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***B.Tech. Degree IV Semester Regular/Supplementary Examination
in Marine Engineering June 2024***

19-208-0405 HYDRAULIC MACHINERY

(2019 Scheme)

Time: 3 Hours

Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

- CO1: Understand dimensional analysis and principles of similitude.
 CO2: Apply the momentum principles to impinging jets and analyse the performance of hydraulic turbine.
 CO3: Learn the performance characteristics of various hydraulic turbines, their specific speed and speed control.
 CO4: Understand the working of roto-dynamic pumps and positive displacement pumps.
 CO5: Study the principle of working of hydraulic devices.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate,
 L6 – Create

PI – Programme Indicators

(Answer **ALL** questions)

(5 × 15 = 75)

| | Marks | BL | CO | PI |
|--|-------|----|----|-------|
| I. (a) Write the physical significance of Reynold's number, Froude's number and Euler's number. | 5 | L2 | 1 | 1.2.1 |
| (b) A ship 300 m long moves in sea-water, whose density is 1030 kg/m ³ , A1: 100 model of this ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m ³ . Take the kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively. | 10 | L4 | 1 | 2.1.2 |
| OR | | | | |
| II. (a) Explain the three types of similarities that must exist between the model and the prototype. | 5 | L2 | 1 | 1.2.1 |
| (b) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon 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 sound in the medium C. | 10 | L4 | 1 | 2.1.2 |

(P.T.O.)

BT MRE-IV(R/S)-06-24-3243

| | Marks | BL | CO | PI |
|---|-------|----|----|-------|
| III. (a) Compare impulse and reaction turbines based on any five parameters. | 5 | L2 | 2 | 1.2.1 |
| (b) The following data is given for a Francis Turbine. Net head $H = 60$ m, Speed $N = 700$ rpm., shaft power = 294.3 kW, Overall efficiency = 84%, hydraulic efficiency = 93%, flow ratio = 0.20, breadth ratio $n = 0.1$, Outer diameter of the runner = $2 \times$ inner diameter of runner. The thickness of vanes occupy 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine: (i) Guide blade angle (ii) Runner vane angles at inlet and outlet (iii) Diameters of runner at inlet and outlet (iv) Width of wheel at inlet. | 10 | L4 | 2 | 2.1.2 |
| OR | | | | |
| IV. (a) Write a note on classification of hydraulic turbines. | 5 | L2 | 2 | 1.2.1 |
| (b) A jet of water having a velocity of 15 m/s strikes a curved vane which is moving with a velocity of 5 m/s. The vane is symmetrical and is so shaped that the jet is deflected through 120° . Find the angle of the jet at inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per unit weight of water? Assume the vane to be smooth. | 10 | L4 | 2 | 2.1.2 |
| V. (a) A Pelton turbine develops 3000 kW under a head of 300 m. The overall efficiency of the turbine is 83%. If speed ratio = 0.46, $C_v = 0.98$ and specific speed is 16.5, then find: (i) Diameter of the turbine (ii) Diameter of the jet. | 5 | L3 | 3 | 2.1.2 |
| (b) Derive the equation for specific speed of a turbine. | 10 | L2 | 3 | 2.1.2 |
| OR | | | | |
| VI. (a) With help of simple sketches, briefly explain any two types of draft tubes. | 5 | L2 | 3 | 2.1.2 |
| (b) With help of a diagram, explain the governing of a pelton turbine. | 10 | L2 | 3 | 2.1.2 |

(Continued)

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| | | Marks | BL | CO | PI |
|-----------|---|-------|----|----|-------|
| VII. | (a) A double acting reciprocating pump running at 40 rpm is discharging 1 m^3 of water per minute. The pump has a stroke of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump. | 5 | L3 | 4 | 2.1.2 |
| | (b) With help of line sketches, explain different types of casings used in centrifugal pump. | 10 | L2 | 4 | 2.1.2 |
| OR | | | | | |
| VIII. | (a) Briefly explain cavitation and priming in centrifugal pumps. | 5 | L2 | 4 | 2.1.2 |
| | (b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm. Works against a total 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 an 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) Work done by impeller on water per second (iii) Manometric efficiency. | 10 | L3 | 4 | 2.1.2 |
| IX. | (a) Explain the working of vane pump with the help of a neat figure. | 5 | L2 | 5 | 1.2.1 |
| | (b) Explain the working of hydraulic crane with the help of a neat figure. | 10 | L2 | 5 | 1.2.1 |
| OR | | | | | |
| X. | (a) Compare free vortex and forced vortex. | 5 | L2 | 5 | 1.2.1 |
| | (b) Explain the working of hydraulic lift with the help of a neat figure. | 10 | L2 | 5 | 1.2.1 |

Blooms's Taxonomy Level

L2 – 60%, L3 – 13.33%, L4 – 26.67%.
