* R M - 6 5 7 1 / 4 0 0 *

RM-6571

B. E. - II (Sem. IV) (Mechanical) Examination

May / June – 2010

Fluid Mechanics

Time : **3** Hours] [Total Marks : **100**

Instruction :

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 2 (Sem. 4) (Mechanical)**

Name of the Subject :

☛ **Fluid Mechanics**

☛ Subject Code No. : **6 5 7 1** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

SECTION - I

1 (a) Explain the following terms (any **five**) **10**

(i) Kinematic Viscosity

(ii) Centre of pressure

(iii) Cavitation

(iv) Meta Centre

(v) Vapor pressure

(vi) Specific gravity

(vii) Pascal's law

(b) Answer the following questions : **10**

(i) Explain surface tension. Derive the equation for surface tension on a liquid jet.

(ii) Explain stability of a submerged body.

(iii) Explain capillarity. Derive the equation for the capillary rise.

(iv) Derive Euler's equation of motion along a stream line.

(v) Derive an expression for continuity for two dimensional flow and deduce steady incompressible two dimensional flow.

2 Attempt any **three** : **15**

(i) Derive an expression for total pressure and centre of pressure for vertically immersed surface.

(ii) Given that $u = x^2 - y^2$ and $V = -2xy$. Determine the stream function for the flow.

(iii) 2 litre of petrol weights 14 N. Calculate the specific weight, mass density specific volume and specific gravity of petrol with respect to water.

(iv) In 1 in 20 model of stilling basin, the height of hydraulic jump in the model is observed to be 20 cm. What would be the corresponding value in the prototype?

3 Attempt any **two** : **15**

(i) A square metal plate 1.8 m side and 1.8 mm thick weighing 60 N is to be lifted through a vertical gap of 30 mm of infinite extent. The oil in gap has a specific gravity of 0.95 and viscosity $3 Ns/m^2$. If the metal plate is to be lifted at constant speed of 0.12 m/sec, find force and power required.

(ii) The wall of a reservoir is inclined at 30^o to vertical. A slice 1m long along the slop and 0.8 m wide is closed a plate. The top of the opening is 8m bellow the centre of water level. Determine the location of centre of pressure and total force on the plate.

(iii) Find out the pressure in the pipe if the area of the reservoir is 100 times the area of the tube for the manometer reading. A single column manometer is connected to a pipe containing of liquid of specific gravity 0.9 the specific gravity of mercury is 13.6.

SECTION - II

4 (a) Choose the correct answer : **10**

(i) For turbulent flow in smooth pipes, the entrance length is taken as

(a) 20 (b) 50

(c) 80 (d) 115

(ii) Loss of head at exit of a pipe is given as

(a) $\frac{V^2}{2g}$ (b) $\frac{V^2}{g}$

(c) $\frac{V^3}{g}$ (d) $\frac{V^3}{2g}$

(iii) In which of the following measuring devices Bernoulli's equation is used:
(a) Venturimeter
(b) Orifice meter
(c) Pitot tube
(d) All of the above

(iv) In case of a closed cylindrical vessel sealed at the top and the bottom the volume of air before rotation is _____ the volume air after:
(a) More than
(b) Less than
(c) Equal to
(d) None of above

(v) The maximum velocity in a circular pipe when flow is laminar occurs at
(a) The top of the pipe
(b) The bottom of the pipe
(c) The centre of the pipe
(d) Not necessarily at the centre

(b) Answer the following questions : **10**

(i) List out different obstruction type of flow meters.

(ii) Define - 'Energy Thickness $(\delta_e)''$'

(iii) What is the relationship between shear stress and pressure gradient for Boundary layer flow?

(iv) Write down expression for mass conservation.

(v) Write down - "Newton's Law of Viscosity".

5 (a) Write a note on venturimeter. Also derive expression for coefficient of discharge. **7**

OR

(a) Make a short note on following topics for shear stres in Turbulent flow :
(i) Prandtl's mixing length theory
(ii) Reynold's Theory

(b) Solve any **two** : **8**

(i) A nozzle is situated at a distance of 1.2 m above the ground level and is inclined at 60^o to the horizontal. The diameter of the nozzle is 40 mm and the jet of water from the nozzle strikes the ground at a horizontal distance of 5m. Find the flow rate.

(ii) A horizontal venturimeter with inlet diameter 200 cm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If the coefficient of discharge is 0.98, determine the rate of flow.

(iii) A 2500 m long pipeline is used for transmission of power. 120 kW power is to be transmitted through the pipe in which water having a pressure of 4000 kN/m^2 at inlet is flowing. If the pressure drop over the length of pipe is 800 kN/m^2 and f = 0.006, find :

(a) Diameter of the pipe, and

(b) Efficiency of transmission.

6 (a) Write a short note : "Separation of Boundary Layer". **7**

OR

(a) Explain Reynolds Experiment with proper diagrams and expressions. **7**

(b) Solve any **one** : **8**

(i) A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drop permetre length of pipe is 20 kN/m^2, determine:

(a) The mass flow rate in kg/min

(b) The shear stress at the pipe wall

(c) The Reynold number of flow, and

(d) The power required per 50 m length of the pipe to maintain the flow.

(ii) In a rough pipe of diameter 0.6 m and length 4500 m water is flowing at the rate of 0.6 m^3/s. If the average height of roughness is 0.48 mm, find the power required to maintain this flow.

Use $\frac{1}{\sqrt{4f}} = 2.0 \log_{10}\left(\frac{R}{k}\right) + 1.74$ for rough pipe.