Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER MAKE-UP EXAMINATION – JUNE 2018
SUBJECT: FLUID MECHANICS (MME 2202)
REVISED CREDIT SYSTEM

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

Note: (i) Missing data, if any, may be appropriately assumed.
(ii) Assumptions made must be clearly mentioned.
(iii) Support your answers with sketches wherever necessary.

1A. Derive an expression for the following: (a) to relate pressure and surface tension on a liquid jet surface (b) to relate capillary rise and surface tension. 03

1B. A wooden cylinder of specific gravity 0.6 and circular in cross-section is required to float in oil (specific gravity 0.90). Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of cylinder and D is its diameter. 03

1C. Define the following: (i) Mass density (ii) Surface tension (iii) Specific gravity (iv) Compressibility. 02

1D. Determine the minimum size of the glass tubing that can be used to measure water level if capillary rise is not to exceed 2 mm. Take σ = 0.0736 N/m at 20˚C. 02

2A. The dam in Fig. (Q 2A) is a quarter circle 50 m wide into the paper. Determine the
(i) Horizontal and vertical components of the hydrostatic force against the dam, and
(ii) Orientation of the resultant hydrostatic force.

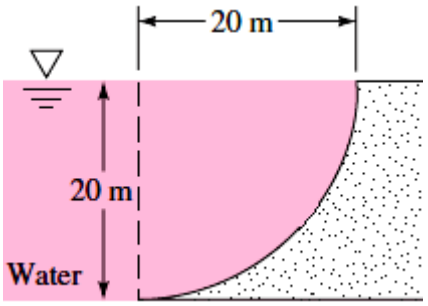

Fig. (Q 2A) 03

2B. A differential manometer is attached to two tanks, as shown in Fig. (Q 2B). Calculate the pressure difference between chambers A and B. 02

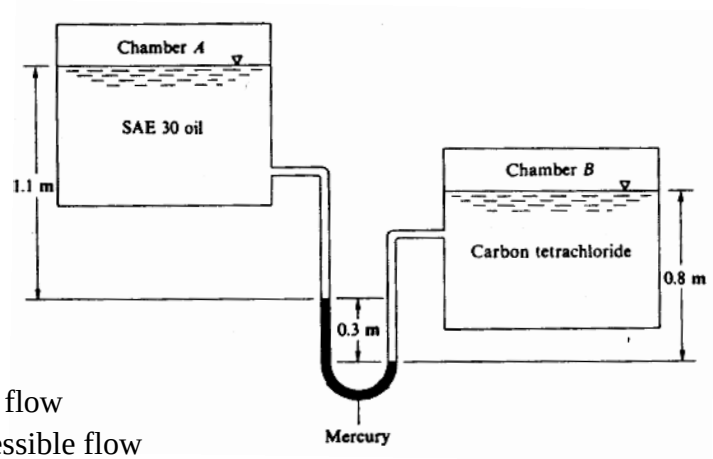

Fig. (Q 2B) 03

2C. Explain the following
(i) Laminar flow and turbulent flow
(ii) Compressible and incompressible flow
(iii) Rotational and irrotational flow

2D. Given the velocity field $V = (4 + xy + 2t)i + 6x^3j + (3xt^2 + z)k$, find the acceleration of a fluid particle at (2, 4, -4) at t = 3. 02

3A. A 2 m long pipe line tapers uniformly from 10 cm diameter to 20 cm diameter at its upper end. The centre line of pipe slopes upwards at an angle of 30^o to the horizontal and flow direction is from smaller to bigger cross section. If the pressures at lower and upper end are 200 kPa and 230 kPa respectively, determine the flow rate and the fluid pressure at the mid length of the pipe line. Assume no energy losses. 03

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

3C. An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury-oil differential manometer connected on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil (specific gravity 0.9) when the coefficient of discharge of the orifice meter 0.64. 03

3D. A pipe of constant diameter 80 mm carries a fluid of specific gravity 0.8 and is inclined to the ground such that the higher end of the pipe is 8 m above the reference datum. The pressure at the lower end is 200 kPa, where the pipe axis crosses the datum. Find the pressure at the higher end. Assume no energy losses. 01

4A. Derive an expression for shear stress and velocity distribution in the case of a viscous fluid flow between two fixed parallel plates. 04

4B. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m through which water is flowing at a velocity of 3 m/s using (i) Darcy's formula for which the coefficient of friction is $f = 0.00256$ (ii) Chezy's formula for which the Chezy's constant is $C = 60$. Take kinematic viscosity of water = 0.01 stoke. 03

4C. A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the larger and smaller pipe is given as 137.34 kPa and 117.72 kPa respectively. Find the loss of head due to contraction if $C_c = 0.62$. Also determine the rate of flow of water. 03

5A. The resisting force F of a supersonic plane during flight can be considered as dependent upon the length of the aircraft L, velocity V, aircraft viscosity μ, air density ρ, and bulk modulus K. Express the functional relationship between these variable and the resisting force using Buckingham's π theorem. 03

5B. Explain the three types of similarities that one needs to consider during Model analysis. 02

5C. 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 coefficient of lift and drag are 0.75 and 0.15 respectively. Determine the (i) lift force (ii) drag force (iii) resultant force (iv) power exerted by the air stream on the plate. 03

5D. Define the following with reference to Boundary layer theory:

(i) Local drag coefficient

(ii) Average drag coefficient 02

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