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Seat No.	

S.E. (Mechanical) (Semester - III) (Revised) Examination, April - 2018

FLUID MECHANICS

Sub. Code: 63354

Day and Date : Saturday, 28 - 04 - 2018 **Total Marks : 100**

Time : 2.30 p.m. to 5.30 p.m.

Instructions :
1) **All questions are compulsory.**
2) **Neat diagrams must be drawn wherever necessary.**
3) **Figures to the Right indicate full marks.**
4) **Use of non programmable calculator is allowed.**
5) **Assume suitable data if necessary.**

Q1) a) Define surface tension and show that the gauge pressure within a liquid droplet varies inversely with the diameter of the droplet. **[6]**

b) A U tube containing water has two limbs of internal diameters 3 mm and 8 mm respectively. The free surfaces of water are observed to be having approximately zero contact angles with the U tube surface. What is the approximate difference of water level between the two limbs? Surface tension coefficient and density of water are 0.073 N/m and 1000 Kg/m^3 respectively. **[6]**

c) Explain the terms stable, unstable and neutral equilibrium with reference to the floating bodies. **[4]**

Q2) a) The velocity field in a fluid flow is given by $V = x^2ti + 2xytj + 2yztk$ where x, y and z are given in metre and time t in seconds. Determine the velocity vector at a point (2, –1, 1) at time $t = 1$ second. Also determine the magnitude of velocity and acceleration of the flow for the given location and time. **[8]**

b) Solve any one of the following : **[8]**

i) Define stream function and velocity potential. Show that the lines of constant stream function and velocity potential must intersect orthogonally.

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ii) Explain briefly the phenomenon of propagation of elastic waves in a compressible fluid and hence define zone of action and zone of silence.

Q3) a) i) Starting from steady flow energy equation show how Bernoulli's equation for an inviscid incompressible fluid can be obtained. **[4]**

ii) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing fluid on a pipe bend? **[5]**

b) Solve any one of the following : **[9]**

i) Gasoline of specific gravity 0.8 is flowing upwards in a vertical pipeline which tapers from 30 cm to 15 cm diameter. A gasoline mercury differential manometer is connected between 30 cm and 15 cm pipe section to measure the rate of flow. The distance between the manometer tappings is 1 metre and gauge reading is 0.5 metre of mercury find

1) Differential gauge reading in terms of gasoline head.

2) Rate of flow. Neglect friction and other losses between tappings.

ii) A 300 mm × 150 mm venturimeter is to be replaced by an orificemeter both the meters are to give the same differential mercury manometer reading for a discharge of 100 lit/sec and the inlet diameter to remain as 300 mm. What should be the diameter of orifice? The coefficient of discharges of the venturimeter and orificemeter are 0.98 and 0.6 respectively. Assume the working fluid as water.

Q4) a) i) Explain why there is a need of defining correction factors for kinetic energy and momentum? And hence define kinetic energy correction factor and momentum correction factor. **[4]**

ii) Explain the concept of Total Energy Line and Hydraulic gradient Line. **[4]**

b) An oil of dynamic viscosity 20 centipoise and density 1200 Kg/m^3 flows through a 2.5 cm diameter pipe 250 metre long. What is the maximum flow in m^3/s that will ensure laminar flow? What would be the pressure drop for this flow? **[8]**

Q5) a) Show that the loss of head due to friction in a circular pipe can be expressed as $h_f = fLV^2/2gD$ where f is friction factor, L is length of pipe, V is average velocity and D is diameter of pipe. **[9]**

b) Solve any one of the following : **[9]**

i) Two pipelines of equal length and with diameters of 20 cm and 30 cm are in parallel and connect two reservoirs. The difference in water levels in the reservoirs is 4 metres. If the friction factors are assumed to be equal, find the ratio of the discharges due to the large diameter pipe to that of the smaller diameter pipe. Neglect all minor losses.

ii) Water is flowing through a horizontal pipe when the diameter of the pipe is suddenly enlarged from 20 cm to 40 cm, the hydraulic gradient line rises by 15 mm. Find the rate of flow of water.

Q6) a) Explain the effect of pressure gradient on boundary layer separation. **[8]**

b) Solve any one of the following : **[8]**

i) The power P required to run a centrifugal pump depends on the impeller diameter D, the rotational speed N, the rate of discharge Q, density ρ and viscosity μ. Using Buckingham's π theorem obtain an expression for power of the form $P=\rho N^3D^5\Phi\left[\left(Q/ND^3\right),\left(\mu/\rho ND^2\right)\right]$.

ii) A truck having a projected area of 6.5 m^2 travelling at 70 Km/hr has a total resistance of 2000 N of this 20 percent is due to rolling friction and 10 percent due to surface friction. The rest is due to form drag. Make calculations for the coefficient of form drag. Take density of air as 1.22 Kg/m^3.