Code No: W0124 **R07** SET - 1

II B. Tech I Semester Supplementary Examinations Nov – 2012
FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) What are the pressure measuring devices? Explain the working of an inverted U tube differential manometer.
   b) A pipe containing water at 172 kN/m^2 pressure is connected by a differential gauge to another pipe 1.5m lower than first pipe and containing water at high pressure. If the difference in the heights of the two mercury columns of the gauge is equal to 75mm, what is the pressure in the lower pipe? Specific gravity of mercury is 13.6.

2. Find the net hydrostatic force per unit width on the rectangular gate AB in Figure 1 and the line of action. Specific gravity of Glycerin is 1.263.

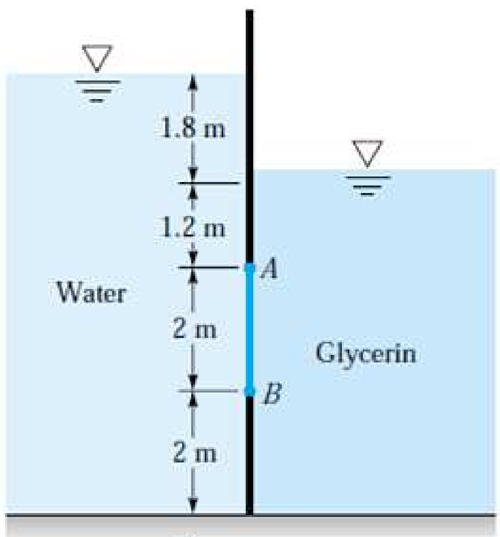

Figure 1

3. a) What is flow net? What are its characteristics? What are the uses of flow nets?
   b) A flow field is represented by a velocity potential function as given below $\varphi = c(2x^2 - 3y^2)$ verify whether it is a valid function or not? If valid, then find out the corresponding stream function.
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4. A pipeline carrying oil of specific gravity 0.87., changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is 4 m at a higher level. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and direction of flow.

5. For the velocity profile for laminar boundary layer $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^2$ Find the boundary layer thickness, shear stress, force and co-efficient of drag in terms of Reynolds number.

6. a) Water at 15^0c flows between two large parallel plates at a distance of 1.6 m apart. Determine (i) the maximum velocity (ii) the pressure drop per unit length and (iii) the shear stress at the walls of the plates if the average velocity is 0.2 m/s. the viscosity of water at 15^0C is given as 0.01 poise.
   b) Describe Reynold's experiment to demonstrate the two types of flow.

7. A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference in water levels as 20 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take f = 0.015 and neglect minor losses.

8. a) Derive an equation for discharge of an orifice meter.
   b) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 14.715 N/cm^2 and 9.81 N/cm^2 respectively. Find the rate of flow of water through the pipe in litres/sec. Take $C_d = 0.60$.

Code No: W0124 **R07** SET - 2

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FLUID MECHANICS
(Civil Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
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1. a) Define and Write short note on the fallowing
   i) Pascal Law ii) Hydrostatic law iii) Surface Tension

   b) The velocity distribution in a fluid is give by u = 30000 y (1-2y) where u is the velocity in m/sec at a distance of y meters normal to the boundary. If the dynamic viscosity of fluid is 1.8 × 10 poise, determine the shear stress at y = 0.2m.

2. a) Explain three conditions of equilibrium of a floating body.
   b) Panel *ABC* in the slanted side of a water tank is an isosceles triangle with the vertex at *A* and the base *BC* = 2 m, as in Fig. 1. Find the water force on the panel and its line of action.

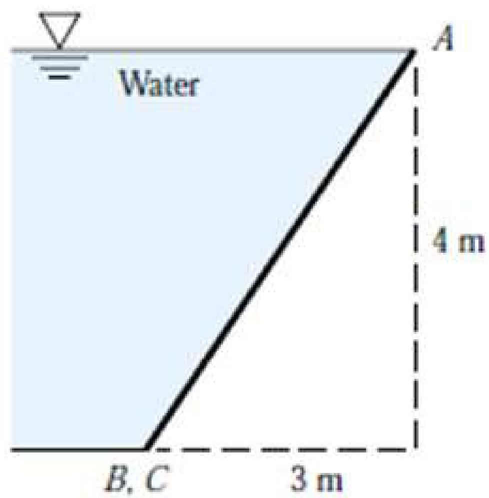

Figure 1

3. a) Define Steady flow and unsteady flow
   b) Show that $\varphi=x^2-y^2$ represents on two dimensional irrotational flow. Find the potential function

4. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from the first principle and state the assumptions made for such a derivation.
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5. Air is owing over a smooth plate with a velocity of 8 m/s. The length of the plate is 1.5 m and width 1 m. If the laminar boundary exists up to a value of Reynold number = 5 x 10^5, find the maximum distance from the leading edge up to which laminar boundary layer exists. Find the maximum thickness of laminar boundary layer if the velocity profile is given by $\frac{u}{U} = \left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$ Take Kinematic viscosity for air = 0.15 stokes.

