

[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2064)

14663

B. Tech 4th Semester Examination

Fluid Machinery (O.S.)

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. Prove that the force exerted by a jet of water on a fixed semi-circular plate in the direction of the jet when jet strikes at the centre of the semi-circular plate is two times the force exerted by the jet on an fixed vertical plate. (20)
2. A Pelton wheel produces 44 kW at the shaft when available water head across the turbine is 40 m. The energy transferred from the water to the runner is 35.0 N-m/N of water. If the mechanical efficiency is 94 %, determine the overall efficiency and the discharge through the turbine. (20)

SECTION - B

3. Define and explain hydraulic efficiency, mechanical efficiency and overall efficiency of a Francis turbine. How would you carry out the governing of a Francis turbine? (20)
4. A Kaplan turbine working under a head of 29 m develops 1287.5 kW shaft power. If the speed ratio is equal to 2.1, flow ratio = 0.62, diameter of boss = 0.34 times the diameter of runner and overall efficiency of turbine = 89%, find the diameter of the runner and the speed of the turbine. (20)

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SECTION - C

5. State Buckingham's π -theorem. What are repeating variables? How the repeating variables are selected for dimensional analysis? Discuss the procedure to carry out the dimensional analysis using Buckingham's π -theorem. (20)
6. The ratio of the lengths of a submarine and its model is 30:1. The speed of submarine (Prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag (resistance) between the model and its prototype. Take the value of kinematic viscosities for sea water and air as 0.012 stokes and 0.016 stokes respectively. The density for sea water and air is given as 1030 kg/m³ and 1.24 kg/m³ respectively. (20)

SECTION - D

7. (a) What do you mean by pump characteristics? Briefly explain the uses of such characteristics. (10)
- (b) With a neat sketch, explain the principle and working of a centrifugal pump. (10)
8. Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. Find an expression for the work done per second in case of single acting reciprocating pump. (20)

SECTION - E

9. Reply the following (tick the right one) (10×2=20)
- (i) Pelton turbines are mostly
- | | |
|----------------|-------------------|
| (a) horizontal | (b) inclined |
| (c) vertical | (d) none of above |

- (ii) Turbines give best performance (i.e. work at peak efficiency) when they are operated at full or design load. The performance of many turbines deteriorates considerably at part load. Which of the following turbines is best suited for operation at part loads?
- (a) Pelton turbine (b) Francis turbine
(c) Propeller turbine (d) Kaplan turbine
- (iii) The power which appears in the expression for specific speed is:
- (a) the water horse power (b) the horse power developed by the runner
(c) the shaft horse power (d) the power input to the turbine
- (iv) Cavitation in the turbine causes:
- (a) Low efficiency (b) blade surface is damaged
(c) vibration and noise (d) all of these
- (v) The scale ratio for acceleration according to Froude model law is
- (a) g_r (b) $L_r^{1/2} g_r^{1/2}$
(c) $\mu_r \rho_r^{-1} L_r^{-1}$ (d) $L_r g_r$
- (vi) The scale ratio in a model of a spillway is 1:100. If the discharge in the prototype is 2000m³/sec, the discharge in the model is
- (a) 20m³/sec (b) 2m³/sec
(c) 0.2m³/sec (d) 0.02m³/sec

[P.T.O.]

- (vii) A Francis turbine of 0.8 m dia operating under a head of 9m and running at 240 rpm develops 84.5 kW by consuming water at rate of $1.2 \text{ m}^3/\text{s}$. If same turbine is operated under a head of 16 m, its new speed (rpm) will be
- (a) 285 (b) 320
(c) 345 (d) 402
- (viii) For same data the new discharge (m^3/s) will be
- (a) 1.3 (b) 1.8
(c) 1.6 (d) 1.72
- (ix) For same data what will be the new power (kW) developed
- (a) 198.6 (b) 210.62
(c) 177.3 (d) 200.28
- (x) The full load point of a turbine corresponds to a point of
- (a) Maximum efficiency
(b) Best speed
(c) Maximum efficiency under best speed
(d) Normal speed under maximum efficiency.