Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

II SEMESTER B.S. DEGREE EXAMINATION – APRIL/ MAY 2017

SUBJECT:FLUID MECHANICS (ME 122)

(BRANCH: MECH /AVI)

Wednesday, 26 April 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A) Distinguish between

(a) Dynamic and kinematic viscosity
(b) Reynolds's number and Mach number
(c) Compressible and incompressible flow
(d) Laminar and turbulent flow
(e) Stream line and stream tube (10)

1B) A rectangular gate 5 m × 2 m is hinged at its base and inclined at 60° to the horizontal as shown in Figure 1. To keep the gate in stable position, a counter weight of 5000 kgf is attached to the upper end of the gate. Find the depth of water at which the gate begins to fall. Neglect the weight of the gate and also friction at the hinge and pulley. (10)

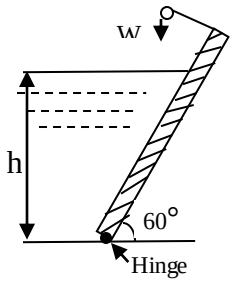

Figure 1.

2A) Derive an expression to determine the metacentric height of a floating body. (10)

2B) Two coaxial cylinders 10 cm and 9.75 cm in diameter and 2.5 cm high have their both ends open and have a viscous fluid in between. A torque of 1.2 N-m is produced on the inner cylinder when the outer one rotates at 90 rpm. Determine the coefficient of viscosity of the fluid. (10)

3A) Derive an expression for the shear stress and velocity distribution for the flow of viscous fluid through a circular pipe. Also plot them across a section in the pipe. (10)

3B) An oil of relative density 0.9 flows through a vertical pipe of diameter 20 cm. the flow is measured by a 20 cm × 10 cm venturimeter. The throat is 30 cm above the inlet section. A differential U tube manometer containing mercury is connected to the throat and inlet. If the C_d of the venturimeter is 0.99 what is

(a) flow for a manometer reading of 9 cm

(b) Manometer reading for a flow rate of 50 L/s? (10)

4A) Derive Euler's equation for the fluid flow and hence deduce Bernoulli's equation. List the assumptions made. (10)

4B) An underwater device 1.5 m long is to move at 3.5 m/s. A geometrically similar model 30 cm long is tested in a variable pressure wind tunnel at a speed of 35 m/s. Calculate the pressure of air in the model. If the model exhibits a drag force of 40N Calculate the prototype drag force.

Assume ρ_{water} = 998 kg/m^3, ρ_{air} =1.17 kg/m^3, μ_{air} = 1.9×10^{-5} Pa.s

and μ_{water} = 1.0×10^{-3} pa.s

(10)

5A) Derive Darcy -Weisbach equation for determining the loss of head due to friction in a pipe flow. (10)

5B) In a two dimensional incompressible flow, velocity components are given by u = x - 4y and v = – y – 4x. Show that velocity potential exists and determine its form. Find also the stream function. (10)

6A) Rate of flow of water through a horizontal pipe is 0.25 m^3/s. Diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. Pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (a) loss of head due to sudden enlargement
(b) pressure intensity in the larger pipe (c) power lost due to enlargement (10)

6B) A wooden cylinder of relative density 0.6 and circular in cross section is required to float in oil with specific gravity 0.9. Find L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of the cylinder and D is the diameter. (10)

7A) Explain with necessary diagrams how will you determine the forces on a curved plane submerged in a liquid. (10)

7B) Petrol of specific gravity 0.8 flows upwards through a vertical pipe. A and B are two points in the pipe, B being 0.3 m higher than A. Connections are led from A and B to a U – tube manometer containing mercury. If the difference of pressure between A and B is 0.18 kgf /cm^2, find the reading shown by the differential mercury manometer. Sketch the arrangement. (10)

8A) The discharge Q from a centrifugal pump is dependent upon the pump speed (N), diameter of the impeller (D) head (H), acceleration due to gravity (g) density of the fluid (ρ) and viscosity (μ). Show by Buckingham's π theorem

$$\frac{Q}{D^2\sqrt{gD}} = \phi\left(\frac{N\sqrt{D}}{\sqrt{g}}, \frac{H}{D}, \frac{\mu D^2}{\rho Q}\right)$$

(10)

8B) Oil of relative density 0.9 and dynamic viscosity 2.5 poise is pumped through a 100 mm diameter pipe 500 m long at the rate of 2L/s. Find

(a) Reynolds' number for the fluid flow.
(b) Calculate the pressure required at the pump if the outlet end which is free is at 20 m above the pump level.
(c) What should be the power input if the overall efficiency of the pump set is 65%? (10)