6. a) Determine (i) the pressure gradient, (ii) the shear stress at the two horizontal parallel plates and (ii) the discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/sec between two horizontal parallel fixed plates which are 100 mm a part. Given μ = 2.4525 N s/m^2.
   b) Describe Reynold's experiment to demonstrate the two types of flow.

7. Lubricating oil of specific gravity 0.82 and dynamic viscosity 12.066 x 10^2 N.s/m^2 is pumped at a rate of 0.02 m^3/s through a 0.15 m diameter 300 m long pipe. Calculate the pressure drop, average shear stress at the wall of the pipe and the power required to maintain the flow, if the pipe is inclined at 15 degree with the horizontal and the flow is in upward direction.

8. a) Derive the expression for computing the discharge through an orifice meter
   b) A rectangular notch of 250 cm width is used to measure the flow rate of water in an open channel. If the actual flow rate is 1.16 m^3/s, under a head of 0.253 m. Determine the coefficient of discharge of the notch.

Code No: W0124 **R07** SET - 3

II B. Tech I Semester Supplementary Examinations Nov – 2012
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(Civil Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
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1. a) For measuring small pressure differences, explain with sketches how an inclined U-tube manometer is used.

   b) A pressure gauge is fitted at the bottom of a closed vessel to which a simple manometer is also fitted as shown in figure 1. Determine the reading indicated by the pressure gauge, if manometric liquid is mercury.

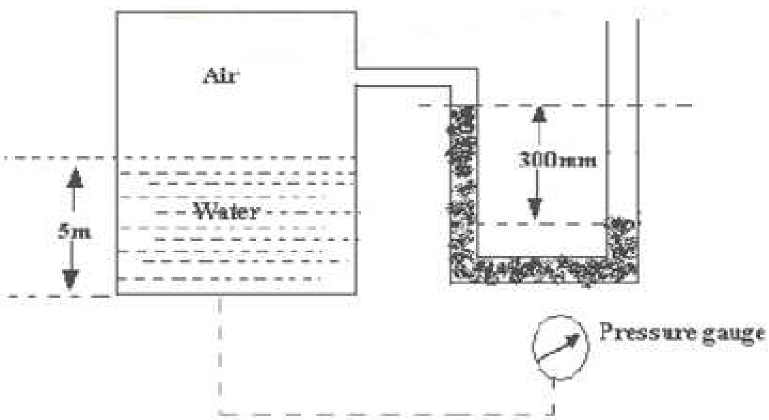

Figure 1

2. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid.

   b) Find the total pressure and position of centre of pressure on a triangular plate of base 2.4m and height 3.6m which is immersed in water in such a way that the plan of the plate makes an angle of 600 with the free surface of the water. The base of the plate is parallel to water surface and is at a depth of 3.0m from water surface.

3. a) What type of acceleration is to be expected if:
   i) Stream lines are parallel and equidistant
   ii) Stream lines are straight and converging
   iii) Stream lines are curved but equi-spaced
   iv) Stream lines are curved and converging

   b) Derive the equation for a stream line.
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4. Crude oil of specific gravity 0.85 flows upwards at a volume rate of flow of 60 litre per second through a vertical venturimeter with an inlet diameter of 200 mm and a throat diameter of 100 mm. The coefficient of discharge of the venturimeter is 0.98. The vertical distance between the pressure tapings is 300 mm. i) if two pressure gauges are connected at the tapings such that they are positioned at the levels of their corresponding tapping points, determine the difference of readings in N/mm^2 of the two pressure gauges. ii) If a mercury differential manometer is connected, in place of pressure gauges, to the tapings such that the connecting tube up to mercury are filled with oil, determine the difference in the level of the mercury column.

5. For the velocity profile for turbulent boundary layer $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{1/7}$ Obtain an expression for boundary layer thickness, shear stress and drag force on one side of the plate, in terms of Reynold`s number. Given the shear stress for turbulent boundary layer as $0.0225 \rho u^2 \left(\frac{\mu}{\rho} u \delta\right)^{1/4}$

6. a) Draw neat sketch of Reynold's apparatus and explain how the laminar flow can be demonstrated with the help of the apparatus.
   b) Two parallel plates kept 100 mm apart having laminar flow of oil between them with a maximum velocity of 1.5 m/sec. Calculate discharge per meter width, shear stress at the plates and the difference in pressure between two points 20 m apart. Assume viscosity of oil to be 0.0245 poise.

