21-12-06

Thapar Institute of Engineering and Technology

End Semester Examination, Dec. 2006

B.E. II Year

ES 201 FLUID MECHANICS

Time: 3 hours **Max. Marks: 100**

- *Attempt all questions*

Q1.a What is viscosity? What is the effect of temperature on viscosity of liquids and gases?

Q1.b A circular disk of radius R is kept at a small height h above a fixed bed by means of a layer of oil of dynamic viscosity μ. If the disk is rotated at an angular velocity ω, obtain an expression for the viscous torque on the disk. Assume linear variation of velocity within the oil film.

Q1.c Derive an expression for surface tension in case of a soap bubble.

[5+10+5]

Q2.a. The fuel gauge for a gasoline tank in a car reads proportional to the bottom gauge as shown in Figure 2a. The tank is 25 cm deep and accidentally contains 1.5 cm of water in addition to the gasoline. Estimate the height of air remaining at the top when the gauge erroneously reads "full". Take specific weight of gasoline = 6.65 kN/m^3, and specific weight of air = 0.0118 kN/m^3.

Q2.b What are the stability criteria of submerged and floating bodies?

Q2.c Give one example each of **(i)** non steady uniform flow, **(ii)** steady non-uniform flow.

[10+5+5]

Q3.a A closed tank of a fire engine is partly filled with water, the air space above being under pressure. A 5 cm hose connected to the tank discharges on the roof of building 2 m 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?

Q3.b A closed tank 1 m x 1.25 m in plan x 4.5 m high and weighing 1175 N is filled with water to a depth of 3 m. A hole in one of the sidewalls has an effective area of 7.5 cm^2 and is located at 20 cm above the tank bottom. If the coefficient of friction between the ground and the wheels is 0.012, determine the air pressure in the tank that is required to set it into motion.

[10+10]

Q4.a The resistance R experienced by a partially submerged body depends upon the velocity V, length of the body l, viscosity of the fluid μ, density of the fluid ρ and gravitational acceleration g. Show with the help of dimensional analysis:

$R = l^2V^2\,\rho$ function [$\rho Vl/\mu$, $V/\sqrt{(lg)}$]

Q4b. A pipeline, 40 m long, is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 15 cm diameter and then its diameter is suddenly enlarged to 30 cm. The height of water level in the tank is 8 m above the center of the pipe. Considering all losses (major + minor) of head, which occur, determine the rate of flow. Assume pipe friction factor $4f = 0.04$, for both sections of the pipe.

[10+10]

Q5.a Consider a tank of uniform cross-sectional area containing some liquid and having an orifice at its bottom. Find an expression for T, time in seconds for the liquid to fall from height H_1 to H_2 in terms of :

A = area of the tank,

a = area of the orifice,

H_1 = initial height of the liquid,

H_2 = final height of the liquid.

Q5.b Show that the flow defined by the stream function $\psi=2xy$ is irrotational. Also the corresponding velocity potential

Q5.c Compare Impulse turbines and Reaction turbines. *[10+5+5]*

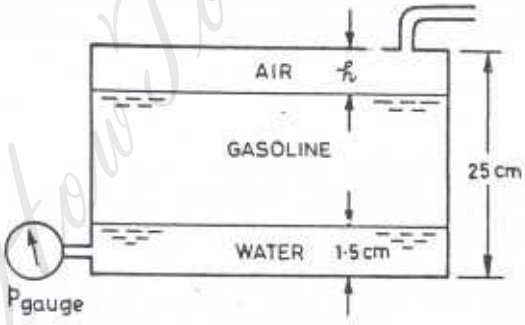

Figure 2a