S.E. Sem IV CBGS
Mechanical Engg.
Fluid Mechanics

19/5/2016
3 pm to 6 pm

QP Code : 30793

Mechanical/Automobile

(3 Hours) **[Total Marks : 80**

Question no.1 is compulsory.
Attempt **Any Three** from question no. 2 to 6.
Use illustrative diagrams where ever required.

Q1 Solve any **FOUR**

a Define a fluid and explain Newton's law of viscosity 05

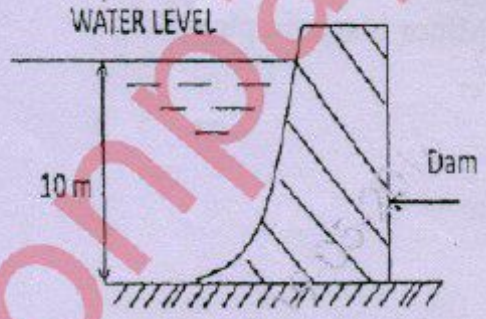
b Explain boundary layer separation and methods to control it 05

c A two dimensional flow is described in the Lagrangian system as 05
$x = x_0e^{-kt} + y_0(1 - e^{-2kt})$ and $y = y_0e^{-kt}$.
Find the equation of a fluid particle in the flow field

d Explain Induced drag 05

e Draw a sketch of an Orifice meter 05

Q2 a Find the magnitude and direction of resultant pressure acting on a curved face of a dam which is shaped according to the relation $y = x^2/9$ as shown in the figure. The height of the water retain by the dam is 10m. Consider the width of the dam as unity. 10



b The stream lines is represented by $\psi = x^2 + y^2$ 10
(i) Find its corresponding velocity potential
(ii) Determine the velocity and its direction at (2,2)
(iii) Sketch the streamlines and also show the direction of flow.

Q3 a Starting from Navier stoke equation for incompressible laminar flow; derive an equation for velocity profile for Couette flow. State the assumptions made. 10

b 360 lit/sec of water is flowing in a pipe. The pipe is bent by 120^0. The pipe bend measures 360 mm x 240 mm and volume at the bend is $0.14m^3$. The pressure at the entrance is 73 KN/m^2 and exit is 2.4m above the entrance section. Find the resultant force and the direction on the bend. 10

Q4 a If velocity distribution, u in laminar boundary layer over a flat plate is assumed to be given by second order polynomial 10
$$u = a + by + cy^2$$
where y is the perpendicular distance measured from the surface of the flat plate, and a, b and c are constants. Determine the expression of velocity distribution in dimensionless form as, U is main stream velocity at boundary layer thickness δ. Further also find boundary layer thickness in terms of Reynolds number.

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b A pipe 60 mm diameter and 450 m long slopes upwards at 1 in 50 . an oil of viscosity 0.9 Ns / m^2 and sp. gr. 0.9 is required to be pumped at the rate of 5 liters/s. 10

(1) Is the flow laminar?
(2) What pressure difference is required to attain this condition?
(3) What is the power of the pump required assuming overall efficiency 65%?
(4) What is the centre line velocity and the velocity gradient at pipe wall?

Q5 a For a normal shock wave in air Mach number is 3. If the atmospheric pressure and air density are 26.5 KN/m^2 and 0.413 kg/m^3 respectively, determine the flow conditions before and after the shock wave. Take $\gamma = 1.4$ 10

b Derive an expression of "critical pressure ratio" for compressible fluid flow 10

Q6 a A pipe of diameter 0.4 m and of length 2000 m is connected to a reservoir at one end. The other end of the pipe is connected to a junction from which two pipes of length 1000m and diameter 30 cm runs parallel. These parallel pipes are connected to another reservoir which is having a level of water 10m below the water level of the above reservoir .Determine the total discharge, if coefficient of friction f = 0.015.neglect the minor losses. 10

b Explain 10

i) Moodys Diagram
ii) Major and Minor losses in pipes