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CE–402(O)

B. E. (Fourth Semester) EXAMINATION, Dec., 2009

(Old Scheme)

(Civil Engg. Branch)

FLUID MECHANICS – I

[CE – 402(O)]

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt all questions. Assume suitable data if required.

1. (a) Define and distinguish between the following : 10

   (i) Mass density and specific weight

   (ii) Cohesion and adhesion

   (iii) Surface tension and capillarity

   (iv) Dynamic viscosity and kinematic viscosity

   (b) A 3 cm wide gap between two vertical plane surfaces is filled with an oil of specific gravity 0·85 and dynamic viscosity 2·5 N s/m^2. A metal plate 1·25 m × 1·25 m × 0·3 cm thick and weighing 30 N is placed midway in the gap. Find the force required to lift the plate at a constant velocity of 0·12 m/sec. 10

Or

2. (a) Explain the term centre of buoyancy and obtain an expression for calculating metacentric height. 10

   (b) An inclined rectangular plate 0·5 m wide and 1·1 m deep is submerged in an oil of specific gravity 0·80. The maximum and minimum depth of the plate are 1·6 m and 0·75 m from the free surface. Calculate the hydrostatic force on one side of the plate. Also calculate the depth of centre of pressure. 10

3. (a) Define the stream function and velocity potential function and bring out its physical significance. 10

   (b) A two-dimensional flow is described by velocity components :

   $$u = 5x^3 \text{ and } v = (-)\ 15x^2y$$

   Evaluate the stream function, velocity and acceleration at point P ($x = 2$ and $y = 2$). 10

Or

4. (a) Describe the different types of displacements and deformations a fluid particle may undergo in course of its motion. 10

   (b) If the velocity field is given by :

   $$u = x + y \text{ and } v = x^3 - y$$

   find the circulation around a closed contour defined by $x = 1, y = 0, y = 1$ and $x = 0$. 10

5. (a) Derive Euler's equation of motion along a stream line and hence derive the Bernoulli's theorem. 10

   (b) 0·25 m^3/sec. of water is flowing in a pipe of diameter 30 cm. If the pipe is bend by 130°, find the magnitude

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and direction of resultant force on the bend. The pressure of water flowing in the pipe is 500 kPa. 10

Or

6. (a) Define and explain the significance of the kinetic energy correction factor and the momentum correction factor. Also suggest their practical values for laminar and turbulent flows. 10

(b) A sharp edged rectangular notch 50 cm broad has been used to measure the discharge estimated to be about 25 lit. per second. Find the percentage error in computing the discharge that would be introduced by an error of 2 mm in observing the head over the notch. Take $C_d = 0{\cdot}63$ for notch. 10

7. (a) What are the various methods of dimensional analysis ? Explain any *one* of them in detail. 10

(b) State the reasons for constructing distorted models. Discuss the various types of distortions in models. What are the merits and demerits of distorted models ? 10

Or

8. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust 'T' depends upon the angular velocity 'ω', speed of advance 'V', diameter 'D', dynamic viscosity 'μ', mass density 'ρ' and elasticity of the fluid medium which can be represented by the speed of sound 'c' in the medium. 20

9. (a) Establish a relation for the average and maximum velocity for one-dimensional viscous flow between two fixed parallel plates. 10

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(b) Oil of specific gravity 0·82 is pumped through a horizontal pipeline of 15 cm diameter and 3 km long at the rate of 1000 litres per minute. The pump has an efficiency of 70% and requires 7·35 kW to pump the oil. Calculate the dynamic viscosity of oil and verify whether the flow is laminar. 10

Or

10. (a) Obtain an expression for Hogen-Poiscuille's equation. 10

(b) For one conical thrust bearing, 100 watt power gets dissipated when a shaft with maximum cone radius 10 cm turns with 600 r. p. m. over a uniform fluid layer of thickness 0·5 cm. If semi-angle for the conical bearings is 30°, make calculations for the dynamic viscosity of the fluid. 10