BT SH-III(R)-11.21-1019 Reg. No. | | | | | | | | |

C

B.Tech. Degree III Semester Regular Examination in Naval Architecture and Ship Building November 2021

20-215-0302 FLUID MECHANICS I

(2020 Scheme)

Time: 3 Hours Maximum Marks: 100

PART A

(Answer *ALL* questions)

(5 × 4 = 20)

I. (a) Explain the phenomenon of capillarity. Obtain an expression for capillary rise of a liquid.

(b) Write a note on stability of floating bodies with reference to centre of gravity, G and centre of buoyancy, B.

(c) Distinguish between Lagrangian and Eulerian description of motion of fluid particles.

(d) Prove that the shear stress variation across the section of a circular pipe is linear in laminar flow.

(e) Define slip, percentage slip and negative slip of a reciprocating pump.

PART B

(5 × 16 = 80)

II. (a) Give a detailed description of Newtonian and Non-Newtonian fluids. (8)

(b) 3 litres of petrol weigh 23.7 N. Calculate the mass density, specific weight and specific volume of petrol. (8)

OR

III. (a) State and explain Newton's law of viscosity. (4)

(b) The velocity distribution near the solid wall at a section in a laminar flow is given by: $u = 5 \sin(5\pi y)$, for $y \leq 0.10$ m. Compute the shear stress at a section at: (12)

(i) $y = 0$

(ii) $y = 0.05$

(ii) $y = 0.10$

The dynamic viscosity of the fluid is 0.5 Ns/m^2.

IV. (a) Derive an expression for the total pressure and the depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in liquid. (8)

(b) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Also find the position of centre of pressure. (8)

OR

V. (a) Explain the terms 'meta-centre' and 'meta-centric height'. Also derive an expression for meta-centric height of a floating body. (8)

(b) A rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the pontoon is 0.80 m in sea water. If the centre of gravity is 0.6 m above the bottom of the pontoon, determine the metacentric height (Assume density of sea water = 1025 kg/m^3). (8)

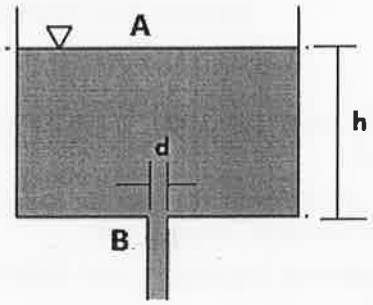
(P.T.O.)

VI. Derive Continuity equations for three-dimensional flow in Cartesian co-ordinates and discuss the same for incompressible flow and steady flow. (16)

OR

VII. (a) Explain Bernoulli's equation. Write an application of Bernoulli's equation for measuring velocity of flow at any point. How is it done? (8)

(b) Water is discharged through the drain pipe at B from the large basin at 0.03 m^3/s, as shown in Figure. If the diameter of the drainpipe d = 60 mm, determine the pressure at B, just inside the drain when the depth of the water h = 2 m. (8)



VIII. (a) Derive an expression for shear stress and velocity distribution for the flow of viscous fluid between two parallel plates. (8)

(b) For an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1m wide, maintained 10 mm apart, calculate the pressure gradient along the flow and the average velocity. (The velocity midway between the plates is 2 m/s). (8)

OR

IX. Write notes on: (16)

(i) Turbulent shear stress, in terms of eddy viscosity, η

(ii) Reynold's expression for turbulent shear stress

(iii) Empirical hypotheses to establish a relationship between the Reynolds stresses produced by the mixing motion and the mean values of the velocity components

X. Differentiate between positive displacement pumps and rotodynamic pumps. Give a detailed description of the working of a reciprocating pump. Also derive expressions for (16)

(i) Discharge through a reciprocating pump

(ii) Work done by a reciprocating pump

OR

XI. (a) Differentiate between impulse turbines and reaction turbines. (6)

(b) The mean bucket speed of a Pelton turbine is 15 m/s. The rate of flow of water supplied by the jet under a head of 42 m is 1 m^3/s. If the jet is defleted by the buckets at an angle of 165^0, find the power and efficiency of the turbine (Coefficient of velocity, $C_v = 0.985$). (10)

***