SE/ME/SEM–IV CBSGS/FM   19/5/16

(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

$$x = x_0 e^{-kt} + y_0(1 - e^{-2kt}) \text{ and } y = y_0 e^{-kt}.$$

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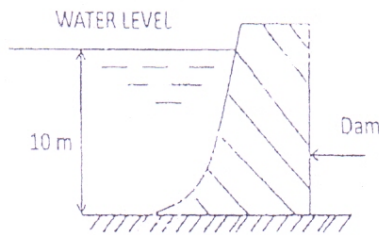
b   The stream lines is represented by $\psi = x^2 + y^2$ 10
   (i)   Find its corresponding velocity potential
   (ii)   Determine the velocity and its direction at (2,2)
   (iii) Sketch the streamlines and also show the direction of flow.

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

   b   360 lit/sec of water is flowing in a pipe. The pipe is bent by 120^0. The pipe bend   10
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.

Q4 a   If velocity distribution, u in laminar boundary layer over a flat plate is assumed to   10
be given by second order polynomial

$$u = a + by + cy^2$$

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   10
viscosity 0.9 Ns / m^2 and sp. gr. 0.9 is required to be pumped at the rate of 5
liters/s.
(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   10
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 $\gamma = 1.4$

  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   10
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.

  b   Explain   10
i) Moodys Diagram
ii) Major and Minor losses in pipes