7. Determine the rate of low of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the center of the pipe. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4flv^2}{2gD}$

8. A broad crested weir of 50 m length has 50 cm height of water above its crest. a) Find the maximum discharge by neglect the velocity of approach. b) If the velocity of approach is to be taken into consideration, find the maximum discharge when the channel has a cross sectional area of 50 m^2 on the upstream side. Take C_d = 0.60.

Code No: W0124 **R07** SET - 4

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(Civil Engineering)

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1. a) Define and Write short note on the fallowing
   i) Pascal Law ii) Hydrostatic law iii) Surface Tension
   b) An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is owing. The vertical distance between the axes of these pipes is 20cm. When an oil of specific gravity 0.7 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted manometer (when measured from the respective centre lines of the pipes) are found to be same and equal to 25cm. Sketch the configuration. Determine the difference of pressure between the pipes.

2. a) What do you mean by Hydrostatic pressure?
   b) Define Total pressure and centre of pressure
   c) A circular plate 2.5m in diameter is submerged in water as shown in figure 1. Its greatest and least depths below free surface of water are 3m and 2m respectively. Find i) Total pressure on front face of the plate and ii) the position of centre of pressure

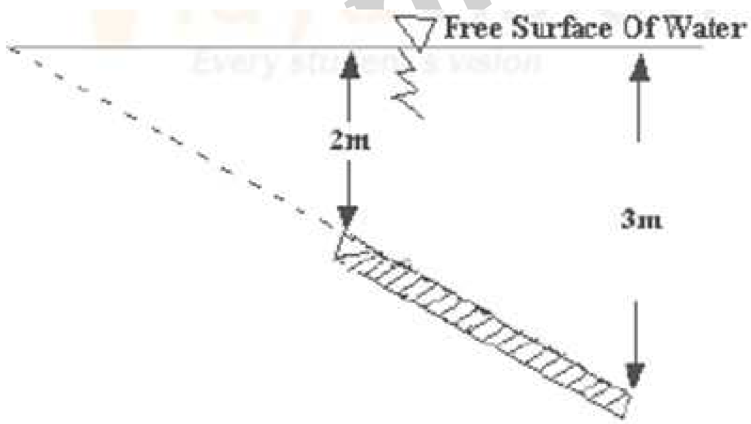

Figure 1

3. a) What are Stream function and velocity functions?
   b) Define the Equation of Continuity? Derive the Continuity Equation for three dimensional flow from fundamentals by indicating the assumptions made where ever is required.

4. A 30 cm x 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. the differential U tube mercury manometer shows a gauge deflection of 25 cm. Calculate the (i) the discharge of oil, and (ii) the pressure difference between the entrance section and throat section. Take the coefficient of meter as 0.98 and specific gravity of mercury as 13.6.
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5. a) Explain the phenomenon of boundary layer separation and its influence on the drag of an immersed body.
   b) In a at plate of 2m length and 1m wide, experiments were conducted in a wind tunnel with a wind speed of 50 Km/hr. The plate is kept at such an angle that the coefficients of drag and lift are 0.18 and 0.9 respectively. Determine drag force, lift force, resultant force and power exerted by the air stream on the plate. Take density of air as 1.15 Kg/m^3.

6. a) Prove that the velocity distribution of viscous flow between two parallel plates when both plates are fixed across a section parabolic in nature. Also prove that maximum velocity is equal to one and half times the average velocity.
   b) Water is flowing between two large parallel plates which are 2 m a part. Determine maximum velocity, pressure drop per unit length and shear stress at walls of the plate, if the average velocity is 0.4 m/sec. Take viscosity of water as 0.01 poise.

7. A pipe of diameter 20 cm and length 10,000 m laid at a slope of 1 in 200. An oil of specific gravity = 0.9 and μ = 1.15 poise is pumped up at the rate of 20 litres per second. Find the head lost due to friction. Also find the power required to pump the oil.

8. a) What are the advantages of triangular Notch over Rectangular Notch?
   b) A rectangular channel 2.0 m wide has a discharge of 250 litres per second, which is measured by a right angled V – notch weir. Find the position of the apex of the notch from the bed of the channel if maximum depth of water is not to exceed 1. 3m. Take $c_d = 0.62$.