Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

IV SEMESTER B.TECH (INDUSTRIAL AND PRODUCTION ENGINEERING)

END SEMESTER EXAMINATION – APRIL/MAY 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. A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. The length of both cylinders is 25 cm. The space between the cylinders is filled with liquid of specific gravity 0.9. If a torque of 12.0 .Nm is required to rotate the inner cylinder at 100 RPM, determine the kinematic viscosity of the fluid in stokes. 03

1B. State and prove the Hydrostatic law. 03

1C. For the gate shown in Fig. (Q1C), determine (i) the horizontal and vertical components of the hydrostatic pressure forces, (ii) resultant hydrostatic pressure force, and its direction. 03

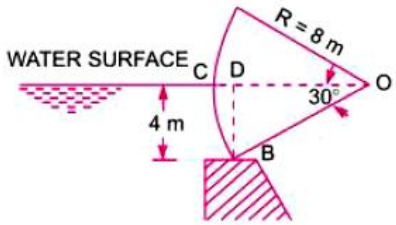

Fig. (Q1C)

1D. In Fig. Q (1D), an inverted differential manometer is connected to two pipes A and B which convey water. The fluid in monometer is oil of specific gravity 0.8. For the manometer readings shown in the Fig. (Q1D), determine the pressure difference between A and B. 01

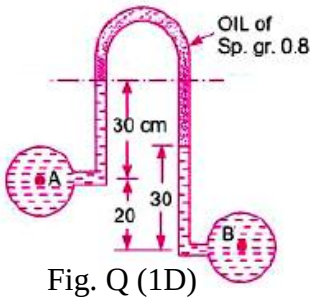

Fig. Q (1D)

2A. The time period of rolling of a ship of weight 29430 kN in sea water is 10 seconds. The center of buoyancy of the ship is 1.5 m below the center of gravity. Find the radius of gyration of ship if moment of inertia of the ship at the water line about fore-aft axis is 1000 m^4. Take the specific weight of sea water as 10100 N/m^3. 03

2B. Derive the continuity equation in the 3D differential form using Cartesian coordinate system. 03

2C. Do the following velocity components represent possible physical flow? Justify your answer. $u = x^2 + z^2 + 5$; $v = y^2 + z^2$; $w = 4xyz$ 02

2D. A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressures at the points A and B are given as 294.3 kPa and 225.63 kPa respectively while the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. 02

3A. Derive the Euler's equation of motion and deduce the Bernoulli's equation from it. 03

3B. Find the discharge of water flowing through a pipe 30 cm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 15 cm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U-tube which gives a reading of 30 cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. 03

3C. Define Mach number. 01

The resisting force R of a supersonic plane during flight can be considered as dependent on the length of the aircraft L, velocity V, viscosity μ, mass density ρ, Bulk modulus K. Apply Buckingham's π theorem, express the fundamental relationship between the resisting force and these variables. 03

4A. Derive an expression for the velocity distribution across a cross section, for the viscous flow of a fluid in a circular cross section pipe, using standard notations. 03

4B. Determine (i) the pressure gradient, (ii) the shear stress at the two horizontal parallel plates and (iii) the discharge per meter width for the viscous flow of an oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100 mm apart. Given $\mu = 2.4525$ Pa.s. 03

4C. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 liters per second. Find the head lost due to friction and the power required to maintain the flow for a length of 1000 m. Take $\nu = 0.29$ stokes. 03

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

5A. 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, as shown in Fig. (Q5A). For the first 25 m of its length from the tank, the pipe is 150 mm in diameter and its diameter is suddenly enlarged to 300 mm. 04

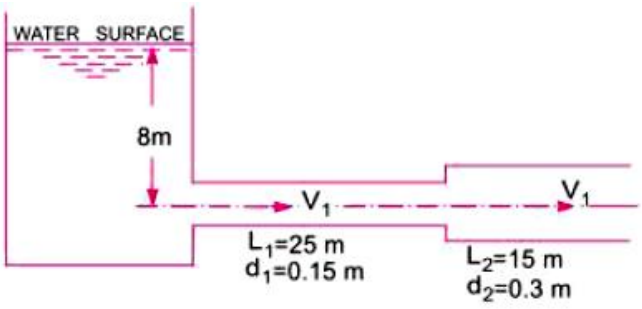

Fig. (Q5A)

The height of water level in the tank is 8 m above the center of the pipe. Considering all losses of head which occur, determine the rate of flow. Take the coefficient of friction $f = 0.01$ for both sections of the pipe.

5B. For a jet of water striking tangentially at one of the tips of an un-symmetrical moving curved plate (or vane), draw the velocity triangles at inlet and outlet. Explain all the terms involved. Also write the general expression for the force exerted by the jet on the vane, in the direction of motion. 03

5C. Define the following: 03

(i) Hydraulic efficiency of a turbine

(ii) Volumetric efficiency of a turbine

(iii) Net head of a turbine

(iv) Discharge through a reaction radial flow turbine

(v) Discharge through a Kaplan turbine

(vi) Specific speed of a turbine

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