Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

II SEMESTER B.S. DEGREE EXAMINATION – NOV. / DEC. 2016

SUBJECT: FLUID MECHANICS (ME 122)

(BRANCH: MECHANICAL)

Monday, 12 December 2016

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

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed.**
- ✓ **Draw neat and proportionate sketches wherever necessary.**

1A Distinguish between the following
a) Ideal fluid and Real fluid
b) Bulk modulus and compressibility
c) Absolute Viscosity and Kinematic viscosity
d) Density and Specific gravity

1B Calculate the dynamic viscosity of an oil which is used for lubrication between a square plate of size 0.8mx0.8m and an inclined plane with an angle of inclination 30^0. The weight of a square plate is 300 N and slides down the inclined plane with uniform velocity 0.3 m/s. The thickness of the oil film is 1.5 mm.

1C Explain the principle of piezometer **(8+8+4)**

2A Figure Q 2A shows a conical vessel with its outlet at A to which a U tube mercury manometer is connected. The right limb is filled with water. The readings given of the manometer given in the figure is when the vessel is empty. Find the reading of the manometer when the vessel is completely filled with water.

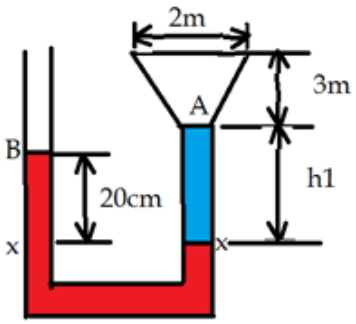


Figure Q 2A

2B Find the resultant force due to water pressure acting on a gate as shown in the figure. The width of the gate is 1 m. What is the angle made by resultant force with the horizontal? Prove that the resultant force passes through the hinge O.

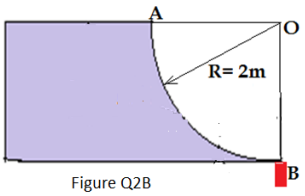
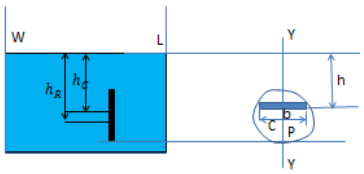


Figure Q2B

(10+10)

3A Derive the expression for the centroid and centre of pressure for a vertical plate immersed in water.

Figure Q 3A



3B A ship is 100 m long and 12 m broad has a displacement of 29.43 MN. The second moment of water plane area about its fore and aft axis (X-X) is 65% of moment of inertia of the circumscribing rectangle. The position of centre of buoyancy is 2.4 m below the water line. Find the position of metacentre.
Also calculate the position of centre of gravity if the weight of 735.750 kN is moved by 6 m across the deck which inclines the ship by 4.5^0. **(10+10)**

4A A ship of 98.1 MN displacement and a draft of 5m in sea water (ρ = 1020 kg/m^3) and a water plane area of 1000 m^2, enters a fresh water portion of a river. What depth of fresh water is necessary to just float the ship?

4B Distinguish between,

a) steady flow and unsteady flow

b) uniform and non uniform flow

c) rotational and irrotational flow

4C A fluid field is given by, $V = xyi + 2yzj-(yz+z^2)k$. Determine whether this is a possible steady incompressible flow. Calculate the acceleration at point (1,2,3) **(6+6+8)**

5A A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressure at the points A and B are given as 29.43 N/cm^{2}and 22.563 N/cm^2 respectively while the datum head at A and B are 28 m and 30 m respectively. Find the head loss due to friction between A and B.

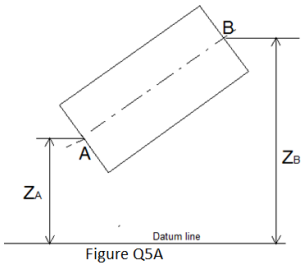


Figure Q5A

5B Derive the expression for Euler's equation for flow along stream line. Also derive the Bernoulli's equation from Euler's equation.

5C The pressure drop in an aero plane model of size $\frac{1}{40}$ of its prototype is 80N/cm^2. The model is tested in water. Find the corresponding pressure drop in prototype. Take the density of air as 1.24 kg/m^3. The viscosity of water is 0.01 **poise** while viscosity of air is 0.00018 poise. **(6+10+4)**

6A A model of an airship is tested in deep water. The length of the model was 10 m and it had a speed of 25 m/s , which was measured in water. Determine the speed of actual sized ship when its length is 350 m. Assume the kinematic viscosity of air is 13 times that of water. The flow is dynamically similar. What would be the resistance of actual ship in air , when its model gave a reading of 280 N in water?. The density of air is 1.235 kg/m^3.

6B The force F on the propeller of an aircraft depends upon the linear speed V of the air craft , density of air ρ, viscosity of air μ, diameter of the propeller D and the speed of rotation N. Show that, F =$\rho V^2 D^2 \emptyset \left(\frac{\mu}{\rho VD}, \frac{V}{ND}\right)$ **(6+14)**

7A A venturimeter is fitted to a 15 cm diameter pipe line carrying water at 60^0 to the horizontal plane. The throat diameter of the venturimeter is 5 cm and is placed higher than the inlet side. The difference in pressure between throat and the inlet which is 0.9 m apart is equivalent to 7.5 cm of mercury. Calculate the rate of flow. Take Cd = 0.98.

7B Derive the expression for the discharge over a rectangular notch of width L for a head of H.

7C Crude oil μ = 1.5 poise and relative density 0.9 flows through a 20 mm diameter vertical pipe. The pressure gauge fixed 20 m apart read 58.86 N/cm^2 and 19.62 N/cm^2 as shown in the figure Q7C. Find the direction and rate of flow through the pipe.

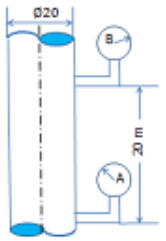


Figure Q7C

(8+4+8)

8A Show that, in a two dimensional flow of real fluid between two stationary plates, the average velocity of flow is equal to two thirds of the maximum velocity of flow.

8B Oil is pumped along a horizontal 15 cm diameter pipe 200 m long. The specific gravity of oil is 0.89 and its kinematic viscosity is 1.3 stokes. Flow is laminar so that the friction factor of pipe is $64Re^{-1}$, in which Re is the Reynold's Number. It takes 18.4 kW to drive the pump which has efficiency of 65%. Find the quantity of oil flowing through the pipe in litres/minute. **(10+10)**