

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL/ AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2017

SUBJECT: FLUID MECHANICS [AAE 2105]

REVISED CREDIT SYSTEM (02/01/2018)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- **1A.** Define the following terms:
 - (i) Specific weight
 - (ii) Dilatent fluid
 - (iii) Capillary effect
- 1B. A fluid has absolute viscosity, μ, of 0.048 Pa s. If at point A, 75mm from the wall (03) the velocity is measured as 1.125 m/s, calculate the intensity of shear stress at point B, 50mm from the wall in N/m². Assume a linear (straight line) velocity distribution from the wall.
- 1C. A solid cylinder, having a diameter of 4.5 cm and length 12 cm, with a mass of (04) 1.5 kg, falls concentrically with a velocity 10 m/s through a hollow vertical container (inner diameter 30 cm) filled with oil (specific gravity=0.89). Assuming the oil to be incompressible, estimate the oil average velocity in the annular clearance between cylinder and container.
- **2A.** Classify steady and unsteady flows.

(02)

2B. An 8-cm-diameter piston compresses manometer oil into an inclined 7-mmdiameter tube, as shown in Fig. 2B. When a weight W is added to the top of the piston, the oil rises an additional distance of 10 cm up the tube. Determine the value of the weight.



(03)

2C. In the spillway flow (Fig. 2C), the flow is assumed to be uniform and hydrostatic **(05)** at sections 1 and 2. If losses are neglected, compute (a) V_2 and (b) the force per unit width of the water on the spillway.



- **3A.** Distinguish between convective acceleration and local acceleration. (03)
- 3B. Define the following dimensionless numbers:(i) Weber Number (ii) Froude's Number (iii) Euler's Number
- 3C. A parallel connection between pipe A (φ60 mm and length 150 m) and pipe B (04) (φ100 mm and length 150 m) is made between two reservoirs whose water levels are at a difference of 15 m. If friction factor is taken as 0.32, determine the flow rate through each pipe. Also find out the diameter of a single pipe 150 m long which can replace the parallel connection for same discharge rate.
- **4A.** Differentiate between streamlines and pathlines with the aid of neat sketches. (03)
- **4B.** Derive the expression for stagnation pressure, temperature and density for air. **(05)**
- 4C. A missile is moving with a velocity of 980 kmph through quiescent air at 20°C. (02) The air pressure is 98kPa. Estimate the Mach Number and determine if the motion is supersonic.
- **5A.** What is meant by "Lift" force?

(02)

(04)

(03)

- **5B.** Derive the Hagen-Poisuille equation for viscous flows.
- **5C.** A spar buoy as shown has a period T of vertical (heave) oscillation which (04) depends upon the waterline cross-sectional area A, buoy mass m, and fluid specific weight γ . How does the period change due to doubling of (a) the mass and (b) the area?

