Mid-West University

Examinations Management Office

End Semester Examinations 2081

Bachelor level/ B.E. Civil/ 3rd Semester — Full Marks: 50

Time: 3 hours — Pass Marks: 25

Subject: Fluid Mechanics (CE432/CE205)

- *Attempt all the questions*
- *Figures in the margin indicate full marks.*
- *Assume suitable values, with a stipulation, if necessary.*
- *Candidates are required to answer the questions in their own words as far as possible.*

1. What is the difference between dynamic viscosity and kinematic viscosity? Also state their dimensions. Two large fixed parallel planes are 12mm apart. The space between the surfaces is filled with oil of viscosity 0.972 Ns/m^2. A flat thin plate 0.25m^2 area moves through the oil at a velocity of 0.3 m/s. Calculate the drag force: [2+4]
   i. When the plate is equidistant from both the planes.
   ii. When the thin plate is at a distance of 4mm from one of the plane surfaces.
2. What are the conditions of equilibrium of floating body and submerged body? A rectangular pontoon 8m long, 7m broad and 3m deep weighs 588.6 KN. It carries on its upper deck an empty boiler of 4m diameter weighing 392.4 KN. The centre of gravity of the boiler and the pontoon are at their respective centre along a vertical line. Find the metacentric height. (weight density of sea water is 10104 N/m^3) [3+4]
3. Derive the general expression for pressure in relative equilibrium. A U-tube differential manometer connects two pressure pipes A and B. Pipe A contains carbon tetrachloride having a specific gravity 1.594 under pressure of 11.772 N/cm^2. The pipe A lies 2.5m above pipe B. find the difference of pressure measured by mercury as fluid filling U-tube. [3+4]
4. Derive an expression of continuity equation for cylindrical polar co-ordinates for two dimensional flow. [3]
5. Given that,
   $u = -4ax(x^2-3y^2)$
   $v = 4ay(3x^2-y^2)$
   Examine whether these velocity components represent a physically possible two-dimensional flow, if show the flow is rotational or irrotational. [2]
6. Develop the Bernoulli's equation based on Euler's equation of motion. Also write the limitations of Bernoulli's equation [4+1]
7. The water is flowing through a pipe of diameter 30cm. the pipe is inclined and a venturimeter is inserted in the pipe. The diameter of venturimeter at throat is 15cm. The difference of pressure between the inlet and throat of venturimeter is measured by a liquid of sp. gr. 0.8 in an U-tube manometer which gives a reading of 40cm. the head loss between the inlet and the throat is 0.3 times the kinetic head of the pipe. Find the discharge. [5]
8. Differentiate between notch and weir. During an experiment in laboratory, 0.05m^3 of water flowing over a right-angled V- notch was collected in one minute. If the head of the sill is 50mm calculate the coefficient of discharge of the notch. [1+2]
9. Define boundary layer thickness. A smooth plate 2m wide and 2.5m long is towed in oil (sp. gr.=0.8) at a velocity of 1.5m/s along its length. Find the thickness of boundary layer and shear stress at the trailing edge of the plate. Take $\nu_{oil}=10^{-4}$ m^2/s [1+3]

10. Define the terms drag and lift with sketch. A 75mm diameter water jet having a velocity of 12m/s impinges on a plane, smooth plate at an angle of 60^0 to the normal to the plate. What will be the impact when;
    i. The plate is stationary?
    ii. The plate is moving in the direction of the jet at 6m/s?

    Estimate the work done per unit time by the jet on the plane in each case. Taking the density of water as 998 kg/m^3 [2+3]
11. Show that the ratio of inertia force to viscous force gives the Reynold number. Also state Buckingham's π theorem. [2+1]

The End

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