BT-MRE-IV(R)-04.21-0532 Reg. No. | | | | | | | | |

B

B.Tech. Degree IV Semester Regular Examination in Marine Engineering April 2021

19-208-0405 HYDRAULIC MACHINERY
(2019 *Scheme*)

Time: 3 Hours Maximum Marks: 60

(5 × 15 = 75)

I. (a) Why Buckingham's pie theorem is considered superior to Rayleigh's method for dimensional analysis? (4)

(b) The thrust of a propeller is assumed to depend upon the speed of advance, dynamic viscosity, angular velocity, diameter, mass density, and elasticity of the medium which can be denoted by the speed of sound in the fluid medium. Derive a relation for thrust based on dimensional analysis. (11)

OR

II. (a) Define Weber number and its significance. (4)

(b) A 1:100 model of a ship is tested in a wind tunnel with 30 m/s airflows around it. The model offers a resistance of 60 N. Determine the velocity of a 300 m long ship in seawater and the resistance of the ship in seawater. (11)
(Take the density of air and seawater as 1.24 kg/m^3 and 1030 kg/m^3 respectively. Also. Kinematic viscosity of air and seawater as 0.018 stokes and 0.012 stokes respectively.)

III. A series of radial curved vanes mounted on a wheel which is rotating at 200 r.p.m. having outer and inner radii of the wheel as 500 mm and 250 mm respectively. A 30 m/s water jet makes an angle of 20° with the tangent to the wheel at the inlet and leaves with 5 m/s making 130° to the tangent to the wheel at the outlet. The water is flowing from outward in a radial direction. Then determine: (15)

(i) Inlet and outlet vane angle
(ii) Work done per unit weight of water
(iii) Efficiency of the wheel

OR

IV. A Kaplan turbine produces 24.647 MW power at 39 m head. Let the flow ratio and speed ratio as 0.6 and 2 respectively. The diameter of the boss is equal to 0.35 times the diameter of the runner and the overall efficiency of the turbine is 90%. Then calculate: (15)

(i) Diameter of the turbine.
(ii) Speed of the turbine.
(iii) Specific speed of the turbine.

(P.T.O.)

V. (a) Derive the equation for the specific speed of the turbine. Also, state the significance of specific speed. (4)

(b) A Pelton wheel produces 3 MW power under 300 m head. The overall efficiency of the turbine is 83%. If the specific speed , speed ratio and coefficient of velocity are 16.5, 0.46 and 0.98, then find: (11)

(i) Diameter of the turbine.

(ii) Diameter of the jet.

OR

VI. (a) Define unit power. Also, derive the equation of unit power. (4)

(b) A Pelton wheel is supplied with water under a head of 35 m at the rate of 0.675 m^3/s. The bucket deflects the jet through an angle of 160° and the mean bucket speed is 13 m/s. Calculate: (11)

(i) The power at the runner

(ii) The hydraulic efficiency of the turbine

VII. (a) Explain the usage of air vessels in reciprocating pump. (4)

(b) Find the actual discharge and actual power of a double acting reciprocating pump running at 40 r.p.m., and deliver water to a height of 20 m. The diameter of the piston is 200 mm. The stroke length is twice the diameter of the piston, while the diameter of the piston rod is 10% of the diameter of the piston. The slip of the pump is 4%. (11)

OR

VIII. (a) Explain and illustrate the connection in multistage centrifugal pump to get high discharge. (4)

(b) Find the manometric efficiency of a centrifugal pump that runs at 1000 rpm, and delivers water to a height of 15 m through a 20 cm diameter pipe and 50 m long. The coefficient of friction is 0.02 for the pipes. The vanes are set back at an angle of 30° at the outlet and the outlet impeller width is 50 mm. Also, the tangential velocity of the impeller and relative velocity of water at the outlet are 22 m/s and 4 m/s respectively. (11)

IX. (a) Identify and illustrate a system that can transmit power between driving and driven shaft without any mechanical connection. (7)

(b) Identify and illustrate a fluid system that can raise the level of water without any external power. (8)

OR

X. (a) Explain the experimental setup and procedure to evaluate the forced vortex. (7)

(b) Identify and illustrate a device that can increase the intensity of pressure of water using available hydraulic energy. (8)

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