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(2063)

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B.Tech 4th Semester Examination

Fluid Machinery

CE-4003

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/ continuation sheet will be issued.

Note : Attempt five questions in all, select one question from each sections A, B, C and D. Section E is compulsory.

SECTION - A

1. A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of jet. The jet is deflected through an angle of 165º. Assuming the plate to be smooth, find (i) force exerted on the plate in the direction of jet (ii) Power of the jet (iii) efficiency of the jet. **(20)**

2. A Pelton wheel is having a mean bucket diameter of 0.8 m and is running at 1000 r.p.m. The net head on the Pelton wheel is 400 m. If the side clearance angle is 15° and discharge through nozzle is 150 litres/s, find: (i) Power available at the nozzle (ii) Hydraulic efficiency of the turbine. **(20)**

SECTION - B

3. The following data is given for a Francis turbine. Net head = 60 m; Speed = 700 r.p.m.; shaft power = 294.3 kW; η_0 = 84%; η_h = 93%; flow ratio –0.20; breadth ratio n = 0.1; outer diameter of the runner = 2x inner diameter of runner. The thickness of vanes occupies 5% of the 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, and

(iv) Width of wheel at inlet. **(20)**

4. (a) Explain the difference between a Kaplan turbine and Propeller turbine. **(10)**

(b) What is draft tube? Explain its functions and different forms. **(10)**

SECTION - C

5. The drag force F on a partially submerged body depends on the relative velocity V between the body and the fluid, characteristic linear dimension 'l', height of surface roughness 'k', fluid density ρ, the viscosity μ and the acceleration due to gravity g. Obtain an expression for the drag force using the Buckingham π theorem. **(20)**

6. (a) Explain different type of hydraulic similarities that must exist between a prototype and its model. **(10)**

(b) Discuss briefly the function, construction and operation of (i) Hydraulic intensifier (ii) Hydraulic crane. **(10)**

SECTION - D

7. A centrifugal pump has the following dimensions: inlet radius = 80 mm; outlet radius = 160 mm; width of impeller at the inlet = 50 mm; β_1 = 0.45 radians; β_2 = 0.25 radians; width of impeller at outlet = 50 mm. Assuming shockless entry determine the discharge and the head developed by the pump when the impeller rotates at 90 radians/second. **(20)**

8. (a) Define slip, percentage slip and negative slip of a reciprocating pump. **(10)**

(b) What is the effect of acceleration of the piston on the velocity and acceleration of the water in the suction and delivery pipes? Obtain an expression for the pressure head due to acceleration in the suction and delivery pipes. **(10)**

SECTION - E

9. Reply the following (tick the right one)

i. Governing of a turbine means

(a) the head is kept constant under all conditions of working

(b) the speed is kept constant under all conditions

(c) the discharge is kept constant under all conditions

(d) the efficiency is maintained constant under all conditions of working

ii. You have to select turbines for a hydropower plant having 150 m head of stored water behind the dam. The water is sandy and load on the power house is highly variable. Which type of turbine would you generally recommend?

(a) Pelton wheel (b) Francis (c) Kaplan (d) Propellar

iii. A turbine develops 9025 kW power under a head of 25 meters at 135 r.p.m. Choose the specific speed of the turbine

(a) 196.2 (b) 205.28 (c) 229.42 (d) 218.65

iv. The use of draft tube in a reaction turbine helps to

(a) increase the flow rate

(b) provide safety to turbine

(c) transport water to downstream without eddies

(d) reconvert residual kinetic energy to pressure energy

v. Regulation of Pelton turbine is done by changing

(a) head available at nozzle

(b) area of nozzle

(c) blade angle

(d) length of nozzle

vi. A Pelton wheel produces 50 kW at the shaft, when available water head across the turbine is 40 m. The energy transferred from water to the runner is 35.0 N-m/N of water. If the mechanical efficiency is 92%, what will be the overall efficiency?

(a) 82% (b) 80.5% (c) 92.6% (d) 85.2%

vii. For same turbine how much will be the discharge (m^3/s) through the turbine?

(a) 0.16 (b) 0.19 (c) 0.22 (d) 0.125

viii. Consider following statements

(i) An impulse turbine is ideal for high head development

(ii) Speed ratio of a reaction turbine is in the range of 0.6 to 0.9

(iii) The specific speed of a Kaplan turbine is in the range of 50 to 150

Of these statements

(a) only (i) is correct

(b) (i) and (ii) are correct

(c) (i) and (iii) are correct

(d) All are correct

ix. The head loss in a pipe running full is dependent on length of pipe, diameter of pipe, velocity of flow, roughness height of pipe walls, density and dynamic viscosity of the fluid. The number of dimensionless parameters that may be formed are

(a) 6 (b) 4 (c) 3 (d) 1

x. The ratio of inertia force to viscous force is known as

(a) Reynolds number

(b) Froude number

(c) Mach number

(d) Euler number **(10×2=20)**