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CE–402

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

(Old Scheme)

(Civil Engg. Branch)

FLUID MECHANICS – I

(CE – 402)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : All questions are compulsory and carry equal marks. Assume suitable data if necessary.

1. (a) Distinguish between Newtonian and Non-Newtonian fluids. Give *two* examples of each. Also explain the Newton's law of viscosity. 10

   (b) Calculate the power absorbed by fluid friction in a thrust bearing consisting of flat disc 10 cm diameter, placed at the lower end of a vertical shaft. The oil film is 0·25 mm thick and the viscosity of oil is 1·3 poise. The shaft rotates at 2000 r. p. m. 10

Or

2. (a) Explain the following : 10

   (i) Absolute and Gauge pressure

   (ii) Metacentric height

   (iii) Metacentre

   (iv) Stability of floating and submerged body

   (v) Centre of pressure

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(b) Prove that the centre of pressure of a completely submerged inclined surface is always below the centre of gravity of the submerged surface. 10

3. (a) Derive the equation of continuity in differential form. Define stream function and potential function. 10

(b) Two velocity components are given in the following cases. Find the third component such that they satisfy the continuity equation : 10

(i) $u = x^2 + y^2 + 2z^2$, $v = -x^2y - yz - xy$

(ii) $u = \frac{-2xyz}{(x^2 + y^2)^2}$, $w = \frac{y}{x^2 + y^2}$

Or

4. (a) Differentiate between the following : 10

(i) Streak line and Stream line

(ii) Free and Forced vortex

(iii) Sources and Sinks

(iv) Rotational and Irrotational flow

(b) Determine whether the following cases of velocity fields represent possible case of irroational flow : 10

(i) $u = x + y$, $v = x - y$

(ii) $u = 2x$, $v = x^2 - y^2$

5. (a) Derive an expression for energy equation. 10

(b) A horizontal venturimeter of 30 cm × 15 cm is used to gauge the flow of water. The differential gauge connected to the inlet and throat shows a reading of 20 cm of mercury. Find the rate of flow. Take $Cd = 0 \cdot 97$. 10

Or

6. (a) What is orifice ? How are they classified ? Define different hydraulic coefficient of an orifice. 10

(b) A bend in pipeline conveying water gradually reduces from 60 cm to 30 cm diameter and deflect the flow through an angle of 60°. At the larger end the gauge pressure is $1 \cdot 95\ kg/cm^2$. Determine the magnitude and direction of force exerted on the bend when the flow is 900 litre per sec. 10

7. (a) Explain the different type of dimensionless numbers and state their significance. 10

(b) A fluid of kinematic visosity ν is metered over a 'V' notch of a given angle. By considering the dimensions involved show that : 10

$$Q = H^{5/2} g^{1/2} \phi \left[\frac{H^{3/2} g^{1/2}}{\nu} \right]$$

Or

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

(b) A $\frac{1}{30}$ model of a ship 900 m^2 wetted area travelling in water at 3 m/sec. experiences a resistance of 20 N, calculate : 10

(i) Corresponding speed of the ship

(ii) The skin friction drag if the skin drag coefficient for model is $0 \cdot 004$ and for prototype is $0 \cdot 015$.

(iii) The total drag on the ship.

(iv) The power to propel the ship.

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9. (a) Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe. 10

(b) An oil having viscosity $0 \cdot 143\ Ns/m^2$ and specific gravity of $0 \cdot 90$ flows through a pipe $2 \cdot 5$ cm diameter and $3 \cdot 0$ m long at $\frac{1}{10}$th of the critical velocity for which Re No. is 2500. Find the velocity of flow through pipe, the head in metres of oil across the pipe length required to maintain the flow and power required to overcome viscous resistance to the flow of oil. 10

Or

10. (a) Obtain an expression for laminar flow between two fixed parallel flow. 10

(b) Two fixed parallel plates kept 10 cm apart have laminar flow of oil between them with a velocity of $1 \cdot 5$ m/sec. Assuming viscosity of oil $0 \cdot 20$ kg sec/m^2, calculate discharge per metre width. The pressure difference between two points is 30 m apart.