FLUID MECHANICS-1
(ME 206, May-08)

SECTION- A

Q1)

A) Show graphically the variation of shear stress with velocity gradient for ideal plastic, ideal, Newtonian, pseudo plastic fluids.

B) State pascal law.

C) What is the value of mach number for subsonic and hypersonic flow?

D) Discuss the limitations and characteristics of flow net.

E) State the assumptions used in derivation of Bernoulli's theorem.

F) What is Froude's number. State its significance.

G) Write the Darcy equation for head loss due to friction in turbulent flow.

H) Classify turbulent motion.

I) What are the advantages of using venturimeter and orifice meter in fluid flow measurements?

J) Why is a triangular weir more suitable than a rectangular weir for measuring discharge?

SECTION- B

Q2) An inclined rectangular gate 5 m wide and 1.5 m deep has been installed to control the discharge of fluid. It is immersed in fluid such that its edge view makes an angle of 50° with the free surface of fluid. The upper end is hinged and lies at a distance of 2.5 m vertically from the free surface of the water. Find the force normal to the gate is applied at lower end to open it.

Q3) A 2-D flow is developed by the velocity components:

$U = 6x^3$ and $v = -20x^2y$

Evaluate the stream function, velocity and acceleration at point A(x = 2 m and y = 3 m)

Q4) Using dimensional analysis, find the power developed by a hydraulic turbine if it depends on mass density of liquid, Þ, rotational speed, N, diameter of runner, D, working head, H and the gravitational acceleration, g.

Q5) A venturimeter is to be fitted in a pipe of 15 cm diameter where pressure head is 8 m of flowing fluid and the maximum flow is 8000 liters per minute. Find the least diameter of throat to ensure that pressure head does not become negative. Take discharge coefficient for the meter at 0.96.

Q6) Find the expression for discharge per unit width between two parallel plates at distance b apart, when one plate is moving at velocity v while other one is held stationary, for the condition of zero shear stress at fixed plate.

SECTION- C

Q7) Derive the differential equation of continuity in the Cartesian coordinates. Thereafter deduce the same into 2-D steady flow for compressible and incompressible flow.

Q8) (a) How do you account for friction loss when applying Bernoulli's equation to real fluid flow?

(b) A pipe bend placed in a horizontal plane tapers from 45 cm diameter at inlet to 20 cm diameter at outlet. A fluid having density 900 kg\m^3 enters the reducing bend horizontally and get turned through 45° in clockwise direction. The fluid flows at the rate of 0.5 m^3\s, the pressure of 50kN\m^2 at inlet section drops to 25kN\m^2 at outlet section due to frictional effects. Calculate the magnitude and direction of resultant force on the bend.

Q9) a) Derive an expression for head loss at sudden expansion in pipe flow.

b) At sudden enlargement of waterline from 30 cm to 50 cm diameter pipe, the hydraulic gradient rises by 1 cm. Calculate the rate of flow.