Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (AUTOMOBILE/AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: FLUID MECHANICS [AAE 2105]

REVISED CREDIT SYSTEM
(01/12/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Distinguish between the liquid and gaseous fluids in terms of the variation of viscosity with temperature. **(02)**

1B. The distribution of velocity ***u*** for water near a wall is given by the relation, $u = a\left(\frac{y}{b}\right)^{1/6}$ where ***a***=10 m/s, ***b***= 2 mm, and ***y*** is the distance from the wall in mm. Determine the shear stress in the water at ***y***= 1 mm. Take the viscosity of water as 1 centipoise. **(03)**

1C. The pressure difference between an oil pipe and water pipe is measured by a double-fluid manometer, as shown in Figure 1C. The specific gravities and heights of the respective fluid columns are given in the figure. Determine the pressure difference between the pipes A and B. **(03)**

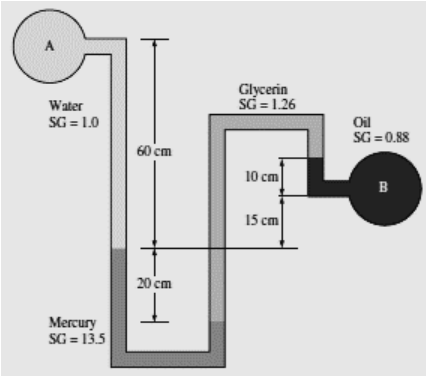

Figure 1C

1D. Derive an expression for the pressure difference across a fluid bubble. **(02)**

2A. Explain the working of a single column manometer with the aid of a neat sketch. **(03)**

2B. If the velocity $\vec{V} = (1 + y)\hat{\imath} + (1 - y)\hat{\jmath}$, determine the expression for the pathlines that pass through the point (-1,1) at time t=0.5 s. **(02)**

2C. Obtain the expression for the magnitude of the hydrostatic force and the location of center of pressure for an inclined plate submerged within a fluid. **(05)**

3A. Define the following terms: **(04)**

(i) Streaklines
(ii) Unsteady flow
(iii) Convective acceleration
(iv) Vena Contracta

3B. A football, intended for travel at 25 m/s in sea-level air (ρ=1.22 kg/m^3, μ= 1.78×10^{-5} kg/ms), is to be tested using a one-quarter scale model in a water tunnel (ρ=998 kg/m^3, μ=1 poise). For dynamic similarity, what is the model velocity in the water? **(02)**

3C. A 50 cm diameter pipe circulates water at a rate of 500 liters per second. If the pipe is bent by 140°, find the magnitude and direction of the resultant force on the bend. The pressure of flowing water is 34.335 N/cm^2. **(04)**

4A. The pressure rise $\Delta \boldsymbol{p}$, across a pump can be expressed as a function of $\boldsymbol{D}$ (Impeller diameter), $\boldsymbol{\rho}$ (fluid density), $\boldsymbol{\omega}$ (rotational speed), and $\dot{\boldsymbol{Q}}$ (flowrate). Determine a suitable set of dimensionless parameters. **(04)**

4B. Distinguish between streamlined bodies and bluff bodies. **(02)**

4C. The difference in the water levels in two tanks is 18 m. The two tanks are interconnected by pipe A (length=650 m, diameter=30 cm) and pipe B (length=450 m, diameter=20 cm) which are in series. Calculate the volumetric flow rate through the pipes if the friction factor is 0.12. The minor losses can be considered as negligible. **(04)**

5A. Derive the Hagen Poiseuille equation for fully developed laminar flows. **(06)**

5B. An airplane is travelling through dormant air at a velocity of 1260 kmph. The air pressure is 0.8 bar, temperature is -15°C. Find out the Mach Number. Take specific gas constant for air as 287 J/kgK and adiabatic index as 1.4. Compute all the stagnation properties. **(04)**