CBCS SCHEME

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17AU42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following and mention their SI units i) Density ii) Dynamic viscosity iii) Surface tension iv) Pressure v) Bulk modulus. **(10 Marks)**

b. Calculate the capillary effect in mm in a glass tube of 4mm diameter when immersed in i) water ii) mercury. The temperature of the liquid is 20°C and the values of surface tension of water and mercury in contact with air are 0.075N/m and 0.52N/m respectively. The angle of contact for water is zero and for mercury is 130°. Take specific weight of water at 20°C as 9810N/m^3. **(10 Marks)**

OR

2 a. Define the following : i) Pascal law ii) Vacuum pressure iii) Manometer iv) Hydrostatic law v) Centre of pressure. **(10 Marks)**

b. The barometric pressure at MSL is 760mm of Hg while on the top of a mountain is 720mm. If the specific weight of air is 0.01185kN/m^3 and constant calculate the elevation of the mountain top. **(05 Marks)**

c. If vessel contains a liquid of specific gravity 1.25 point A is 50 cm below the surface of liquid in the vessel. What is the pressure at A if the mercury rises by 13.6cm in the tube? **(05 Marks)**

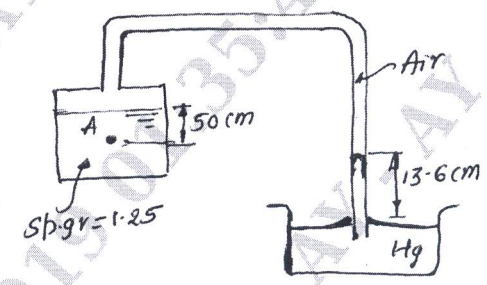

Fig.Q2(c)

Module-2

3 a. Define : i) Buoyancy ii) Metacentre iii) Metacentric height iv) centre of buoyancy. **(10 Marks)**

b. A cylindrical buoy 2m in diameter and 1.5m in height weighs 12kN and floats in salt water of density 1020kg/m^3. Centre of gravity of buoy is 0.65m from bottom. If a load of 2kN on its top symmetrically. Find the maximum height of the centre of gravity of the load above the bottom, if the buoy is to remain in stable equilibrium. **(10 Marks)**

OR

4 a. Differentiate between : i) steady and unsteady flow ii) Laminar and turbulent flow. **(06 Marks)**

b. Define : i) Steam line ii) Velocity potential. **(04 Marks)**

c. The velocity potential in a 2-d flow field for an incompressible fluid is given by $\phi = x(2y - 1)$. Determine the velocity potential at $x = 3$ and $y = 4$. Determine also the stream function Ψ at that point. **(10 Marks)**

Module-3

5 a. Derive Bernoulli's equation starting from the fundamentals and state all the assumptions made. **(10 Marks)**

b. Find the air pressure in the chamber to discharge 20lts of water through a 6cm diameter hose pipe to a height of 20m from the level of water in the chamber. Assume that the head lost in the pipeline is 4m. **(10 Marks)**

OR

6 a. Sketch and explain the working of a pitot tube. Define coefficient of velocity. **(08 Marks)**

b. Define coefficient of discharge and write the relation for it. **(02 Marks)**

c. A pitot tube is inserted in a pipe of 300 mm diameter. The static pressure in the pipe is 100mm of Hg vacuum. The stagnation pressure at the centre of the pipe, recorded by the tube is 0.981 bar. Calculate the rate of flow through the pipe if the mean velocity of flow is 0.85 times the central velocity. Take $C_v = 0.98$. **(10 Marks)**

Module-4

7 a. Define : i) Dimensional homogeneity ii) Reynolds number. Check whether the equation $\Delta p = \frac{32\mu UL}{D^2}$ is dimensionally homogeneous. **(10 Marks)**

b. The power developed by a hydraulic turbine, P's dependent on mass density of the liquid, ρ; rotational speed, N; runner diameter, D; working head, H and the gravitational acceleration, g. Using Rayleigh theorem show that $P = \rho N^3 D^5 \phi\left[\frac{N^2D^2}{gH}\right]$ where ϕ means 'a function of'. **(10 Marks)**

OR

8 a. Define Total Energy Line (TEL) and Hydraulic Gradient Line (HGL). Explain how you draw these lines for two reservoirs having an elevation difference of 'H' meters connected by a pipe of diameter 'D' and length 'L' metre. **(10 Marks)**

b. If 700mm diameter water main for a domestic water supply runs horizontally for 1600m and then branches into two 450mm diameter pipes of 3000m length each. In the first branch, the entire discharge is withdrawn a uniform rate along its length, while in the second branch half the discharge entering the pipe is withdraw at a uniform rate along its length. Assume $f = 0.025$ for all pipes, the flow entering 700mm diameter pipe to be $0.3 m^3/s$ and pressure at the outlet of two branches to be atmospheric and calculate the head loss between entrance and exit. **(10 Marks)**

Module-5

9 a. Starting from Hagen – Poiseuille equation show that for a circular pipe coefficient of friction is $f = 16/Re$. **(10 Marks)**

b. A smooth wrought pipe of iron 20cm in diameter carries crude oil at a velocity 2.5m/s. What is the loss of heat per 100m length of pipe? What is the power required to maintain the flow? Assume kinematic viscosity of oil $0.4 cm^2/s$ and specific gravity 0.9, and $f = 0.01$. **(10 Marks)**

OR

10 a. Define : i) Boundary layer thickness ii) Drag force and lift force iii) Mach number iv) Supersonic and subsonic flow. **(10 Marks)**

b. A man weighing 981N descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The parachute is hemispherical in shape, 2m diameter. Find the velocity of the parachute with which it comes down. Assume $C_d = 0.5$ density and kinematic viscosity of air respectively, 0.00125gm/cc and 0.015 stoke. **(05 Marks)**

c. Determine the velocity of a bullet fired in air at mach angle 30°. For air, temperature is 22°C, density $1.2 kg/m^3$, $\nu = 1.4$ and $R = 287.4$ J/kg K. **(05 Marks)**