CBCS SCHEME

USN | | | | | | | | | | |

15MT42

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Fluid Mechanics and Machines

Time: 3 hrs. Max. Marks: 80

Note: ***1. Answer any FIVE full questions, choosing one full question from each module.***
2. Assume missing data any with suitable reasoning.

Module-1

1 a. Define the following:
i) Specific gravity
ii) Mass density
iii) Surface tension
iv) Newton law of viscosity **(04 Marks)**

b. State and prove Pascal law. **(06 Marks)**

c. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limb is 20 cm. **(06 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(08 Marks)**

b. A tank contains water upto a height of 0.5 m above the base. An immercible liquid of sp.gr. 0.8 is filled on the top of water upto 1 m height. Calculate:
i) Total pressure on one side of the tank.
ii) The position of centre of pressure for one side of the tank which is 2 m wide. **(08 Marks)**

Module-2

3 a. Derive an expression for continuity equation for 3D flow (Cartesian coordinates). **(08 Marks)**

b. The velocity vector in a fluid flow is given by $V = 4x^3i - 10x^2yj + 2tk$. Find the resultant velocity and resultant acceleration of a fluid particle at [2, 1, 3] at t = 1. **(06 Marks)**

c. Write properties of stream function. **(02 Marks)**

OR

4 a. Derive an expression for Bernoulli's equation of motion starting from Euler equation of motion along a stream line with assumptions made. **(08 Marks)**

b. Write the limitation of Bernoulli's equation. **(03 Marks)**

c. A pipe, through which water is flowing is having diameter 20 cm and 10 cm at the cross section ① and ② respectively. The velocity of water at section 1 is given by 4.0 m/sec. Find the velocity head at section ① and section ② and also discharge. **(05 Marks)**

Module-3

5 a. Define dimensional homogeneity. **(02 Marks)**

b. The frictional torque of a disk of diameter (D) rotating at a speed (N) in a fluid viscosity (μ) and density (ρ) in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right]$$

Prove this by Buckingham's π theorem method of dimension. **(08 Marks)**

c. Explain the significance on dimensionless number:
i) Euler's number
ii) Reynolds number
iii) Froude's number **(06 Marks)**

OR

6 a. Derive an expression for rate of flow through venturimeter. **(08 Marks)**

b. 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. Take $C_d = 0.98$. **(08 Marks)**

Module-4

7 a. Define turbo machine. Classify them on basis of work transfer. **(04 Marks)**

b. Write the difference between turbo machine and positive displacement machine. **(04 Marks)**

c. Derive an expression for Euler turbine equation with assumption made. **(08 Marks)**

OR

8 a. Derive an expression for alternative form of Euler equation turbine equation. **(08 Marks)**

b. Derive an expression for degree of reaction (R). **(05 Marks)**

c. Draw the velocity triangle when R = 0 and when R = 0.5. **(03 Marks)**

Module-5

9 a. Explain different efficiencies of water turbine. **(04 Marks)**

b. Derive an expression for maximum hydraulic efficiency of pelton wheel. **(06 Marks)**

c. Explain with a neat sketch working principle of Kaplan turbine. **(06 Marks)**

OR

10 a. Derive an expression for condition for the maximum blade efficiency with equiangular blades for single stage impulse turbine. **(08 Marks)**

b. Steam issuing from a nozzle to a De-Laval turbine with a velocity of 1000 m/s. The nozzle is 20°, the mean blade speed is 400 m/sec. The blades are symmetrical, the mass flow rate 1000 kg/hr, friction factor = 0.8, nozzle efficiency = 0.95. Calculate:
i) Blade angle
ii) Axial thrust
iii) Work done per kg of steam
iv) Power developed
v) Blade efficiency
vi) Stage efficiency
(solve by graphically or analytically) **(08 Marks)**

* * * * *