Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERO/AUTO ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: FLUID MECHANICS [AAE 2105]

REVISED CREDIT SYSTEM
(06/12/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Derive the expression for momentum thickness of boundary layer. Also find the momentum thickness and Energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. **(5)**

1B. An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauge fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Co-efficient of discharge for the meter is given as 0.6. Find the rate of flow through pipe. **(3)**

1C. Differentiate between: **(2)**
(i) Dynamic viscosity and kinematic viscosity.
(ii)Stream line, streak line and Path line.

2A. A horizontal pipe line 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 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300 mm. the height of water level in the tank is 8m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f=0.01 for both sections of the pipe. Also draw the hydraulic gradient and total energy line. **(5)**

2B. Does velocity potential exist for two-dimensional incompressible flow prescribed by *u= x-2y, v= - (y+4x)*? If so determine its form as well as that of stream function. **(3)**

2C. Derive the continuity equation for 2D flow. **(2)**

3A. A gas is flowing through a horizontal pipe at a temperature of 4^0 c. The diameter of pipe is 8 cm and at a section 1-1 in this pipe, the pressure is 30.3 N/cm^2 (gauge). The diameter of the pipe changes from 8cm to 4cm at the section 2-2, where pressure is 20.3 N/cm^2 (gauge). Find the velocities of the gas at these sections assuming an isothermal process. Take R = 287.14 Nm/Kg.k, and a P_{atm} = 10 N/cm^2 . **(5)**

3B. A discharge of 0.06 m^3/s was measured over a right-angled notch. While measuring the head over the notch, an error of 1.5 mm was made. Determine the percentage error in the discharge, if the coo-efficient of discharge for the notch is 0.6. **(3)**

3C. A 6m long pipe is inclined at an angle of 20° with the horizontal. The smaller section of the pipe which is at lower level is of 100 mm diameter and the larger section of pipe is of 300 mm diameter. If the pipe is uniformly tapering and the velocity of water at the smaller section is 1.8 m/s. Determine the difference of pressures between the two sections. **(2)**

4A. Write short notes on the following: **(5)**

(i) Significance of vena contracta and coefficient of contraction.
(ii) Applications of Pascal's law.
(iii) Differentiate between Absolute, Gauge and vacuum pressure.
(iv) Non-Newtonian fluid.
(v) Classification of manometers.

4B. In a pipe of diameter 350 mm and length 75 mm water is flowing at a velocity of 2.8 m/s. find the head lost due to friction using: **(3)**

i. Darcy – Weisbach formula
ii. Chezy's formula for which C= 55

Assume kinematic viscosity of water as 0.012 stoke.

4C. Derive Bernoulli's equation for compressible flow undergoing isothermal process. **(2)**

5A. Derive the expression for velocity distribution, discharge and shear stress across any section in a laminar flow between two parallel flat plates, with one plate moving and other at rest. **(5)**

5B. Figure 1 shows a central plate of area 6 m^2 being pulled with a force of 160 N. If the dynamic viscosities of the two oils are in the ratio of 1:3 and viscosity of top oil is 0.12 Ns/m^2, determine: **(3)**

(i)The velocity at which the central plate will move.
(ii) The power required to move the plate.

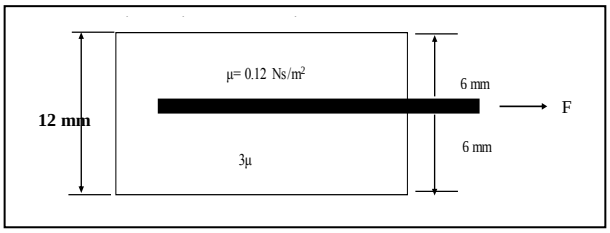

Figure 1.

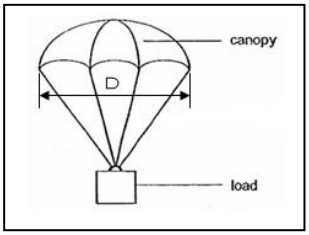

Figure 2.

5C. The vertical component of landing speed of a parachute is 6 m/s shown in Figure 2. Treat the parachute as an open hemisphere with diameter D (fig. 2) and determine its diameter if the total load to be carried is 1200 N. Take ρ= 1.208 $kg/m^3$and C_D= 1.33. **(2)**