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CE-301

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

PAPER ID : 100301

Roll No.

B.Tech

(SEM. III) (ODD SEM.) THEORY EXAMINATION, 2014-15

FLUID MECHANICS

Time : 3 Hours] [Total Marks : 100

1. Attempt any four parts **4x5=20**

(A) Write short notes on the following:

(i) Effect of temperature on viscosity of liquid & gases.

(ii) Vapour pressure

(iii) Surface tension and its effect on pressure rise in water droplet

(iv) Compressibility

(v) Atmosphere, gauge and absolute pressure.

(B) A liquid of specific gravity 1.0 flows through pipe A and B at pressure of 50 kN/m^2 and 25 kN/m^2 respectively .Pipe A is 6m higher than pipe B .What would be the difference in levels of U tube manometer connected to A and B having manometer liquid of specific gravity 13.6? Liquid level in limb attached to pipe A is lower than that in limb attached to B.

(C) Explain conditions of stability of floating bodies. Derive an expression for Metacentric height by analytical method.

(D) What do you understand by total pressure and centre of pressure .A circular plate 2.5 m diameter is immersed in water, its greatest and least depth below the free surface being 3m and lm respectively. Find total pressure on one face of the plate and position of centre of pressure.

(E) A tank 4m long 2m wide and 1.5m deep is completely filled with water .If it is accelerated in the direction of its length at the rate of 1.2m/sec^2 .How many litres of water is spilled?

(F) Explain Newton's law of viscosity .A rectangular plate 0.5m×0.5m weighing 500N slides down an inclined plane making 30 degree angle with horizontal at a velocity of 1.75m/sec .If 2mm gap between plane and inclined surface is filled with lubricating oil, find its dynamic viscosity.

2. Attempt any four parts. **4x5=20**

(A) Differentiate between

(i) Uniform and non uniform flow

(ii) Rotational and irrotational flow

(B) Derive Continuity Equation for 3 – D and steady flow for incompressible fluid.

(C) Define Stream function ψ and Velocity Potential function ϕ. Express the condition of continuity in terms of ψ and ϕ for 2–D flow.

(D) The velocity components of a 3 – D flow in X & Y direction are given by,

$u=x^2+y^2+5$, $v=x^2+z^2-3$,

Find out the third component of velocity. Further check whether flow is irrotational.

(E) A 500mm diameter pipe carrying water at the rate of 0.5 m^3/sec branched into two pipes of 200 mm and 400mm diameter. If rate of flow of water through smaller diameter pipe is 0.2m^3/sec, determine velocity of flow in each pipe.

(F) What do you understand by dimensional homogeneity? Discuss any three dimensionless numbers.

3. Attempt any two parts. **10x2=20**

(A) (i) Explain Venturimeter with neat sketch. Derive expression for discharge through it.

(ii) Water flows through uniform pipe of 200mm diameter. Point A & B are at elevation 6 m and 8 m respectively along the inclined pipe. Pressure at A & B are 50 kN/m^2 and 20 kN/m^2 respectively. If rate of flow through pipe is 60 1ps, determine (a) direction of flow. (b) head loss between point A & B.

(B) Water flows through a 0.95 m diameter pipe, at the end of which a reducer connecting to 0.65 m diameter pipe. If the gauge pressure at the entrance of the reducer is 412.02 kN/m^2 and velocity is 2m/sec. Determine the resultant thrust on the reducer assuming that the friction loss in the reducer is 1.5 meter.

(C) (i) Discuss Geometric, Kinematic and Dynamic Similarities. Are these similarities truly obtainable? If not, why?

(ii) Flow of glycerin of Kinetic viscosity 5×10^{-4}m^2/sec in an open channel is to be modeled in laboratory with water of kinetic viscosity 1×10^{-6} m^2/sec. If both gravity and viscous forces are important, find length scale required for modeling.

4. Attempt any two parts. **10x2=20**

(A) (i) Define Stoke's law and its limitations. Derive expression for terminal velocity of a sphere falling freely in the fluid.

(ii) For laminar flow of an oil having dynamic viscosity as 1.766 N-s/m^2 in 0.3 m diameter pipe, flows with a maximum velocity of 3 m/sec at the centre of pipe. Calculate Shear stress at the pipe wall and at a point 50mm from the pipe wall.

(B) (i) Explain with neat sketch, Hydro dynamically Smooth and Rough boundaries in turbulent flow.

(ii) Derive Karman — Prandtl equation for velocity distribution for turbulent flow in hydro dynamically Smooth pipe.

(C) (i) Explain Water Hammer Phenomena in pipe flow. Derive an expression for pressure rise in pipe, if downstream valve is suddenly closed.

(ii) The 30 cm diameter pipe 2340 m long is connecting two reservoirs having free surface level difference of 72 m. If in the last 1170 m a second pipe of same diameter be laid beside the first and connected to it, what would be the increase in the discharge? Take friction factor of the pipe as 0.02.

5. Attempt any two parts. **10x2=20**

A. (i) Show that the energy thickness of boundary layer is given by.

$$\delta_E = \int_0^{\delta} \frac{u}{U}\left(1-\frac{u^2}{U^2}\right) by$$

(ii) If the velocity distribution in the boundary layer flow over a plate is given by

$$\frac{u}{U} = \frac{3}{2} * \frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

Find displacement thickness (δ *)

(B) (i) What do you mean by Separation of boundary layer? Explain the effect of pressure gradient in direction of flow on Separation.

(ii) What are different methods to prevent the Separation of boundary layer? Explain.

(C) A kite of dimension 0.6 m × 0.6 m in size weighing 3 N makes an angle of 10° with horizontal. The string attached to it makes an angle of 45° with horizontal and pull on the string is 25 N. Wind is flowing over the kite at a velocity of 15 m/sec. Take mass density of Air as 1.2 Kg/m^3. Find the coefficient of Drag and coefficient of Lift for the kite.
