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

Question Paper Code : 91298

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Third/Fourth Semester
Mechanical Engineering
CE 6451 – FLUID MECHANICS AND MACHINERY
(Common to Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical and Automation Engineering/Mechatronics Engineering/ Production Engineering)
(Regulations 2013)
(Also common to PTCE 6451 – Fluid Mechanics and Machinery for B.E. (Part-Time) – Third Semester – Mechanical Engineering (Regulations – 2014))

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Define Viscosity and what is the effect due to temperature on liquid and gases.
2. Calculate the height of capillary rise for water in a glass tube of diameter 1 mm.
3. Differentiate Hydraulic Gradient Line and Total Energy Line.
4. Define boundary layer.
5. Differentiate Dynamic and Kinematic similarities.
6. State Buckingham's π theorem.
7. When does negative slip occur ?
8. Why is forward curved blading rarely used in pumps ?
9. Distinguish between an impulse turbine and a reaction turbine.
10. Define specific speed and unit speed of a turbine.

PART – B (5×13=65 Marks)

11. a) The velocity distribution of flow over a plate is parabolic with vertex 30 cm from the plate, where the velocity is 180 cm/s. If the viscosity of the fluid is 0.9 Ns/m^2 find the velocity gradients and shear stresses at a distances of 0, 15 cm and 30 cm from the plate.

(OR)

b) Derive the three dimensional continuity equation in cartesian coordinates.

12. a) Oil flows through a pipe 150 mm in diameter and 650 mm in length with a velocity of 0.5 m/s. If the kinematic viscosity of oil is 18.7×10^{-4} m^2/s, find the power lost in overcoming friction. Take the specific gravity of oil as 0.9.

(OR)

b) A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if Darcy's friction factor is 0.04. The head at inlet is 300 mm.

13. a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $v = \sqrt{gH\Phi}\left[\frac{D}{H}, \frac{\mu}{\rho vH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.

(OR)

b) i) Explain the types of similarities. (6)

ii) The ratio of lengths of a submarine and its model is 30:1. The speed of the prototype is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag between the model and prototype. Take values of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively. (7)

14. a) i) A single acting reciprocating pump running at 50 RPM delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine.

1) The theoretical discharge of the pump.
2) Coefficient of discharge.
3) Slip and Percentage slip of the pump. (8)

ii) Discuss the working of Gear pump using its schematic diagram. (5)

(OR)

b) A Centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm determine (i) Vane angle at inlet, (ii) Manometric efficiency (iii) Workdone by impeller on water per second.

15. a) At a location selected to install a hydro electric plant, the head is estimated as 540 m. The flow rate was determined as 22 m^3/s. The plant is located at a distance of 2 km from the reservoir. Two pipes of 2 m diameter are proposed with a friction factor of 0.03. Additional losses amount to about $1/4^{th}$ of frictional loss. Assuming on overall efficiency of 85%, determine how many single jet unit running at 330 rpm will be required.

(OR)

b) A Kaplan turbine delivering 40 MW works under a head of 40 m and runs at 150 rpm. The hub diameter is 3 m and runner tip diameter is 6 m. The overall efficiency is 90%. Determine the blade angles at the hub and tip and also at a diameter of 4 m. Also find the speed ratio and flow ratio based on tip velocity. Assume hydraulic efficiency as 95%.

PART – C **(1×15=15 Marks)**

16. a) A 45° reducing bend is connected in a pipeline, the diameter and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 88290 N/m^2 and rate of flow of water is 0.6 m^3/s.

(OR)

b) A laminar flow is taking place in a pipe of diameter 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also, calculate the velocity at 4 cm from the wall of the pipe.