Seat No. | | | | | | |

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BBI1309

Fluid Mechanics
(New) (1110, 1100, 1090)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

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. All questions are compulsory. Solve **any two** bits from a,b,c in each question.
5. Use of non-programmable calculator is allowed.
6. Assume suitable data if necessary.

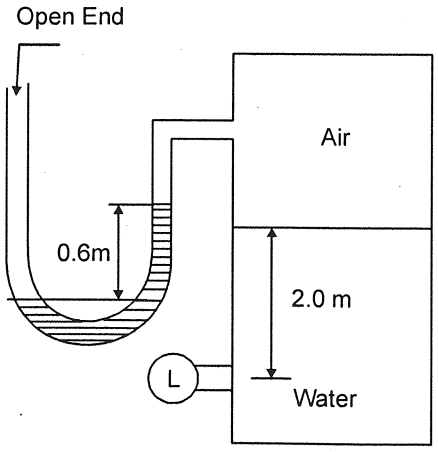
UNIT - I

1. a) A vertical gap 2.1 cm wide of infinite extent contains a fluid of viscosity 20 poise & relative density 0.9. A metallic plate 1.2m x 1.2m x 0.2cm is to be lifted up with a constant velocity of 0.15 m/sec through the gap. If the plate is in the middle of the gap find the force required. The weight of the plate is 40N. **10**

b) In fig. the local atmospheric pressure is 755 mm of mercury (13.6) calculate :

i) Absolute pressure of air in the tank.

ii) Pressure Gauge reading at L. **10**



c) Prove that metacentric height $GM = \frac{I}{\forall} - BG$. 10

UNIT - II

2. a) The velocity components in a two-dimensional incompressible flow are $u = x - 4y$ and $v = - y - 4x$.
   i) Is the flow continuous.
   ii) Is the flow irrotational.
   iii) In case the flow is irrotational find the potential function and the stream function. 10

b)

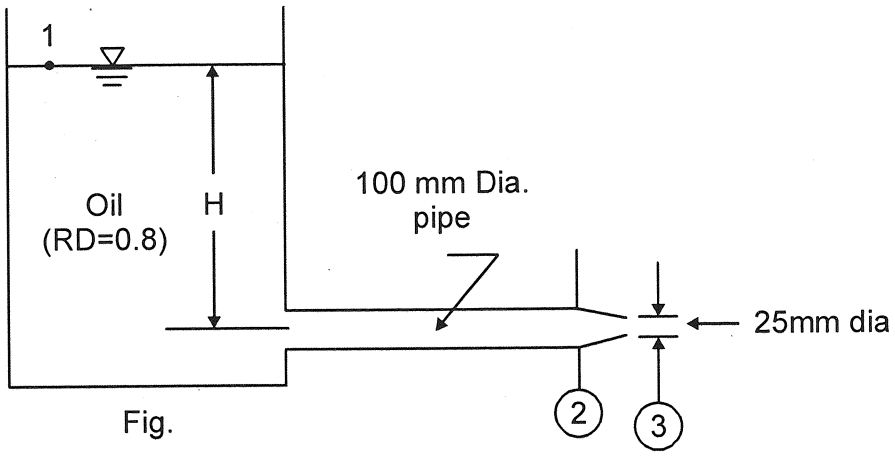


Fig.

Figure shows a nozzle at the end of a pipe discharging oil from a tank to atmosphere. Estimate the discharge from the nozzle when the head H in the tank is 4.0m. The loss in the pipe can be taken as $\frac{20V^2}{2g}$ where V = velocity in the pipe. The loss of energy in the nozzle can be assumed to be zero.
Also determine the pressure at the base of the nozzle. 10

c) In a vertical pipe conveying oil of specific gravity 0.8 two pressure gauges have been installed at A & B Where the diameters are 160 mm and 80 mm respectively. A is 2 meters above B. The pressure gauge reading have shown that the pressure B is greater than at A by $0.981\ N/cm^2$. Neglecting all losses calculate the flow rate. If the gauges at A & B are replaced by tubes filled with the same liquid and connected to U-tube containing mercury. Calculate the difference of level of mercury in the two limbs of the U-tube. 10

UNIT - III

3. a) Derive expression for velocity distribution of laminar flow between two parallel plates when upper plate is moving and lower is stationary. **10**

b) A pipe 60 mm diameter and 450 m long slopes upward at 1 in 50. An oil of viscosity 0.9 NS/m^2 and specific gravity 0.9 is required to be pumped at the rate of 5 litres/sec.

i) Is the flow laminar.

ii) What pressure difference is required to attain this condition.

iii) What is the power of the pump required assuming an overall efficiency of 65%.

iv) What is the centre line velocity and the velocity gradient at pipe wall. **10**

c) A smooth pipe of diameter 80 mm and 800 m long carries water at the rate of 0.480 m^3/minute. Calculate the loss of head, wall shearing stress. Centre line velocity. Velocity and shear stress at 30 mm from pipe wall. Also calculate the thickness of Laminar sub-layer. Take kinematic viscosity of water as 0.015 stokes. The value of coefficient of friction 'f' from the relation given as

$f = \frac{0.791}{R_e^{(1/4)}}$ where Re - Reynold Number. **10**

UNIT - IV

4. a) Derive the expression for velocity of sound wave in fluid. **10**

b) Two reservoirs with a difference in elevation of 15 m are connected by the three pipes in series. The pipes are 300 m long of diameter 30 cm, 150 long of 20 cm diameter and 200 m long of 25 cm diameter respectively. The friction factor (f) in relation $hf = \frac{fLV^2}{Dx29}$ for the three pipes are respectively 0.018, 0.020 and 0.019 and which account for friction and losses. Further the contractions and expansions are sudden. Determine the flow rate in L/S. The loss coefficient for sudden contraction from diameter 30 to 20 cm = 0.24. **10**

c) A 200 mm diameter pipe 4000 m long connects two reservoirs whose surface levels differ by 40 m. At a distance of 400m from the upper reservoir the pipe crosses a ridge the summit of which is 9 m above the level of water in the upper reservoir. Determine.

i) The Minimum depth of the pipe below the summit of the ridge, if the absolute pressure head at the summit of syphon is not to fall below 3.0 m of the water (absolute).

ii) The discharge through the pipe. Take coefficient of friction f = 0.006 and atmospheric head = 10.3 m of water. Neglect minor losses. **10**

UNIT - V

5. a) What is reciprocating pump. Describe the principle and working of a reciprocating pump with neat sketch. **10**

b) Explain with neat sketch working of hydraulic circuit for shaping machine. **10**

c) A single acting reciprocating pump running at 50 rpm delivers 0.00736 m^3/s of water. The diameter of piston is 200 mm and stroke length 300 mm. The suction & delivery heads are 3.5 m & 11.5 m respectively. Determine **10**

i) Theoretical discharge.

ii) Coefficient of discharge.

iii) Percentage slip of the pump.

iv) Power required to run the pump.

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