Exam.Code:0940
Sub. Code: 6715

2014

B.E. (Mechanical Engineering)

Fourth Semester

MEC-405: Fluid Mechanics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Q. No. 1 which are compulsory and selecting two questions from each Part.***

x-x-x

Q.1 i) Define total hydrostatic force and centre of pressure.

ii) Write the conditions for stable, and unstable equilibrium of submerged and floating body.

iii) Explain Dynamic Viscosity and Eddy Viscosity.

iv) Differentiate between the Eulerian and Lagranjian method of representing fluid motion.

v) Define the term Mach number, Mach angle, and Mach line. **(02x05=10)**

Part-A

Q.2 a) A single column vertical manometer is connected to a pipe containing oil of specific gravity 0.9. The area of reservoir is 80 times the area of the manometer tube. The reservoir contains mercury of specific gravity 13.6. The level of mercury in the reservoir is at a height of 300mm below the centre of the pipe and difference of mercury levels in the reservoir and right limb is 500 mm. Find the pressure in the pipe. **(06)**

b) A trapezoidal plate measuring 1m at the top edge and 1.5m at the bottom edge is immersed in water with the plan making an angle of 30^0 to the free surface of water. The top and bottom edges lie at 0.5m and 1m respectively from the surface. Determine the hydrostatic force on the plate. **(04)**

Q.3 a) In a 2-D incompressible flow field the fluid velocity components are:

$$u = 2x - x^2y + \frac{y^3}{3}; v = xy^2 - 2y - \frac{x^3}{3}$$

Find: i) the velocity, and acceleration at point L (x=1m, y=3m); ii) Is the flow possible? If so, obtain an expression for the stream function; iii) Is the flow irrotational? If so, find the corresponding velocity potential; iv) Show that each of the stream and velocity function satisfy Laplace equation. **(07)**

b) What is flow net? Write its uses and limitations. **(03)**

Q.4 a) Define all dimensionless numbers along with applications. **(05)**

b) A geometrically similar model of an air duct is built to 1/25 scale and tested with water which is 50 times more viscous and 800 times denser than air. When tested under dynamically similar conditions, the pressure drop is 2 bar in the model. Find the corresponding pressure drop in the full-scale prototype. **(05)**

P.T.O.

Part-B

Q.5 Derive the Euler's equation of motion and from that derive the Bernoulli's equation in cartesian coordinates. Also, list the assumptions made while deriving the Bernoulli's equation.

(10)

Q.6 a) Using Von-Karman momentum integral equation for the flow past a flat plate, find boundary layer thickness, wall shear stress, for the given velocity profile:

$$\frac{u}{U_0} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$ **(06)**

b) Derive the area-velocity relationship for a compressible flow. **(04)**

Q.7 Show that the momentum correction factor and energy correction factor for laminar flow through a circular pipe are 4/3 and 2 respectively. **(10)**

x-x-x