ASSIGNMENT-2

NOTE: Due date is 12th Nov-2010 upto 3:00 PM only.

Q-1: In the 2-dimensional incompressible flow field the velocity components are expressed as

$$u=2x-x^2\ y+y^3/3,\ \ v=xy^2-2y-x^3/3$$

i) Determine the velocity and acceleration at a point (1,3)

ii) Is the flow possible? If so obtain the expression for the stream function.
iii) What is the discharge between streamlines passing through (1,3) and (2,3)
iv) Is the flow irrotational ? if so determine the corresponding velocity potential.
v) Show that each of the stream and potential function satisfies Laplace equation.

Q-2 : The flow field of a fluid is given by $V=xyi+2yzj-(yz+z^2)k$

i) Show that it represent a possible 3-dimensional steady incompressible flow.
ii) Is this flow rotational? If determine angular velocity at a point (2,4,6)
iii) Vorticity at point (2,4,6)

Q-3 i) Determine the circulation around the rectangle defined by x=1,y=5,x=5 and y=4 for the velocity field u=2x+3y and v=-2y
ii) The velocity along the centerline of nozzle of length l is given by $V=2t(1-x/2l)^2$ where V is velocity in m/s, t is time in second from commencement of flow, x is distance from inlet to nozzle. Calculate convective acceleration, local acceleration and the total acceleration when t=6s, x=1m and l=1.6m.

Q-4:A solid cylinder of 200mm diameter and 800 mm length has its base 20mm thick and of specific gravity 6. The remaining part of the cylinder is of specific gravity 0.6. state if it can float vertically in water.

Q-5:A buoy having a diameter of 2.4 m and length 1.95 m is floating with its axis vertical in sea water (specific weight $=10kN/m^3$). Its weight is 16.5 kN and a load of 1.65 kN is placed centrally at its top. If the buoy is to remain in stable equilibrium, Find the maximum permissible height of the centre of gravity of the load above the top of buoy.

[0.368]

Q-6:The outlet pipe from a pump is a bend of 45 degree rising in the vertical plane (i.e. and internal angle of 135 degree).The bend is 150mm diameter at its inlet and 300mm diameter at its outlet. The pipe axis at the inlet is horizontal and at the outlet it is 1m higher. By neglecting friction, calculate the force and its direction if the inlet pressure is 100kN/m2 and the flow of water through the pipe is 0.3m3/s. The volume of the pipe is 0.075m3.

[13.94kN at 67degree 40' to the horizontal]

Q-7 360 litre per second of water is flowing in a pipe. the pipe is bent by 120 degree. The pipe bend measures 360mm*240 mm and volume of the bend is 0.14 cubic meter. The pressure at the entrance is 73 kN/m^2 and the exit is 2.4 m above the entrance section. Find the force exerted on the bend.

[11.57 kN at 24 degree 20' to the horizontal]

Q-8 Find the discharge of water flowing through a pipe of 20 cm diameter placed in an inclined position, where a venturimeter is inserted, having a throat diameter of 10cm. the difference of pressure between the main and throat is measured by a liquid of specific gravity 0.4 in an inverted U-tube ,which gives a reading of 30 cm. the loss of head between the main and throat is 0.2 times the kinetic head of pipe.

[15.14 litre/sec]

Q-9 A venturimeter with a throat diameter of 7.5 cm is installed in a 15 cm diameter pipe. The pressure at the entrance to the meter is 70 kPa (gauge) and it is desired that the pressure at any point should not fall below 2.5 m of water absolute. Determine the maximum flow rate of water through the meter. Take Cd as 0.97 and P_{atm} as100 kPa.

[75.488litre/sec]

Q-10 A liquid of specific gravity 0.8 is flowing upwards at the rate of .08 m^3/sec, through a vertical venturimeter with an inlet diameter of 200mm and throat diameter of 100mm. the Cd is 0.98 and the vertical distance between the pressure tapping is 300 mm. find 1) the difference in reading of the two pressure gauges, which are connected to the two pressure tapings. And 2) the difference in the level of the mercury columns of the differential manometer which is connected to the tapings, in place of pressure gauges.

[49.928kN/m*m, 32.3 cm]