the following terms :   8
   i) Buoyancy.
   ii) Centre of Buoyancy.
   iii) Metacenter
   iv) Metacentric height.

UNIT - II

2. a) A conical tube of length 2.5 m is fixed vertically with its smaller end upwords the velocity of flow at the smaller end is 6 m/s while at the lower end is 3.5 m/s The pressure head at the smaller end is 3m of oil (specific gravity of oil is 0.85)

   The loss of head in the tube is $\dfrac{0.45(v_1 - v_2)^2}{2g}$ where v_1 is the velocity at

   smaller end and v_2 is velocity at lower end respectively. Find pressure at the lower end. The flow of oil takes place in downward direction.   8

b) An orifice meter consisting of 100 mm diameter orifice in a 250 mm diameter pipe has $C_d = 0.65$. The pipe delivers oil of specific gravity of 0.8. The pressure difference on two sides of the orifice plate is measured by a mercury - oil differential manometer.
If differential gauge reading is 800 mm of mercury. Find the rate of flow in lit/s.   8

c) Define the following and give one practical example for each.   8
   i)   Laminar flow   ii)   Rotational flow
   iii) Compressible flow   iv)   Steady flow.

UNIT - III

3. a) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and a length of 10 m. Calculate difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds.   8

b) Prove that power absorbed in overcoming viscous resistance in foot-step bearing is given by,

$$P = \frac{\mu \pi^3 N^2 R^4}{60 \times 30\,t}$$

where,
   R = Radius of shaft,
   N = Speed of shaft,
   t = clearance between shaft and foot step bearing
   μ = viscosity of fluid.   8

c) What do you mean by boundary layer separation ? What are different methods of preventing the separation of boundary layers ?   8

UNIT - IV

4. a) What are the methods of dimensional analysis ? Describe the Rayleigh's method for dimensional analysis.   8

b) A syphon of diameter 200 mm connects two reservoirs having a difference in elevation of 20 m. The length of the syphon is 500 m and the summit is 3 m above the water level in the upper reservoir. The length of pipe from upper reservoir to the summit is 100 m determine the discharge through the syphon and also pressure at the summit neglect minor losses. The coefficient of friction, f = 0.005.   8

c) A 2500 m long pipeline is used for transmission of power 120 kw power is to be transmitted through pipe in which water having a pressure of

4000 kN/m^2 at inlet is flowing. if pressure drop over the length of pipe is

800 kN/m^2 and f = 0.006 find,
  i) Diameter of the pipe, and
  ii) Efficiency of transmission.   8

UNIT - V

5. a) A centrifugal pump has the following dimensions, inlet radius = 80 mm, outlet radius = 160 mm, width of impeller at the inlet = 50 mm, vane angle at inlet = 0.45 radians, vane angle at outlet = 0.25 radians ;
width of impeller at the outlet = 50 mm
Assuming shockless entry determine the discharge and the head developed by the pump when impeller rotates at 90 rod/s.   8

  b) Explain in details cavitation. What are the effects of cavitation ? Give the necessary precautions against cavitation.   8

  c) What is Reciprocating pump ? Describe the principle and working of a reciprocating pump with a neat sketch.   8

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