QP Code : 3470

(03 Hrs) [Total Marks 80]

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary and justify the same.**

Q.1(A) Explain Newton's law of viscosity and concept of continuum of fluid   05

(B) A two dimensional flow is described in the Langrangian system as   05

$$x = x_0 e^{-kt} + y_0(1 - e^{-2kt})$$

and

$$y = y_0 e^{kt}$$

Find :
  (i) the equation of a fluid particle in the flow field and
  (ii) the velocity components in Eulerian system
(C) Write short note on boundary layer separation and methods to control it.   05

D) An aeroplane is to move at Mach number of 1.5 at altitude of 1000 m.   05
The atmospheric pressure and densities at this elevation are 89.89 KPa
(abs) and 1.112 Kg/m^3 respectively. Calculate the speed of the plane in
Km/h at this altitude. Assume ratio of specific heats k=1.4.

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Q. 2(A) A hemisphere projection of diameter 0.6 m exists on one of the vertical 10
sides of a tank. If the tank contains water to an elevation of 1.5 m above
the centre of the hemisphere, calculate the vertical and horizontal forces
acting on the projection.

(B) The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the
flow is turned through 120^0 (angle measured in clockwise direction
between direction of fluid flow at inlet and outlet) in a vertical plane. The
axis at inlet is horizontal and the centre of the outlet section is 1.5 m 10
below the centre of the inlet section. Total volume of water in the bend is
0.9 m^3. Neglecting friction, calculate the magnitude and direction of the
force exerted on the bend by water flowing through it at 250 litres/s and
when inlet pressure is 0.15 N/mm^2.

Q.3 (A) A venturimeter is installed in a pipeline carrying water and is 30 cm in
diameter. The throat diameter is 12.5 cm. The pressure in pipeline is 140 10
KN/m^2, and the vacuum in the throat is 37.5 cm of mercury. Four
percentages of the differential head is lost between the gauges. Working
from first principles find the flow rate in the pipeline assuming the
venturimeter to be horizontal.

(B) If velocity distribution, u in laminar boundary layer over a flat plate is 10
assumed to 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 $\frac{u}{U}=f\left(\frac{y}{\delta}\right)$,

where, 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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Q. 4(A) Fluid is in laminar motion between two parallel plates separated by   10
distance 'b' under the action of motion of one of the plates and also under
the presence of a pressure gradient in such a way that the net forward
discharge across any section is zero. Consider 'U' be the velocity of the
moving plate.

(i) Find out the point where minimum velocity occurs and its magnitude

(ii) Draw rough sketch of velocity distribution across any section.

(B) The velocity potential function for two dimensional flow is   10

$\phi = x(2y-1)$ determine: (i) velocity, and (ii) stream function.

Q.5(A) Explain eddy viscosity theory for turbulent fluid flow.   05

(B) What is critical pressure ratio for compressible flow in nozzle? Explain   05
its significance.

(C) The pressure, velocity and temperature just upstream of a normal shock   10
wave in air are 100 KPa (abs), 660 m/s and -20^0C respectively. Calculate
the pressure, velocity and temperature just downstream of the shock
wave. [Take ratio of specific heats k=1.4 and gas constant R=287
J/(Kg.K)].

Q.6 (A) A pipeline carrying water has a diameter of 0.5 m and is 2 Km long. To   10
increase the delivery another pipeline of the same diameter is introduced
parallel to the first pipe in the second half of its length. Find the increase
in discharge if the total head loss in both the cases is 15 m. Assume
4f=0.02 for all the pipes.

(B) Draw rough nature of Moody chart showing different regimes of fluid   05
flow and explain its significance

(C) Write short note on stalling of aerofoil.   05