CBCS SCHEME

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17MA44

Fourth Semester B.E. Degree Examination, Aug./Sept.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. Define the following fluid properties. Write their unit.
(i) Density (ii) Specific weight (iii) Specific volume (iv) Specific gravity **(10 Marks)**

b. A cubical block of sides 1m and weighing 350 N slides down on inclined plane with a uniform velocity of 1.5 m/s. The inclines plane is laid on a slope 5 vertical to 12 horizontal and has an oil film of 1.0 mm thickness. Calculate the dynamic viscosity of oil. **(10 Marks)**

OR

2 a. State and explain Pascal's law. Derive the equation also. **(10 Marks)**

b. The right column of a simple U tube manometer is open to atmosphere and the left column is connected to a pipe in which fluid of specific gravity 0.8 is flowing. The difference of mercury level in two columns is 23 cm the center of the pipe is 15 cm below the mercury level in the right column. Calculate the pressure of fluid in the pipe. **(10 Marks)**

Module-2

3 a. Explain the following types of fluid flow:
(i) Steady flow (ii) Unsteady flow (iii) Uniform flow
(iv) Non-uniform flow (v) Laminar flow **(10 Marks)**

b. Check whether the flow of liquid given by $u = 5x$ and $v = -5y$ is (i) continuous (ii) irrotational. **(10 Marks)**

OR

4 a. Derive Euler's equation of motion for one-dimension flow along a stream line. State the assumptions. **(10 Marks)**

b. A conical tube is fixed vertically with its small end upwards, velocity of flow down the tube is 4.5 m/s at the upper end and 15 m/s at the lower end. Tube is 1.5 m long and the pressure at the upper end is 24.3 kPa (abs). Loss in the tube expressed as head is $0.3(V_1 - V_2)^2/2g$ where V_1 and V_2 are the velocities of fluid (s = 0.8) flow at the upper and lower ends respectively. What is the pressure head at the lower end? **(10 Marks)**

Module-3

5 a. What is venturimeter? Draw a neat sketch indicating different parts and explain. **(10 Marks)**

b. A pitot-tube is used for measuring the velocity of air flow through a duct. A U – tube water manometer shows a deflection of 12 mm of water. If the coefficient of pitot tube is 0.98, find velocity of air flow and mass flow rate of air. Assume specific weight of air ad 10 N/m^3. Diameter of the duct is 500 mm. **(10 Marks)**

OR

6 a. State and explain Buckingham π - theorem. **(10 Marks)**

b. Write short note on five laws of similitude. **(10 Marks)**

Module-4

7 a. Derive Darcy-Weisbach equation and explain its significance. **(10 Marks)**

b. Find the diameter of a pipe of length 2000 m when the rate of flow of water through the pipe is 200 liters/s and head loss due to friction is 4m. Take the value of 'c' is equal to 50 in Chezy formula. **(10 Marks)**

OR

8 a. Derive Hagen-Poiscuille equation and state the assumptions made in the derivation. **(10 Marks)**

b. An oil of viscosity 0.2 Pa-S and specific gravity 0.85 flows through a circular pipe of diameter 75 mm and length 250 m. If the rate of flow through the pipe is 5 liters/s, find the pressure drop in a length of 25 m and the shear stress at the pipe wall. **(10 Marks)**

Module-5

9 a. Define the following terms as referred to the centrifugal pump,
(i) Suction head (ii) Static head (iii) Menometric efficiency
(iv) Hydraulic efficiency (v) Volumetric efficiency **(10 Marks)**

b. A CF pump with 1.2 m diameter runs at 200 rpm and pumps 1880 lit/s, the average lift being 6m. The angle which the vanes make at exit with the tangent to the impeller is 26° and radial velocity of flow is 2.5 m/s. Determine the manometric efficiency and the least speed to start pumping against a head of 6m inner diameter of impeller being 0.6m. **(10 Marks)**

OR

10 a. Draw a sketch of an axial flow compressor with inlet guide vane and explain the working principle of the compressor. **(10 Marks)**

b. A single stage axial flow blower with no inlet guide vanes but a raw of stationary vanes after the rotor runs at 3600 rpm. The rotor hub and tip diameters are 20 cm and 12.5 cm respectively. The mass flow rate of air is 0.5 kg/s. The turning angle of the rotors is 20° towards the axial direction during the air flow over the blade. If the atmospheric temperature and pressure are 25°C and 1 atm respectively, assuming constant axial velocity through the machine, find:
(i) The total pressure rise of the air of $\eta_{ft} = 0.9$
(ii) The power required
(iii) The degree of reaction **(10 Marks)**

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