(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0021 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2012–13

FLUID MECHANICS

Time : 3 Hours *Total Marks : 100*

Note :– (i) Attempt **all** questions.

(ii) Each question carries equal marks

(iii) Assume any missing data suitably.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) Explain the concept of fluid continuum. A rectangular plate of 0.50 m × 0.50 m weighing 500 N slides down an inclined plane making 30° angle with horizontal at a velocity of 1.75 m/s. If the 2 mm gap between the plate and the inclined surface is filled with a lubricating oil, find its dynamic viscosity in poise.

(b) Determine the reading of the pressure gauge 'B' shown in the fig. 1

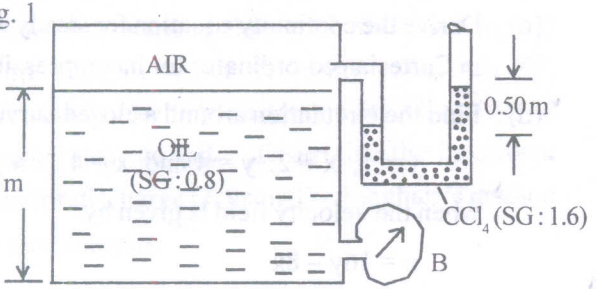

Fig. 1

(c) An annular circular plate of 2 m external diameter and 1 m internal diameter is immersed vertically in water so that its lowest edge is 5 m below the free water surface. Determine the total force and position of centre of pressure.

(d) A sphere of diameter 0.50 m and S.G. 7.0 when submerged completely in a liquid causes a tension of 3.465 kN in a string from which it is suspended. What is the specific gravity of the liquid ?

(e) What is the significance of metacentric height ? For rotational stability is it enough that the floating body has as large meta-centric height as possible ? Explain.

(f) A tank 3 m in length, 2m wide and 2 m deep containing 1.5 m depth of water is given a constant horizontal acceleration of 3 m/s^2. Determine the water surface slope. Will the water spill out ?

2. Attempt any **four** parts of the following : **(5×4=20)**

(a) Distinguish between :

(i) Steady and unsteady flows

(ii) Sub-critical, critical and super critical flows.

(b) Show that the stream lines, path lines and streak lines a identical for a 2-dimensional steady-irrotational flow.

(c) Derive the continuity equation for steady irrotational flows in Cartesian co-ordinates for incompressible fluids.

(d) Find the circulation around a closed curve defined by :

$y = 1,\ x = 2,\ y = 4$ and $x = 4$

when the velocity field is given by

$u = 16y - 8x$

$v = 8y - 7x.$

(e) If $\phi = -\frac{A}{2u} \ell_n r$; where A is a positive constant, determine Ψ and plot typical equipotential lines and stream lines. Identify the flow pattern.

(f) List the assumptions in the flow-net study. Under what condition a solid boundary will act as extreme stream line ? In a converging section of open channel why it is difficult to draw a flownet for flows ?

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) If the velocity distribution in an open channel with depth 'D' follows a triangular profile (zero velocity at the bed and maximum free stream velocity u_m at top free surface) : what will be the value of kinetic energy correction factor ?

(b) In an experiment of flow through orifices the following data were recorded :

diameter of sharp orifice : 100 mm

diameter of jet at vena contractar : 78.42 mm

height of water tank maintained :constant : 3.60 m

Discharge measured (Tank-method) : 0.0385 cumec.

Determine C_c, C_o and C_d.

(c) For the flow over a triangular notch the discharge Q depends on head of water 'H', angle of notch 'Q', acceleration due to gravity 'g' : mass density, viscosity and surface tension i.e. ρ μ and σ. Determine the functional relationship for discharge Q; using Buckingham's method of dimensional analysis.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) For steady laminar flow in a circular pipe, obtain an expression for wall shear stress τ_ω.

(b) Explain the Prandtl mixing length concept to describe the turbulence during the fluid flows at high Reynold's Number. Describe hydro-dynamically smooth and rough boundary surface.

(c) If 300 m length of 200 mm diameter pipe with friction factor 0.018 is to be replaced by 150 mm diameter pipe with friction factor 0.02 to carry the same discharge, what length will have to be provided ?

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) A flat plate of 2 m width and 4 m length is kept parallel to air flow at 5.0 m/s velocity at 15°C. Determine the length of plate over which the boundary layer is laminar, shear at the location where boundary layer ceases to be laminar, and total force on both sides on that portion of plate where the boundary layer is laminar.

(b) If velocity distribution in laminar boundary layer is given by :

$$\frac{u}{v} = \eta \text{ where } \eta = \frac{y}{\delta}; \text{ obtain values for } \frac{\theta}{\delta}, \frac{\delta}{x} \text{ and } \frac{\delta^*}{\theta}$$

where the symbols appear for their usual meanings.

(c) How will you control the separation of flow ? Explain the magnus effect with suitable example.