PAPER II

B. Tech.

(SEM. III) (ODD SEM.) EXAMINATION, 2010-11

FLUID MECHANICS

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1 Attempt any **four** of the following : 5×4=20

(a) Explain Subsonic, Sonic and Supersonic flows ?

(b) Discuss the difference between Source and Sink with suitable mathematical expressions ?

(c) Check if $\varphi = x^2 - y^2 + y$ represents the velocity potential for 2-dimensional irrotational flow. Also determine the stream function.

(d) Prove that the stream function and potential function lead to orthogonality of stream lines and equipotential flow lines.

(e) What is pressure transducer ?

2 Attempt any **two** of the following : 10×2=20

(a) Define total pressure and centre of pressure. A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depths below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure.

(b) A venturimeter with throat diameter 0.065 m and coefficient of discharge 0.95 is used to calibrate a pitot static tube. Air flows through a 110 mm diameter horizontal pipe in which the venturimeter is fitted. The difference in water level in the manometer attached to the venturimeter is 50 mm. The pitot static tube is placed downstream of the venturimeter and the water manometer attached to the pitot static tube shows a reading of 7 mm. Calculate the flow rate through the pipe and the coefficient of velocity of the pitot static tube. Assume the density of air as 1.13 kg/m^3 and that of water as 1000 kg/m^3.

(c) A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 60 litres/s.

3 Attempt any **two** of the following : **10×2=20**

(a) The thrust force, F generated by a propeller is found to depend on the following parameters: diameter D, forward velocity u, density ρ, viscosity μ and rotational speed N. Determine the dimensionless parameters to correlate the phenomenon.

(b) To predict the drag on an aircraft at a flight speed of 150 m/s, where the condition of air is such that the local speed of sound is 310 m/s, a pressurized low temperature tunnel is used. Density, viscosity and local sonic velocity at tunnel condition are 7.5 kg/m^3, 1.22×10^{-5} Ns/m^2 and 290 m/s. Determine the flow velocity and the scale of the model. Assume full dynamic similarity should be maintained. Density and viscosity at the operating conditions are 1.2 kg/m^3 and 1.8×10^{-5} Ns/m^2.

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(c) Prove that the maximum velocity in a circular pipe for viscous flow (Laminar flow) is equal to two times the average velocity of the flow.

4 Attempt any **two** of the following : **10×2=20**

(a) Explain the mechanism of Boundary Layer Formation over a Flat Plate. Also get the expression for displacement thickness.

(b) A kite 0.8 m × 0.8 m weighing 3.924 N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal. The pull on the string is 24.525 N when the wind is flowing at a speed of 30 km/hour. Find the corresponding co-efficient of drag and lift. Density of air is 1.25 kg/m^3.

(c) A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm^2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 N/cm^2. Take f = .0065

5 Write short notes on any **four** of the following : **5×4=20**

(a) Hot-wire anemometer

(b) Sub-critical, Critical and Super-critical flows

(c) Stability of immersed bodies

(d) Any two types of similarities between model and prototype

(e) Turbulent flow
