CBCS SCHEME

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15AE35

Third Semester B.E. Degree Examination, June/July 2018
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State Newton's law of viscosity and explain Newtonian and non-Newtonian fluids with suitable plot. **(04 Marks)**

b. Define Absolute gauge and Vacuum pressure. Also bring out the relation between the same. **(04 Marks)**

c. An oil of viscosity '5' poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil film is 1.0 mm. **(08 Marks)**

OR

2 a. Give reasons for the following :
(i) Viscosity of liquids decreases with increase in temperature, whereas viscosity of gas increases with increase in temperature.
(ii) Rain drops and tiny dew drops are spherical in shape. **(04 Marks)**

b. Define : (i) Buoyancy and centre of buoyancy (ii) Meta-centre and meta-centric height. **(04 Marks)**

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

Module-2

3 a. List and explain different types of fluid flow. **(08 Marks)**

b. With usual notations derive momentum equation in integral form for a compressible fluid flow. **(08 Marks)**

OR

4 a. Define velocity potential, stream function and prove that the product of the slope of the equipotential line and the constant stream line at a point of intersection is equal to (– 1). **(10 Marks)**

b. Explain source, sink and doublet flow. **(06 Marks)**

Module-3

5 a. State and prove Bernoulli's theorem and also state the assumptions made for the same. **(08 Marks)**

b. A pump has a tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2m and 0.6m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of difference of velocity head. Determine the discharge, the flow is vertically upwards and difference of elevation is 3.9m. **(08 Marks)**

OR

6 a. The efficiency (η) of a fan depends on density, dynamic viscosity of the fluid, angular velocity, diameter of the rotor and discharge. Express efficiency in terms of dimensionless parameter using the Buckingham's π theorem. **(08 Marks)**

b. Define similitude and briefly explain types of similarities. **(08 Marks)**

Module-4

7 a. Define Lift, Drag and derive expression for the same. **(08 Marks)**

b. Define displacement thickness, momentum thickness, energy thickness and determine the same for the velocity distribution in the boundary layer given by

$$(u/U) = 2(y/\delta) - (y/\delta)^2$$ **(08 Marks)**

OR

8 a. State and explain Kutta – Joukowski theorem. **(04 Marks)**

b. With a neat sketch, briefly explain boundary layer theory. **(04 Marks)**

c. A kite 0.8m × 0.8m weighting 3.924 N assumes an angle 12° to the horizontal. The string attached to the kite make an angle of 45° to the horizontal. The pull on the string is 24.525 N, when the wind is flowing at a speed of 30 km/hr if the density of the air is 1.25 kg/m^3, find the corresponding co-efficient of drag and lift. **(08 Marks)**

Module-5

9 a. Define stagnation point and derive an expression for stagnation pressure for a compressible flow. **(08 Marks)**

b. Define Mach number and derive an expression for the same. **(04 Marks)**

c. Sketch the propagation of pressure waves in a compressible fluid for supersonic flow and define Mach cone and Mach angle. **(04 Marks)**

OR

10 a. Derive an expression for :

(i) Velocity of sound in terms of Bulk modulus

(ii) Velocity of sound in isothermal process

(iii) Velocity of sound for adiabatic process. **(12 Marks)**

b. An airplane is flying at an altitude of 15 km, where the temperature is – 50°C. The speed of the plane corresponds to the Mach number of 1.6. Assuming k = 1.4 and R = 287 J/kg.K for air, find the speed of the plane and Mach angle. **(04 Marks)**

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