Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEM. B.TECH. (MECH. ENGG.) END SEM. EXAMINATIONS JUNE/JULY 2016

SUBJECT: FLUID MECHANICS [MME-2202]

(REVISED CREDIT SYSTEM)

Time: 3 Hours. MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Additional data, if any, may be appropriately assumed.
- Assumptions made must be clearly mentioned.
- Sketches are to be drawn wherever necessary.

1A) State the Newton's law of viscosity. Show that the rate of shear strain is equal to the velocity gradient. 03

1B) The velocity in fluid flow field is (expressed as a function of space coordinates x, y and z and time t) given by $\vec{V} = (6x-3)\hat{i} + 6y\hat{j} + 12t\hat{k}$.

(i) Analyze if an incompressible flow is possible.

(ii) Deduce the total acceleration vector. 03

1C) What is the purpose of carrying out the dimensional analysis for fluid systems?

The force of propulsion of a submarine which is moving under water depends on length L, shape factor S_f, velocity V, mass density ρ and dynamic viscosity μ. Use Buckingham-π theorem to derive the expression for force of propulsion F. 04

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 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of the pipe. Considering all the losses of head which occur, determine the rate of flow. Take the coefficient of friction, f = 0.0025 for both sections of the pipe. 04

2B) Deduce an expression for the resultant force exerted by a fluid on a pipe-bend. 03

2C) Define the following and mention one application of each:

(i) Froude number (ii) Euler number (iii) Mach number 03

3A) Derive an expression for the hydrostatic pressure force acting on an inclined plane surface using standard notations. Also determine for the location of the center of pressure. 04

3B) What is a syphon? On what principle does it work? 02

3C) A square plate of size 1m×1m and weighing 350 N slides down an inclined plane with a uniform velocity of 1.5 m/s. The inclined plane is laid on a vertical of 5 vertical to 12 horizontal.

(i) If an oil film of 1mm thickness is present between the plate and the inclined plane, calculate the dynamic viscosity of the oil and express it in cP.

(ii) If the oil film thickness is reduced by 50%, what will be the velocity with which plate slides down the inclined plane? 04

4A) In Fig. (Q4A) the water and gasoline surfaces are open to the atmosphere and at the same elevation. What is the height *h* of the third liquid in the right leg?

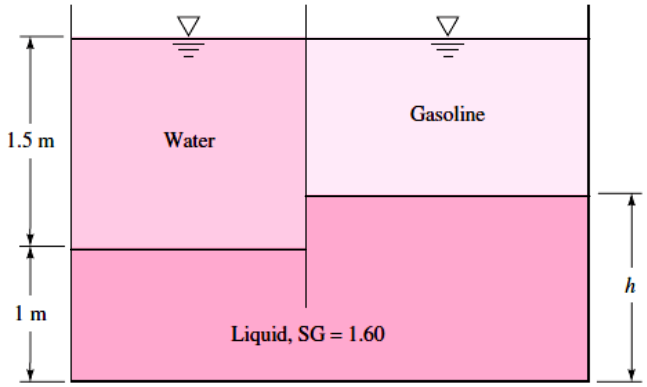

Fig. (Q4A) 03

4B) Derive an expression for (i) determining the capillary depression (ii) determining the pressure difference between the inside and outside of a jet of liquid of uniform diameter as a function of the surface tension between the liquid and air interface. 04

4C) Water at 15 °C flows between two large parallel plates separated by a distance of 1.6 mm apart. The average velocity is 0.2 m/s. The viscosity of water at 15 °C is given as 0.01 poise. Determine (i) the maximum velocity, (ii) the pressure drop per unit length and (iii) the shear stress at the plates. 03

5A) Experiments were conducted in a wind tunnel with a wind speed of 50 km/hr on a flat plate 1 m long and 1 m wide. The density of air is 1.15 kg/m^3. The plate is kept at such an angle that the coefficients of lift and drag are 0.75 and 0.15 respectively. Determine (i) the lift force (ii) the drag force (iii) the resultant force and (iv) Power exerted by air stream on the plate. 03

5B) A solid block, of specific gravity 0.9, floats such that 75 percent of its volume is in water and 25 percent of its volume is in fluid *X*, which is layered above the water. What is the specific gravity of fluid *X*? 03

5C) Neatly sketch the arrangement of a Prnadtl probe (pitot-static probe) and explain its principle of working. Derive an expression to measure the actual velocity through the same. 04

******