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

# Question Paper Code : X 60841

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Third/Fourth Semester
Mechanical Engineering
ME 2204/CE 1208/10122 ME 305/ 080180007/ME 34 – FLUID MECHANICS AND MACHINERY
(Common to Manufacturing Engineering/Industrial Engineering and Management/Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Mechanical and Automation Engineering/Mechatronics Engineering and Production Engineering)
(Regulations 2008/2010)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Give the dimensions of the following : (a) Torque (b) Momentum.
2. Define capillarity and surface tension.
3. Mention the use of moody diagram.
4. Differentiate laminar and turbulent flow.
5. State the methods of dimensional analysis.
6. What are the limitations of dimensional analysis ?
7. Define hydraulic efficiency and axial thrust of a roto-dynamic hydraulic machine.
8. Distinguish between reaction turbine and impulse turbine.
9. What is the use of an air vessel ?
10. When does the negative slip occur ?

PART – B **(5×16=80 Marks)**

11. a) The velocity distribution for flow over a flat plate is given by u = (2/3) y – y2, where u is the point velocity in meter per second at a distance y metre above the plate. Determine the shear stress at y = 0 and y = 15 cm. Assume dynamic viscosity as 8.63 poise. **(16)**

(OR)

b) Calculate the capillary rise in glass tube of 3 mm diameter when immersed in mercury, take the surface tension and angle of contact of mercury as 0.52 N/m and 130° respectively. Also determine the minimum size of the glass tube, if it is immersed in water, given that the surface tension of water is 0.0725 N/m and capillary rise in tube is not to exceed 0.5 mm. **(16)**

12. a) A lubricating oil, having S = 0.89 and $\mu = 82.5 \times 10^{-3}$ Ns/$m^3$ flows through a 250 mm diameter horizontal cast iron pipe 2000 m long at the rate of 0.035 $m^3$/s. Show that (i) the flow in laminar. Hence (ii) find the pressure difference between the two ends of the pipe. Also find (iii) the power needed by a pump ( $\eta$ = 0.9) in KW, to maintain the flow. **(16)**

(OR)

b) i) Distinguish between laminar flow and the turbulent flow in pipes. **(6)**

ii) Two pipes each 200 m long are available for connections to a reservoir from which a flow of 0.090 $m^3$/s is required. If the diameters of the pipes are 0.30 m and 0.15 m respectively, determine the ratio of head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect Minor losses. **(10)**

13. a) The pressure difference $\Delta$ p in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity $\mu$ and density $\rho$. Using Buckingham's $\pi$-theorem, obtain an expression for $\Delta$ p. **(16)**

(OR)

b) The characteristics of the spillway are to be studied by means of a geometrically similar modal constructed to the scale ratio of 1 :10.

i) If the maximum rate of flow in the prototype is 28.3 $m^3$, what will be the corresponding flow in model ?

ii) If the measured velocity in the model at a point on the spillway is 2.4 m/s, what will be the corresponding velocity in prototype ?

iii) If the hydraulic jump at the foot of the model is 50 mm high, what will be the height of jump in prototype ?

iv) If the energy dissipated per second in the model is 3.5 Nm, what energy is dissipated per second in the prototype ? **(16)**

14. a) Give the classification of turbo machines. Explain the working principle, construction and operation of a centrifugal pump and also discuss the velocity triangles for flow in a centrifugal pump.

(OR)

b) An inward flow reaction turbine is required to produce a power of 280 kW at 200 rpm. The effective head on the turbine is 20 m. The inlet diameter is twice as the outlet diameter. Assume hydraulic efficiency as 80%. The radial velocity is 3.5 m/s and is constant. The ratio of breadth to wheel diameter is 0.1 and 5% of the flow area is blocked by vane thickness. Determine the inlet and outlet diameters, inlet and exit vane angle and guide blade angle at the inlet. Assume radial discharge.

15. a) The cylinder of a single-acting reciprocating pump is 15 cm in diameter and 30 cm in stroke. The pump is running at 30 r.p.m. and discharge water to a height of 12 m. The diameter and length of the delivery pipe are 10 cm and 30 m respectively. If a large air vessel is fitted in the delivery pipe at a distance of 2 m from the centre of the pump, find the pressure head in the cylinder.

i) At the beginning of the delivery stroke, and **(8)**

ii) In the middle of the delivery stroke. Take f = 0.01. **(8)**

(OR)

b) i) Explain in detail the working principle and construction of rotary pumps with neat sketch. **(8)**

ii) Calculate the work saved by fitting an air vessel for a double acting single cylinder reciprocating pump. **(8)**