C 15211 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2010

CE 04 404—FLUID MECHANICS

(2004 admissions)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

1. (a) State Pascal's law. Give two examples where this principle is applied.
   (b) Define rotational flow and what are the conditions for the same.
   (c) What is a pitot tube and explain its principle.
   (d) State four assumptions in the derivation of Bernoulli's equation.
   (e) Write short notes on minor losses in pipe flow.
   (f) What do you understand by hydro dynamically smooth and rough pipes ?
   (g) State (i) The law of dimensional homogeneity and (ii) Buckingham's π theorem.
   (h) Define displacement and momentum thickness of a boundary layer on a flat plate.

(8 × 5 = 40 marks)

Part B

2. (a) Explain what is meant by metacentric height of a floating body. Derive an expression for metacentric height.

(7 marks)

(b) A 300 mm. × 150 mm. venturimeter is provided in a vertical line carrying oil of specific gravity 0.8, the flow being upwards. The difference in elevation of the throat section of the venturimeter is 250 mm. The differnetial U-tube manometer shows a gauge deflection of 200 mm. Calculate (i) the discharge of the oil and (ii) the pressure difference between the entrance section and the throat section. Take the coefficient of venturimeter as 0.98 and the specific gravity of mercury as 13.6.

(8 marks)

Or

(c) Verify whether the following field is rotational. If so, determine the components of rotation about various axes :—

$$u = xyz,\ v = zx,\ w = \frac{1}{2}\ yz^2 - xy$$

(7 marks)

(d) The velocity distribution in a viscous flow over a plate is given by $u = 4y - y^2$ where u is the velocity in m./s. at distance y from the plate. Given, coefficient of dynamic viscosity is 1.5 Pa. s, determine the shear stress at $y = 0$ and $y = 2.0$ m.

(8 marks)

Turn over

3. (a) Deriver Euler's equation of motion and along a stream line and hence derive Bernoulli's theorem.

(9 marks)

(b) What is Cippoletti weir ? (6 marks)

Or

(c) A rectangular contracted weir has a length of 3 m. between the abutments. There are two 0.20 mm. thick rectangular piers like obstructions on the crest. Estimate the discharge under a head of 0.75 m. Assume $C_d = 0.62$ and neglect velocity of appraoch.

(8 marks)

(d) Describe how the coefficeints of an orifice can be determined. (7 marks)

4. (a) Explain the concept of equivalent pipes. (7 marks)

(b) A tank of 100 m.^{2} in area contains water 4 m. deep. Find the time taken to fall water level to 2 m. through a pipe 300 m. long and 150 mm. diameter connected to the bottom of the tank. Take $f = 0.01$.

(8 marks)

Or

(c) Derive Darcy Weisbach equation for energy loss due to friction in pipe flow. (7 marks)

(d) If two pipes of diameter D and d and equal length L are arranged in parallel the loss of head for a flow of Q is h. If the same pipes are arranged in series the loss of head for the same flow Q is H. If d = 0.5 D, find the percentage of total flow through each pipe when placed in parallel and the ratio (H/h). Neglect minor losses and assume f to be constant.

(8 marks)

5. (a) Briefly explain :

(i) Geometric similarity.

(ii) Kinematic similarity.

(iii) Dynamic similarity.

(7 marks)

(b) A 1 : 16 scale model was tested in fresh water at a corresponding velocity. The prototype flying boat has to move in sea water of specific weight 10105 N/m.^{3} at a velocity of 25 m./s. Find the corresponding speed of the model. If the wave making resistance of the prototype is estimated to be 5490 N, what would be the corresponding wave making resistance of the model ?

(8 marks)

Or

(c) Define Weber number, Mach number and Cauchy number. (7 marks)

(d) State Buckingham's π-theorem. What are repeating variables ? How are the repeating variables selected in dimensional anlaysis ?

(8 marks)

[4 × 15 = 60 marks]