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BIME-004

B.Tech. – VIEP – Mechanical Engineering / B.Tech. Civil Engineering (BTMEVI/BTCLEVI)

Term-End Examination

00186

June, 2015

BIME-004 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. Assume missing data, if any, suitably. Use of calculator is permitted.*

1. (a) State and prove the Pascal's law and give some examples where this principle is applied. *5*

(b) A wooden block (specific gravity = 0·7) of width 15 cm × depth 30 cm and length 150 cm floats horizontally on the surface of sea water (sp. wt. = 10 kN/m^3). Calculate the volume of water displaced, depth of immersion and the position of centre of buoyancy. Also find the metacentric height and the righting moment for a tilt of 5°. *9*

2. (a) State and explain Archimedes principle and mention some of its practical applications. *5*

(b) An oil tanker 4·5 m long, 3 m wide and 1·5 m deep is half filled with oil. What should be the linear horizontal acceleration in the direction of tank movement so that after attainment of relative equilibrium, the depth at the forward edge is zero ? . *9*

3. (a) Define path line, streak line and the streamline. For what type of flow are these lines identical ? *6*

(b) Water flows through a 10 cm diameter pipe with velocity 8 m/s. Compute the discharge rate. If the same flow now takes place through a 20 cm diameter pipe, evaluate the new flow velocity. *8*

4. (a) Define rotation as applied to fluid flow. Derive an expression for fluid rotation in two-dimensional flow. *7*

(b) The velocity component of a particular two-dimensional, steady, incompressible flow is given by

$$u = e^{-x} \cos hy + 1 .$$

Find the y-component of velocity v presuming that $v = 0$ at $y = 0$. Also work out the stream function. *7*

5. (a) Define and explain the significance of the kinetic energy correction factor and the momentum correction factor. *6*

(b) A rectangular orifice 1·25 m deep and 75 cm wide in the side of a tank has its top edge 1 m below the free water surface in the tank. Find the discharge through the orifice. Take $C_d = 0{\cdot}6$. *8*

6. (a) Explain the significance of dimensional analysis as applied to fluid flow problems. *6*

(b) The efficiency (η) of a fan depends on the density (ρ), the dynamic viscosity (μ) of the fluid, the angular velocity (ω), diameter (D) of the rotor and the discharge (Q). Express η in terms of dimensionless parameters. *8*

7. (a) Describe Reynolds' experiments to demonstrate the laminar and turbulent fluid flows. How is the type of flow related to Reynolds number ? *6*

(b) Determine the nature of flow when an oil of specific gravity 0·85 and kinematic viscosity $1{\cdot}8 \times 10^{-5}$ m^2/s flows in a 10 cm diameter pipe at 0·5 litre per second. *8*

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