Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

IV SEMESTER B.TECH (INDUSTRIAL AND PRODUCTION ENGINEERING)
END SEMESTER EXAMINATION JUNE 2017

SUBJECT: FLUID MECHANICS AND MACHINERY (MME 2214)

REVISED CREDIT SYSTEM

Time: 3 Hour **Max. Marks: 50**

Note: (i) Missing data, if any, may be appropriately assumed
(ii) Draw sketches as applicable
(iii) Assumptions made must be clearly mentioned

1A. The space between two square flat parallel plates is filled with oil. Each side of the plate is 0.6 m. The thickness of the oil film is 12.5×10^{-3} m. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine: 03

(i) the dynamic viscosity of the oil, and

(ii) the kinematic viscosity of the oil if the specific gravity of the oil is 0.95.

1B. State and prove the Pascal's law. 03

1C. A rectangular plane surface 2 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30^{o} with the free surface of water. Determine the total pressure force and the position of center of pressure when the upper edge is 1.5 m below the free surface of water. 03

1D. Water is flowing through two different pipes to which an inverted differential manometer having an oil of specific gravity 0.8 is connected. The gauge pressure at the center of the pipe A is 19.62 kPa. Find the gauge pressure in the pipe B for the manometer readings as shown in Fig. Q (1D). 01

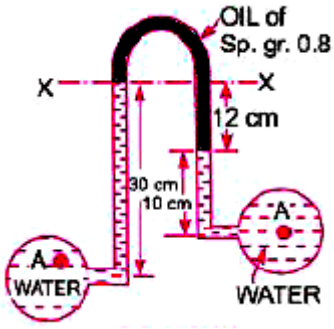

Fig. Q (1D)

2A. A uniform body of size 3 m long × 2 m wide × 1 m deep floats in water. 03

(i) What is the weight of the body if depth of immersion is 0.8 m?

(ii) Determine the meta-centric height also.

2B. Write the equations for the components of total acceleration in the *x*, *y* and *z* directions, in case of (i) unsteady flow (ii) steady flow. 03

2C. Determine the third component of velocity such that they satisfy the continuity equation for a steady flow. $v = 2y^2$ $w = 2xyz$ 02

2D. Water is flowing through a tapering inclined pipe having diameter 0.3 m and 0.2 m at the bottom and upper end respectively. The intensity of pressure at the bottom end is 245.25 kPa and the pressure at the upper end is 98.1 kPa. Determine the difference in datum head if the rate of flow through pipe is 40 liters per second. 02

3A. Derive the expression for determining the actual discharge through a venturimeter. 03

3B. A pitot-tube is inserted in a pipe of 0.3 m diameter. The static pressure in the pipe is -13.34 kPa. The stagnation pressure at the center of the pipe, recorded by the pitot-tube is 9.81 kPa. Calculate the rate of flow of water through the pipe, if the mean velocity of flow is 0.85 times the central velocity. Take $C_v = 0.98$. 03

3C. Define Froude's number. 01

The efficiency η of a fan depends on density ρ, dynamic viscosity μ, angular velocity ω, diameter D and discharge Q. Express efficiency in terms of dimensionless parameters. 03

4A. Derive an expression for the velocity distribution across a cross section, for the viscous flow of a fluid between two fixed parallel plates separated by a constant uniform distance, using standard notations. 03

4B. An oil of viscosity 0.1 Ns/m^2 and specific gravity 0.9 is flowing through a circular pipe of diameter 0.05 m and length 300 m. The rate of flow of fluid through the pipe is 3.5 liters per second. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. 03

4C. An oil of specific gravity 0.9 and viscosity 0.006 Ns/m^2 is flowing through a pipe of diameter 0.2 m at the rate of 0.06 m^3/s. (i) Using the Darcy-Weisbach formula find the head lost due to friction for a 500 m length of pipe. (ii) Find the power required to maintain this flow. 03

4D. Define Displacement thickness. Write its expression and explain the terms involved. 01

5A. Determine the rate of flow of water through a pipe of diameter 0.2 m and length 50 m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the center of the pipe. Consider all major and minor losses and take the coefficient of friction for pipe as $f = 0.009$. 04

5B. For a Pelton wheel turbine, draw the velocity triangles at inlet and outlet. Explain all the terms involved. Also write the expression for the force exerted by the jet on the vane, in the direction of motion. 03

5C. Explain the following: 03

(i) Impulse turbine (ii) Outward radial flow reaction turbine

(iii) Mechanical efficiency of a turbine

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