Reg. No.										

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

IV SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATION – APRIL 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 the hydrostatic law of fluid statics. Show how it can be used to measure the variation of pressure in earth's atmosphere, assuming isothermal condition. 03

1B. A ship weighs 30 MN and carries a cargo weighing 1 MN which is placed centrally on its deck. When the cargo shifts to one side by 6 m, the ship tilts by θ degrees. The time period of oscillations about the fore-aft axis is 10 seconds. The ship has a radius of gyration of 8 m. Determine the (i) meta centric height (ii) the angle of tilt θ. 03

1C. State Newton's Law of viscosity and distinguish between Newtonian and Non Newtonian fluid. 02

1D. Find the kinematic viscosity in stokes of an oil having specific weight 9624 N/m^3. The shear stress at a point in oil is 0.2452 N/ m^2 and rate of shear strain at that point is 0.2 per second. 02

2A. A tank with base 3m × 3m and height 2m contains water upto a height of 1m above the base. An immiscible liquid of specific gravity 0.8 is filled on the top of water upto a height of 1.5 m. Calculate the (i) total pressure on one side of the tank (ii) the position of the center of pressure for one side of the tank. 03

2B. Two horizontal pipes A and B are at the same height above the ground. Pipe A carries air of density 1.2 kg/m^3 and pipe B carries a gas of density 2 kg/m^3. The pressure of gas in pipe B is higher than that of air in pipe A.

(i) When a differential U tube manometer containing a manometric liquid of specific gravity 2.25 is connected between the pipes, a manometer reading of 20 cm is recorded. The nearest meniscus is at a distance of 20 cm from center of pipe A. What is the pressure difference between the two pipes?

(ii) If the liquid in the manometer is replaced with another liquid of specific gravity 1.25, and the nearest meniscus is at a distance of 20 cm from center of pipe A, what will be the manometer reading? 02

2C. Derive the continuity equation in its most general form in three dimensional Cartesian coordinate space. 03

2D. Given the two velocity components in an incompressible fluid flow field: $v = 2y^2$ and $w = 2xyz$, determine the third component such that it satisfies the continuity equation. 02

3A. A vertical conical reducer forms a part of piping system and rests on a support. Its diameter changes from 30 cm at inlet (bottom) to 20 cm at exit (top). Water enters the inlet with constant average velocity of 4 m/s at an absolute pressure of 3.5 bar. The absolute pressure at the exit is 3.15 bar. The reducer weighs 100 N and contains 0.03 m^3 of water inside it. Determine the total force on the support due to the reducer and the fluid in contact with it. Take atmospheric pressure = 1.03 bar. 03

3B. Derive Euler's equation of motion for a steady flow and deduce the Bernoulli's equation from it. 03

3C. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturimeter. Assume the coefficient of discharge for the meter to be 0.9. 03

3D. A non-uniform part of a pipe line 5 m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameters at the upper and lower ends are 15 cm and 10 cm respectively, determine the velocity at the lower end. Neglect frictional losses. 01

4A. Derive an expression for shear stress and velocity distribution in the case of a viscous fluid flow through a circular pipe. 04

4B. In a pipe of 300 mm diameter and 800 m length oil of specific gravity 0.8 is flowing at the rate of 0.45 m^3/s. Find the head lost due to friction, and power required to maintain the flow. Take kinematic viscosity of oil as 0.3 stokes and coefficient of friction f = 0.00498. 03

4C. The rate of flow of water through a horizontal pipe is 250 *lps*. The pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (i) Loss of head due to sudden enlargement (ii) pressure intensity in the larger pipe. 03

5A. The pressure drop Δp in a pipe depends upon the mean velocity V, Length of pipe L, diameter of pipe d, viscosity μ, average height of roughness projection on inside pipe surface h and mass density of fluid ρ. Using the Buckingham π theorem, obtain a dimensionless expression for Δp. 03

5B. Define (i) Reynold's number (ii) Mach number. Mention an application of each. 02

5C. A kite weighing 8 N has an effective area of 0.8 m^2. It is maintained in air such that its surface makes an angle of 10^o with the horizontal. The string attached to the kite makes an angle of 45^o with the horizontal. In this position, the coefficients of drag and lift are 0.6 and 0.8 respectively. Determine the speed of the wind and the tension in the string. Take the density of air as 1.25 kg/m^3. 03

5D. Define (i) Momentum thickness, and (ii) Energy thickness 02

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