

(A Constituent Institute of Manipal University)



## V SEMESTER B.TECH (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2015

## SUBJECT: FLUID MECHANICS [AAE 361]

## **REVISED CREDIT SYSTEM**

Time: 3 Hours

INSPIRED BY LIFE

MAX. MARKS: 50

(05)

## Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- ✤ Missing data may be suitable assumed.
- **1A.** Derive Newton's law of Viscosity with suitable assumptions.
- 1B. If a solid cube made of steel is able to float on water at 20°C, determine the maximum dimension of one of its sides. Assume the surface tension of water as 0.073 N/m at 20°C. The density of steel is 7800 kg/m<sup>3</sup>.
- **1C.** Compare the capillarity effect in wetting and non-wetting fluids with neat **(03)** sketches.
- 2A. A single column manometer is connected to a pipe containing a liquid of specific gravity 0.9. The center of the pipe is 20 cm from the surface of mercury in the reservoir, which has 100 times more area than that of tube. The mercury on the right limb is 40 cm above the level of mercury in the reservoir. Find the pressure in the pipe.
- **2B.** Show the construction of a Bourdon tube gauge and explain its working. (03)
- **2C.** A gate supporting water is shown in figure. Find the height 'h' of the water such **(04)** that the gate begins to tip about the hinge. Consider the gate to be of unit width.



- 3A. A solid cylinder of diameter 15 cm and 60 cm length consists of two parts made (04) of dissimilar materials. The first part at the base is 1.2 cm long and has a specific gravity of 5 while the other part has a specific gravity of 0.7. Discuss the vertical stability of the cylinder in water.
- **3B.** Differentiate between uniform and non-uniform fluid flows. (02)

3C. The velocity vector in a certain flow of a fluid is given as

$$V = 2x^3i - 5x^2yj + 4tk$$

Find the velocity and acceleration of a fluid particle at a point (1, 2, 3) at a time t = 1 secs.

- **4A.** Copepod is a sea water crustacean approximately 1 mm in diameter. To find **(04)** the drag force on the copepod when it moves slowly in water, a scaled model 100 times larger is made and tested in glycerin at V= 30 cm/s. the measured drag on the model is 1.3 N. For similarity conditions, what are the velocity and drag of the actual copepod in water? Give properties for Water:  $\mu_p$ = 0.001 kg/ms,  $\rho_p$ = 998 kg/m<sup>3</sup> Glycerin:  $\mu_m$ = 1.5 kg/ms,  $\rho_m$ = 1263 kg/m<sup>3</sup>
- **4B.** Give the dimensionless numbers associated with fluid flow. (02)
- **4C.** With a neat sketch, explain the development of a hydrodynamic boundary layer **(04)** for flow over a flat plate and derive the expression for displacement boundary layer thickness.
- 5A. An oil of viscosity 9 poise and specific gravity 0.9 is flowing through a horizontal pipe of 60 mm diameter. If the pressure drop in 100 m length of the pipe is 1800 kN/m<sup>2</sup>, determine the following:
  - a. The rate of flow of oil
  - b. The centerline velocity
  - c. The total frictional drag over 100 m length
  - d. Power required to maintain flow
  - e. Velocity at 8 mm from the pipe wall.
- **5B.** Derive the compressible flow Bernoulli's equation for an adiabatic process. **(03)**
- 5C. A fluid of absolute viscosity 2 poise and density 850 kg/m<sup>3</sup> flows through a 30 (02) cm diameter pipe. If the loss in 3000 m length of pipe is 20 m, assuming laminar flow, determine the velocity and Reynolds number of the flow.
- 6A. Derive the expression for volumetric fluid flow rate in an orificemeter with (05) diagram.
- **6B.** Write short notes on:
  - a. Syphon
  - b. Vena-contracta
  - c. Mach cone
  - d. Lift force on an immersed body
  - e. Bluff bodies

(05)

(04)