BTS – III – 11.14 – 0995 Reg. No. | | | | | | | | | B

B.Tech. Degree III Semester Examination November 2014

CE 1305 (A/B) FLUID MECHANICS I

(2012 Scheme)

Time: 3 Hours Maximum Marks: 100

PART A

(Answer *ALL* questions)

(8 × 5 = 40)

I. (a) 'The viscosity of gases increases with increase in temperature' – substantiate this statement.

(b) Discuss the stability of floating bodies.

(c) Differentiate between velocity potential and stream function.

(d) List out any three applications of Bernoulli's equation.

(e) Compare pipes connected in series with those connected in parallel.

(f) Distinguish between hydrodynamically smooth and rough pipes.

(g) State Froude's model law and mention its applications.

(h) Suggest the requirements for a model to have complete similitude with its prototype.

PART B

(4 × 15 = 60)

II. (a) Show that the centre of pressure always lie below the centre of gravity. (7)

(b) A rectangular plate 0.6m wide and 1.2m deep lies within a water body such that its plane is inclined at 45° to the horizontal and the top edge is 0.70m below the water surface. Determine the total pressure force on one side of the plate and the location of the centre of pressure. (8)

OR

III. (a) Define metacentre and explain its significance in the design of passenger ships. (5)

(b) A cylindrical buoy 2m in diameter 2.7m high, weights 1.8 tonnes. Show that the buoy will not float with its axis vertical in sea water of specific gravity 1.025. If one end of a vertical chain is fastened to the centre of the base of the buoy, find the pull on the chain in order that the buoy may just float with its axis vertical. (10)

IV. A two-dimensional flow field is given by $\phi = 3xy$, determine: (15)

(i) the stream function, ψ.

(ii) the velocities at points M(2,6) and N(6,6).

(iii) the pressure difference between the points M and N.

(iv) the discharge between the streamlines passing through the points M and N.

OR

V. (a) Differentiate between free vortex and forced vortex. (5)

(b) The closed tank of a fire engine is partly filled with water, the air space above being under pressure. A 6cm diameter hose pipe connected to the tank discharges water on to the roof of a building 2.5m above the level of water in the tank. If the friction losses are 45cm of water, determine the air pressure which must be maintained in the tank to deliver 20 lit/sec on the roof. Neglect the minor losses. (10)

(P.T.O.)

VI. A horizontal pipeline 40m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. The diameter of the pipe is 150mm for the first 25m of the length of the pipe and it suddenly enlarged to a diameter of 300mm for the remaining length. The height of water level in the tank is 8m above the centre of the pipe. Considering all the losses of head which occur, (15)

(i) determine the rate of flow

(ii) draw the HGL and EGL taking $f = 0.01$ for both sections of the pipe.

OR

VII. A pipe of diameter 100mm and length 1000m is used to pump oil of viscosity $0.85 Ns/m^2$ and specific gravity 0.92 at the rate of $1.2 m^3/min$. The first 300m of pipe is laid along the ground sloping upwards 10° to the horizontal and the remaining pipe is laid on the ground sloping upwards at 15° to the horizontal. (15)

(i) State whether the flow is laminar or turbulent.

(ii) Determine the pressure to be developed by the pump

(iii) Power of the driving motor if the pump efficiency is 65%

VIII. A plate 450mm × 150mm has been placed longitudinally in a stream of crude oil having specific gravity 0.925 and kinematic viscosity 0.9 stoke which flows with a velocity of 6m/s. Calculate: (15)

(i) the friction drag on the plate

(ii) thickness of the boundary layer at the trailing edge

(iii) shear stress at the trailing edge.

OR

IX. The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis. (15)

***