Please check that this question paper contains__09 questions and _02 printed pages within first ten minutes.

[Total No. of Questions: 09] [Total No. of Pages: 02]

Uni. Roll No. …….

Program/ Course: B.Tech. (Semester: 4th)
Name of Subject: Fluid Mechanics and Machinery
Subject Code: **PCME-108**
Paper ID: 16198

25-01-2022(M)

Time Allowed: 02 Hours **Max. Marks: 60**

NOTE:
1) Attempt any SIX questions out of NINE questions.
2) Any missing data/dimension may be assumed appropriately

Q1.

(a) A square plate of size 1m x 1m and weighing 392.4 N slides down an inclined plane with a uniform velocity of 0.2 m/s. The inclined plane is laid on a slope of 5 vertical to 12 horizontal and has an oil film of 1mm thickness. Calculate the dynamic viscosity of oil.

(b) The velocity distribution over a plate is given by $u = 3/4\ y - y^2$, where 'u' is the velocity in m/s at a distance 'y' meter above the plate. Determine the shear stress at y=0 and y=0.2 m. Take dynamic viscosity = 8.4 Poise. [5+5=10]

Q2.

(a) A uniform wooden cylinder has a specific gravity of 0.6. Find the ratio of diameter to length of the cylinder so that it will just float upright in a state of Neutral Equilibrium in water.

(b) A 2-D flow is described in the Lagrangian system as:

$x = X_o e^{-Kt} + Y_o (1 - e^{-2Kt})$
$y = Y_o e^{Kt}$
$z = Z_o + 3$ Find

(i) The equation of a fluid particle in the flow field
(ii)The velocity components in Eulerian system [5+5=10]

Q3. Given the velocity field $u = 10\ x^2y$, $v = 15\ xy$, and $w = (25t - 3xy)$.Find the acceleration of a fluid particle at a point (1, 2,-1) at time 't' = 0.5. [10]

Q4.

(a) For the flow $\psi = xy$ and $\psi = \ln (x^2 + y^2)$ represented by stream function. Determine the velocity components and check for the Irrotationality.

(b) An Incompressible flow around a circular cylinder of radius 'a', is represented by

$$\psi = -Ur \sin\theta + Ua^2/r \sin\theta.$$

'U' is free stream velocity. Show that $V_r = 0$ at r =a. Find the values of 'θ' at r=a where IVI= U. [5+5=10]

Q5. Using the Buckingham's Pi – Buckingham theorem, show that the velocity 'U' through a circular orifice is given by:

$$U = (2gH)^{0.5}\, \boldsymbol{\phi}\, (D/H, \rho UH/\mu)$$

Where 'H' is the head causing flow, 'D' is the diameter of the orifice, 'μ' is the coefficient of dynamic viscosity, 'ρ' is the density of fluid flowing through the orifice and 'g' is the acceleration due to gravity. [10]

Q6.

(a) The loss of head from the entrance to the throat of a 254 mm X 127 mm venturimeter is 1/6 times the throat velocity head. If the mercury in the differential gauge attached to the meter deflects 101.6 mm, what is the flow of water through the venturimeter.

(b) Derive an expression for Divergence free flow from conservation of mass theorem.

[5+5=10]

Q7. Two reservoirs 5.2 km apart are connected by a pipeline which consists of a 225 mm diameter pipe for the first 1.6 km, sloping at 5.7 m per km. For the remaining distance, the pipe is diameter is 150 mm laid at a slope of 1.9 m per km. The levels of water above the pipe openings are 6m in the upper reservoir and 3.7 m in the lower reservoir. Taking 4f = 0.024 for both the pipes and coefficient of contraction is 0.6. Calculate the rate of discharge through the pipeline. [10]

Q8. A wheel consists of radial blades with inner and outer radii of 30 cm and 60 cm respectively. Water enters the blades at the outer periphery with velocity of 50 m/s and the supply jet makes an angle of 25^o with tangent to wheel at inlet tip. Water leaving the blade has a flow velocity of 10 m/s. If the blade angles at entrance and exit 40^o and 30^o respectively. Make calculations for work done per kg of water, speed of wheel and efficiency of blading. [10]

Q9.

(a) Draw schematic diagram to explain construction and working of centrifugal pump.

(b) A Pelton wheel of 1.2 m mean bucket diameter works under head of 650 m. The jet deflection is 165^o and its relative velocity is reduced over the buckets by 15 % due to friction. If the water is to leave the bucket without whirl, determine the rotational speed and power developed by the wheel. Take coefficient of velocity is 0.97.

[5+5=10]

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