Reg. No.



ANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (AUTOMOBILE/AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2018

SUBJECT: FLUID MECHANICS [AAE 2105] REVISED CREDIT SYSTEM (02/01/2019)

Time: 3 Hours

MAX. MARKS: 50

(02)

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- 1A. Characterize the liquids and gaseous fluids based on the mobility of their respective (02) molecules.
- **1B.** Calculate the maximum capillary rise of water between two vertical glass plates spaced (03) 1 mm apart.
- 1C. A shaft 70.0 mm in diameter is being pushed at a speed of 400 mm/s through a bearing (03) sleeve 70.2 mm in diameter and 250 mm long. The clearance, assumed uniform, is filled with oil with viscosity of 50 centi-stokes and specific gravity of 0.9. Compute the force exerted by the oil on the shaft.
- **1D.** What is meant by a Bourdon guage?
- 2A. A liquid flows through a 2D slot as shown in the figure below. The velocity of flow (04) can be expressed as $u=2(q_0/b)(t/t_0)$, where q_0 and t_0 are constants. Determine the relation for the local acceleration at x=2B and y=0.



- **2B.** What is meant by Froude number? List the applications where Froude model is used. (03)
- **2C.** A stream function for a steady, axi-symmetric two dimensional cylindrical flow is (03) given by the relation $\psi = \frac{B}{2} \left[r^2 \frac{r^4}{2R^2} \right]$, valid in the regime $0 \le r \le R$, $0 \le z \le L$. Find out the dimensions of the constant B.

3A. From the figure below, determine the height *H* for which the hydrostatic force on the rectangular panel BFEC is the same as the total forces on the semi-circular panels ABF and CDE respectively. ∇ A



- **3B.** A tank contains water up to a height of 1.5 m above the base. Crude oil of specific (03) gravity 0.8 lies on top of water up to 3 m height. Construct the pressure prism, calculate the resultant force and its center of pressure if the tank is 2 m wide.
- **3C.** Using the necessary assumptions, derive the volumetric flow rate across a triangular (04) notch.
- **4A.** Show that the divergence of the vorticity vector is equal to zero. (02)
- 4B. Water at 20°C flows steadily through the piping junction entering section 1.5 litres/min. (03) The average velocity at section 2 is 2.5 m/s. A portion of the flow is diverted through the showerhead, which contains 100 holes of 1-mm diameter. Assuming uniform shower flow, estimate the exit velocity from the showerhead jets.



- Fig 4B
- 4C. A liquid of specific gravity 0.8 is flowing upward at a rate of 80 lit/s through a vertical (03) venturimeter having a throat diameter of 100 mm and inlet diameter of 200 mm. If the coefficient of discharge is 0.98 and the vertical distance between the pressure tapping points is 300 mm, Calculate the pressure head between the two tapping points.

4D.	Define the following:		(02)
	(i)	Convective acceleration (ii) Broad-crested weir	
5 1	An aircr	of t is travelling through still air at 5° C and pressure of 700 kPa. Determine the	(04)

- 5A. An aircraft is travelling through still air at -5°C and pressure of 700 kPa. Determine the (04) following: (Take γ as 1.4 for air and the molecular weight of air as 29 kg/kmol.)
 - (i) Mach number
 - (ii) Stagnation pressure of air
 - (iii) Stagnation temperature of air
- **5B.** The speed of sound c in an ideal gas is known to be a function of the ratio of specific (03) heats γ , absolute temperature T, and specific ideal gas constant R. Derive an appropriate relationship using dimensional analysis.
- **5C.** Distinguish between Lift force and Drag force with suitable examples. (03)