Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech.(ME) (2011 Onwards) (Sem.–4)

FLUID MECHANICS

Subject Code : BTME-403

Paper ID : [A1213]

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1: **Write briefly :**

i) How does :

a) a fluid differ from a solid

b) a liquid differ from a gas?

ii) Explain hydrostatic paradox.

iii) How is the stability of floating and submerged bodies determined?

iv) Define vorticity and circulation.

v) Draw hydraulic and energy gradient lines for flow in an inclined pipe connecting between the two reservoirs at different elevations.

vi) Define free and forced vortex motions. Give examples.

vii) What is Rayleigh's method of dimensional analysis?

viii) Using Darcy and Hagen-Poiseuille equations, derive expression for friction factor.

ix) What is the hydraulics of flow through parallel pipes?

x) What is a mouthpiece and how are mouthpieces classified?

SECTION-B

Q2: A cylindrical shaft of 90 mm rotates about vertical axis inside a fixed cylindrical tube of length 500 mm and 95 mm internal diameter. The space between the tube and the shaft is filled with oil of viscosity 2 poise. Determine the power required to overcome viscous resistance when shaft is rotated at 240 rpm.

Q3: A cube of side 100 mm and weight 5 N is immersed in a liquid of relative density 0.80 contained in a rectangular tank of .plan area 150 mm × 150 mm. If tank contained liquid to a height of 80 mm before the immersion of cube, determine the levels of bottom of cube and the liquid surface.

Q4: A horizontal pipe of diameter 100 mm is fitted to a tank containing oil of relative density 0.80. At the end of pipe, a nozzle of diameter 25 mm is fitted. The head acting on the pipe is 4 m. Determine discharge from the nozzle and pressure at the base of nozzle. The energy loss in the pipe can be taken as 20 times the velocity head in pipe and neglecting energy loss in the nozzle.

Q5: A flow-meter when tested in a laboratory gives a pressure drop of 100 kN/m^2 for a discharge of 0.10 m^3/s in a 150 mm diameter pipe. If a geometrically similar model is tested in 600 mm diameter pipe at identical condition of fluid, determine the corresponding discharge and pressure drop in the model.

Q6: Water flows over a rectangular notch 1 m wide at a depth of 150 mm and afterwards passes through a triangular right-angled notch. The coefficient of discharges for rectangular and triangular notches may be taken as 0.62 and 0.59. respectively. Find depth of water over the triangular notch.

SECTION C

Q7: Does the stream function, $\psi = 4xy$ describe a possible steady and incompressible flow? If yes, find whether the flow is rotational or irrotational. If irrotational, determine expression for potential function. Further, if flow takes place between the boundaries shown in Figure. Calculate (i) velocity and acceleration at point A and (ii) flow rate across AB.

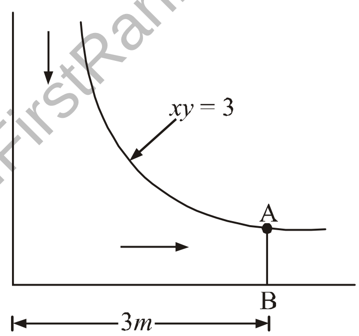

Fig.

Q8: Two reservoirs 1 and 2 having 15.5 m difference of water levels are connected by a pipeline ABC. The elevation of point B being 4 m below the level of water in reservoir 1. The length AB of the pipeline is 250 m and is made of steel and length BC of pipeline is 450 m and is made of cast iron. The diameter of both pipes is 200 mm. A partially closed valve is located in pipe BC at a distance of 150 m from reservoir 2. If flow through the pipeline is 3000 litres per minute, the pressure head at B is 0.50 m and head loss at the valve is 5 m. Find friction factors of two pipes and draw HGL and TEL.

Q9: Derive Euler's equation of motion Cartesian coordinates. Hence deduce equation of energy.