BTS(C) – III – 09 – 066 – J

B. Tech Degree III Semester Examination, November 2009

ME 304 FLUID MECHANICS

(2006 Scheme)

Time : 3 Hours Maximum Marks : 100

PART A

(Answer ***ALL*** questions)

(8 x 5 = 40)

I. (a) Explain how surface tension accounts for
   (i) formation of a droplet
   (j) rise of liquid in a capillary

(b) Explain the conditions of equilibrium of a floating body and a submerged body.

(c) What are the relative merits and demerits of venturimeter with respect to orifice meter?

(d) What do you mean by major energy losses and minor energy losses in pipes?

(e) The stream function and velocity potential function for a certain flow is given by $\Psi = 2xy$ and $\phi = x^2 - y^2$. Show that the conditions of continuity and irrotational flow are satisfied.

(f) Define the terms 'Vorticity' and 'Circulation' in two dimensional flow and how they are related to each other.

(g) Explain clearly the phenomenon of Boundary layer separation.

(h) What do you mean by 'Karman Vortex Street'?

PART B

(4 x 15 = 60)

II. A cylindrical shaft of 90mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50cm and 95 mm internal diameter. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 2.0 poise, determine the power required to overcome viscous resistance when the shaft is rotated at a speed of 240 rpm. (15)

OR

III. A rectangular plate 0.6m wide and 1.2 m deep lies within a water body such that its plane is inclined at 45^0 to the horizontal and the top edge is 0.70m below the water surface. Determine the total pressure force on one side of the plate and the location of the centre of pressure. (15)

IV. (a) What are the limitations to be considered while applying Bernoullis theorem to engineering problems? (5)

(b) A closed tank of a fire engine is partly filled with water, the air space above being under pressure. A 5cm hose connected to the tank discharges on the roof of building 2m above the level of water in the tank. The friction losses are 50 cm of water. What air pressure must be maintained in the tank to deliver 15 litre/s on the roof? (10)

OR

(Turn Over)

V. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1 Ns/m^2 is pumped through a 3cm diameter pipe. If pressure drop per metre length of the pipe is 15 KPa, determine –

(i) the mass flow rate in Kg/mm
(ii) the shear stress at the pipe wall
(iii) the Reynolds number of flow
(iv) the power required per 40m length of the pipe to maintain the flow. (15)

VI. A two-dimensional flow is described by the velocity components.

$$u = 5x^3 \text{ and } v = -5x^2y$$

Evaluate the stream function, velocity and acceleration at point

$P(x = 1m \text{ and } y = 2m)$ (15)

OR

VII. Explain - (i) Source
(ii) Sink
(iii) Doublet (15)

VIII. (a) Cite some examples of boundary layer formation. (5)

(b) Define physically and mathematically the concept of displacement, momentum and energy thickness of a boundary layer. (10)

OR

IX. (a) Write down the 'Navier stokes equations' for viscous fluid flow and how that can be simplified for the flow in boundary layer. (7)

(b) Give a brief outline of the Blasius solution of laminar boundary layer for flow over a flat plate. (8)

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