Q.P. Code: 25343

(3 hours) **Total marks: 80**

N.B.: (1) Question no.1 is compulsory.

(2) Attempt any 3 questions out of the remaining 5 questions.

(3) Assume data wherever necessary and clearly mention the assumptions made.

(4) Draw neat figures as required.

Q1 **Solve any four from the following** **20**

a Explain moment of momentum equation and its practical applications.
b What do you understand by scale effect in models?
c Write a short note on the unit quantities of a turbine.
d What is meant by multistaging of pumps?
e Show that maximum efficiency of propulsion is 50% when the inlet orifices are at right angles to the direction of motion of ship.
f Explain the working principle of hydraulic accumulator.

Q2 a A lawn sprinkler has two nozzles of diameters 3 mm each is connected across a tap of water. The nozzles are at distance of 40 cm and 30 cm from the centre of the tap. The rate of flow of water through the tap is 100 cm^3/s. The nozzles discharge water in the downward directions. Determine the torque required to hold the rotating arm stationary. Also determine the angular speed at which the sprinkler will rotate free. **10**

b. 250 litres/s of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135 degrees, find the magnitude and direction of the resultant force on the bend. The pressure of flowing water is 39.24 N/cm^2. **10**

Q3 a Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends on the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of the fluid medium which can be denoted by the speed of the sound in the medium C. **10**

b A 7.2 m height and 15 m long spillway discharges 94 m^3/s discharge under a head of 2.0 m. If a 1:9 model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experiences a force of 7500 N (764.53 kgf), determine force on the prototype. **10**

TURN OVER

Q4 a A jet propelled boat, moving with a velocity of 5 m/s, draws water amid-ship. The water is discharged through two jets provided at the back of the ship. The diameter of each jet is 150 mm. The total resistance offered to the motion of the boat is 4905 N. Determine (i) Volume of water drawn by the pump per second. (ii) Efficiency of the jet propulsion. **10**

b A jet of water having a velocity of 20 m/s strikes a curved vane, which is moving with a velocity of 10 m/s. The jet makes an angle of 20 degrees with the direction of motion of vanes at inlet and leaves at an angle of 130 degrees to the direction of motion of vanes at outlet. Calculate **10**

(i) Angle of vanes at inlet and outlet so that the water enters and leaves the vane without shock.

(ii) Work done per second/unit weight of water striking the vanes per second.

Q5 a A Pelton wheel is to be designed for the following specifications: **10**
Shaft power = 11,772 kW; Head =380 meters; Speed = 750 r.p.m.; Overall efficiency = 86%; Jet diameter not to exceed one sixth of the wheel diameter. Take K_{v1} = 0.985 and K_{u1} = 0.45.
Determine:

(i) The wheel diameter

(ii) The number of jets required

(iii) Diameter of the jet

b A Kaplan turbine runner is to be designed to develop 9100kW. The net available head is 5.6m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency 86% and the diameter of the boss is 1/3 the diameter of runner. Find the diameter of the runner, its speed and the specific speed of the turbine. **10**

Q6 a A centrifugal pump with 1.2 m diameter runs at 200 r.p.m and pumps 1880 lps, the manometric head being 6 m. The angle which the vanes make at exit with the tangent to the impeller is 26^0 and the radial velocity of flow is 2.5 m/s. Determine the manometric efficiency and the least speed to start pumping against a head of 6 m, the inner diameter of the impeller being 0.6 m. **10**

b Write short notes on **10**

(i) Hydraulic press

(ii) Hydraulic intensifier

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