CBCS SCHEME

USN | | | | | | | | | |

17MA44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics and Machines

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With a suitable graph explain the types of fluids. **(06 Marks)**

b. Derive an expression for the compressibility of gas undergoing :
i) Isothermal compression ii) Isentropic compression. **(06 Marks)**

c. If the velocity profile of a fluid over a plate is parabolic with the vertex of 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0 cm and 10cm from the plate. Assume viscosity of oil as 0.85 Pa-s. **(08 Marks)**

OR

2 a. Define :
i) Atmospheric pressure ii) Gauge pressure iii) Vacuum pressure iv) Absolute pressure. **(04 Marks)**

b. State and prove Pascal's law. **(08 Marks)**

c. A U-tube differential manometer with mercury is used to measure the pressure difference between point 'A' and 'B' on a horizontal pipeline carrying water under pressure. If the deflection shown by manometer 80cm and the level of mercury in the limb connected to 'A' being lower. Find the pressure difference between 'A' and 'B'. **(08 Marks)**

Module-2

3 a. Prove that equipotential line the stream lines are always intersect orthogonally. **(06 Marks)**

b. Distinguish between :
i) Steady and unsteady flow
ii) Uniform and non-uniform flow
iii) Rotational and Irrational flow **(06 Marks)**

c. A stream function is given by $\psi = 5x - 6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. **(08 Marks)**

OR

4 a. With a suitable assumption derive Euler's equation of motion along a stream line and hence obtain the Bernoulli's equation for incompressible fluids. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end, at the rate of 50 litre/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62N/cm^2. **(10 Marks)**

Module-3

5 a. Derive an expression for discharge through an orifice meter. **(10 Marks)**

b. Water flows through a triangular right angled notch first and then over a rectangular notch of 1m width. The discharge co-efficient of the triangular and rectangular notches are 0.6 and 0.7 respectively. If the depth of water over the triangular notch is 360mm. Find the depth of water over the rectangular notch. **(10 Marks)**

OR

6 a. State Buckingham's π theorem. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω diameter D of the rotor and the discharge Q. Express η interms of dimensionless parameters. **(10 Marks)**

b. A pipe of diameter 1.5m is required to transport of an oil of specific gravity 0.9 and viscosity 3×10^{-2} poise at the rate of 3000 ltr/s. Tests were conducted on a 15cm diameter pipe using water at 20°C. Find the velocity of flow in the model, viscosity of water at 20°C = 0.01 poise. **(10 Marks)**

Module-4

7 a. Derive Chezy's equation for loss of head due to friction in pipes. **(10 Marks)**

b. A crude oil of kinematic viscosity 0.4 stoke is flowing through a pipe of diameter 300mm at the rate of 300 ltr/s. Find the head lost due to friction for a length of 50m of the pipe. **(10 Marks)**

OR

8 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the law. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine :

i) The maximum velocity
ii) The pressure drop per unit length
iii) The shear stress at the walls of the plate if the average velocity is 0.2 m/s.

The viscosity of water at 15°C is given as 0.01 poise. **(10 Marks)**

Module-5

9 a. Define the following :

i) Manometric head
ii) Volumetric efficiency
iii) NPSH
iv) Cavitations. **(08 Marks)**

b. Derive an expression for minimum starting speed at pump. **(06 Marks)**

c. A centrifugal pump having outer diameter to 2 times inner diameter and running at 1200rpm work against a total head of 75m. The velocity of flow through the impeller is constant and equal to 3m/s. The vanes are set back at an angle of 30° at outlet. If the outer diameter of impeller is 60cm and width at outlet is 5cm. Determine :

i) Vane angle at inlet
ii) Workdone
iii) Manometric efficiency. **(06 Marks)**

OR

10 a. Define the following terms of centrifugal compressor :

i) Slip factor
ii) Work factor
iii) Pressure co-efficient
iv) Overall pressure ratio
v) Surging in centrifugal compressor. **(10 Marks)**

b. An axial flow compressor of 50% reaction design has blades with inlet and outlet angles with respect to axial direction are 45° and 10° respectively. The compressor is to produce a pressure ratio of 6:1with an overall isentropic efficiency of 0.85 when inlet static temperature is 37°C. The blade speed and axial velocity are constant throughout the compressor. Assume a value of 200m/s for blade speed. Find the number of stages if workdone factor is i) Unity ii) 0.87 for all stages. **(10 Marks)**