Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90115

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third/Fourth Semester

Aeronautical Engineering

CE 8394 – FLUID MECHANICS AND MACHINERY

(Common to Aerospace Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/ Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)

(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. At a certain point in castor oil the shear stress is 0.216 N/m^2 and the velocity gradient 0.216s^{-1}. If the mass density of castor oil is 959.42 kg/m^3, find kinematic viscosity.

2. Differentiate System and Control Volume.

3. Find the displacement thickness if the velocity distribution is given by

   $(u/U) = (y/\delta)$.

4. Find the loss of head when a pipe of diameter 100 mm is suddenly enlarged to a diameter of 300 mm. The rate of flow of water through the pipe is 150 lps.

5. Check whether the equation $Q = 0.67\ C_d(2g)^{0.5}\ LH^{1.5}$ is dimensionally homogeneous.

6. List the applications where Reynold's model law can be applied.

7. Draw the inlet and outlet velocity triangle for centrifugal pump and name the components.
8. Differentiate Single acting and Double acting reciprocating pump.
9. What is runaway speed of the turbine ?
10. Differentiate with examples the tangential flow impulse turbine and axial flow radial turbine.

PART – B **(5×13=65 Marks)**

11. a) By stating the assumptions, prove that the total energy per unit weight of the water is constant at all points in a pipe flow.

(OR)

b) If the velocity distribution over a plate is given by $u = 2/3\ (y) - y^2$ in which u is the velocity in metre per second at a distance y metre above the plate, determine the shear stress at $y = 0$ and $y = 0.15$ m. Take dynamic viscosity of fluid as 8.63 poises.

12. a) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow.

(OR)

b) Derive an expression for loss due to sudden enlargement and contraction in pipes.

13. a) The power P developed by a water turbine depends on the rotational speed N, operating head H, gravity g, diameter D and breadth B of the runner, density ρ and viscosity μ of water. Show by dimensional analysis that

$P = \rho D^5 N^3\ \phi\ [H/D,\ D/B,\ \rho D^2 N/\mu,\ ND/\sqrt{(gH)}]$

Under what conditions it can be used to determine the characteristics of a similar machine ?

(OR)

b) Discuss the importance of dimensionless numbers and derive five dimensionless numbers which are most important in fluid flow problems.

14. a) Derive an expression for pressure head due to acceleration of the piston of a reciprocating pump, assuming motion of the piston to be SHM.

(OR)

b) A centrifugal pump has an impeller of internal diameter 0.12 m and external diameter 0.24m, which rotates at 1200 rpm. The absolute velocity of water at inlet is radial and vanes are curved back at an angle of 25 degree to the tangent at outlet. The width of the impeller at inlet and outlet is 0.016 m and 0.008 m, respectively. Determine the gain of pressure head as water passes through the impeller, neglecting losses. The pump discharges water at the rate of 500 l/min.

15. a) An outward flow reaction turbine has inner and outer diameters of the wheel as 1 m and 2 m respectively. The water enters the vanes at an angle of 20 degrees and leaves radially. If the velocity of flow remains constant as 10 m/s and the speed of the wheel be 300 rpm, find the vane angle at inlet and outlet.

(OR)

b) Explain the components and working of Pelton wheel turbine with neat sketches. Also draw the velocity triangles at inlet and outlet of the vanes and explain the relationship of each components in it.

PART – C **(1×15=15 Marks)**

16. a) The difference in water surface levels in the two tanks, which are connected by three pipes in series of lengths 300 m, 100 m and 200 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 10 m. Determine the rate of flow of water if co-efficient of friction is 0.005, 0.0052 and 0.0048 respectively, considering minor losses.

(OR)

b) Determine the efficiency of Kaplan turbine developing 3000 kW under a net head of 5 m. It is provided with a draft tube with its inlet diameter 3 m set 1.6 m above the tail race. A vacuum gage connected to the draft tube indicates a reading of 5 m of water. Assume a draft tube efficiency as 78%.