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

Question Paper Code: 31734

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Third Semester

Mechanical Engineering

01UME304 – FLUID MECHANICS AND MACHINERY

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What do you mean by absolute pressure and gauge pressure?
2. Define uniform flow.
3. List the causes of minor energy losses in flow through pipes.
4. List few minor losses in flow through pipes.
5. What is Dimensionally Homogeneous equation and give an example?
6. List any two dimensionless parameters and their field of application.
7. State the momentum equation. When can it be applied?
8. Narrate the significance of cavitation in hydraulic turbines.
9. Why is priming necessary in centrifugal pumps?
10. Compare positive displacement pumps with dynamic Pumps.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) The velocity distribution over a plate is given by $u = 2y - y^2$, where u is the velocity in m/sec at a distance of y metre above the plate. Determine the velocity gradient and shear stress at the boundary and 1.5 m from it. Dynamic viscosity of the fluid is 0.9 Ns/m^2. (8)

(ii) Two large plane surfaces are 125 mm apart. The space between the surfaces is filled with oil of viscosity 0.972 Ns/m^2. A flat thin plate of 0.5 m^2 area moves through the oil at velocity of 0.3 m/s. Calculate the drag force

(a) When the plate is in the middle of the two plane surface and
(b) When the thin plate is at a distance of 30 mm from one of the planes. (8)

Or

(b) In a two dimensional incompressible flow the fluid velocities are given by $u = x - 4y$ and $u = -y - 4x$. Show that velocity potential exists and determine its form. Find also the stream function. (16)

12. (a) (i) List out the assumptions involved in Euler's equation of motion. Derive the Bernoulli equation from Euler's equation in the case of incompressible flow. (10)

(ii) A tap discharges water evenly in a jet at a velocity of 2.6 *m/s* at the tap outlet, the diameter of the jet at this point being 15 *mm*. The jet flows down vertically in a smooth stream. Determine the velocity and the diameter of the jet at 0.6 *m* below the tap outlet. (6)

Or

(b) (i) Derive Darcy–Weisbach equation for calculating pressure drop in the process of design of piping systems. (10)

(ii) Two pipes of 0.35 *m* and 0.25 *m* dia and length 2000 *m* and 1500 *m* with *f* values 0.021 and 0.018 connected in series carry water from a reservoir to a supply system, the head available being 8 *m*. Determine the flow quantity neglecting minor losses. (6)

13. (a) Using Buckingham's π Theorem, show that the velocity through circular orifice is given by: $V = \sqrt{2gH}\, f\left[\frac{D}{H}, \frac{\square}{\rho VH}\right]$

where, H = Head causing flow

D = Diameter of orifice
μ = Coefficient of viscosity
ρ = Mass density
g = Acceleration due to gravity. (16)

Or

(b) 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 the efficiency η in terms of dimensionless parameter. (16)

14. (a) A Pelton turbine running at 720 *rpm* uses 300 *kg* of water per second. If the head available is 425 *m*, determine the hydraulic efficiency. The bucket deflects the jet by 165°. Also find the diameter of the runner and jet. Assume C = 0.97 and f = 0.46, Blade velocity coefficient is 0.9. (16)

Or

(b) (i) Explain the various losses in centrifugal pumps. (6)

(ii) A homologus model of a centrifugal pump runs at 600 *rpm* against a head of 8 *m*, the power required being 5 *kW*. If the prototype 5 times the model size is to develop a head of 40 *m* determine its speed, discharge and power. The overall efficiency of the model is 0.8 while that of the prototype is 0.85. (10)

15. (a) (i) A centrifugal pump running at 800 rpm is working against a total head of 20.2 m. The external diameter of the impeller is 480 mm and the outlet width is 60 mm. If the vane angle at outlet is 40^o and mano metric efficiency is 70%, determine

(a) Flow velocity at outlet,
(b) Absolute velocity of water leaving the vane,
(c) Angle made by the absolute velocity at outlet with the direction of motion.
(d) Rate of the flow through the pump. (8)

(ii) Obtain an expression for work done by impeller of a centrifugal pump on water per second per unit weight of water. (8)

Or

(b) (i) The plunger diameter and stroke length of a single-acting reciprocating pump are 300 mm and 500 mm respectively. The speed of the pump is 60 rpm. The diameter and length of delivery pipe are 150 mm and 60 m respectively. If the pump is equipped with an air vessel on the delivery side at the centre lane of the pump, find the power saved in overcoming friction in the delivery pipe. Assume Darcy's friction factor as 0.04 and the plunger undergoes a simple harmonic motion. (8)

(ii) Compare the characteristics of Centrifugal Pump and Reciprocating Pump. (8)