# Question Paper

Exam Date & Time: 31-Dec-2019 (09:30 AM - 12:30 PM)

## MANIPAL ACADEMY OF HIGHER EDUCATION

### INTERNATIONAL CENTRE FOR APPLIED SCIENCES
### END SEMESTER THEORY EXAMINATIONS-NOVEMBER 2019
### III SEMESTER B.Sc.(APPLIED SCIENCES) IN ENGINEERING
### FLUID MECHANICS [IME 234]

**Marks: 100** **Duration: 180 mins.**

**Answer 5 out of 8 questions.**

1) A) Define the following and write relevant equations if any: (10)
i) Surface tension
ii) Capillarity
iii) Kinematic viscosity
iv) Dynamic viscosity
v) Specific gravity of oil

B) Derive the equation for total pressure and centre of pressure for a vertical plane surface submerged in water. (10)

2) A) A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of pipe. (10)

B) Derive the equation for meta-centric height for a floating body in equilibrium. (10)

3) What are the different types of fluid flow? Explain with suitable equations. (10)

A)

B) Derive the Euler's equation of motion for a fluid flow. (10)

4) A) The inlet and throat diameters of a horizontal Venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is 13.734 N/cm$^2$ while the vacuum pressure head at the throat is 37 cm of Hg. Find the rate of flow. Assume that 4% of the differential head is lost between the inlet and throat. Find also the value of $C_d$ for the Venturimeter. (10)

B) With relevant equations explain- (10)
i) Reynold's number
ii) Kinematic similarity between model and prototype

iii) Dimensionally homogeneous equation
iv) Derived quantities
v) Mach's number

5) A) Derive the equation for shear stress across a section for flow of viscous fluid through the circular pipe. (10)

B) Derive the Dracy-Weisbach formula for the flow of fluid through a pipe. (10)

6) A) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 meter per sec requires a force of 98.1 N to maintain the speed. Determine the dynamic viscosity of oil in poise and kinematic viscosity of the oil in stokes if the specific gravity of oil is 0.95. (10)

B) State and prove the Pascal's Law. (10)

7) A) A rectangular plane surface 3 m wide and 4 m deep lies in water in such a way that its plane makes an angle of $30^0$ with the free surface of water. Determine the total pressure force and position of centre of pressure, when the upper edge is 2 m below the free surface. (10)

B) A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2 m x 1 m x 0.8 m. (10)

8) A) Derive the continuity equation in three dimensions by considering the Cartesian coordinates. (10)

B) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 $N/cm^2$ and 9.81 $N/cm^2$ respectively.Co-efficient of discharge for the orifice meter is given as 0.6. Find the discharge of water through the pipe. (10)

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