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B. E. (Mechanical Engineering)
Fifth Semester
MEC-506: Fluid Machinery

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following:-

a) Differentiate between Impulse Turbine and Reaction Turbine

b) What is the significance of Thoma's Cavitation number for water turbines?

c) What is the function of Gear Pump

d) What is the function of spear and deflector in a Pelton turbine

e) What is the basis of selection of a turbine at a particular place?

f) What does an Indicator diagram represents.

g) Why draft tube is used in a Reaction Turbine?

h) Define Slip for reciprocating pump.

i) What are the uses of air-vessels

j) Where do we use Hydraulic Ram (10x1)

UNIT – I

II. Describe with the help of neat sketches the governing mechanism of Pelton wheel. Show that in a Pelton wheel where the buckets deflect the water through (180 -θ), the hydraulic efficiency of the wheel is given by $\eta_h = \frac{2k_v^2(v-u)(1+\cos\theta)u}{v^2}$ where u is the velocity of the wheel at the pitch radius. V *is* the velocity of jet and K_v is the coefficient of velocity. Proceed further to establish that best bucket speed for maximum efficiency is equal to one-half of the jet velocity. (10)

III. The following data is given for a Francis Turbine. Net Head = 60 m. Speed = 700 rpm, Shaft power = 294.3 kW. Overall efficiency = 84%, Hydraulic efficiency = 93%, flow ratio = 0.20, breadth ratio = 0.1, outer diameter of the runner is two times the inner diameter of runner. The thicknesses of vanes occupy 5% of circumferential area of runner. The velocity of flow is constant at inlet and outlet and discharge is radial at outlet.
Determine:

a) Guide Blade angle
b) Runner vane angles at inlet and outlet
c) Diameters of runner at inlet and outlet
d) Width of wheel at inlet. (10)

IV. The Following data pertains to the Kaplan Turbine:

Power available at shaft = 22,500 kW, Head = 20 m, speed = 150 rpm, Hydraulic efficiency = 95 %, Overall efficiency = 88 %, Outer diameter of runner = 4.5 m, diameter of the hub = 2 m. Assume that the turbine discharges without whirl at exit, determine the runner vane angles at the hub and at the outer periphery. (10)

P-T-O

UNIT – II

V. The cylinder bore diameter of a single reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lifts water through a height of 25 m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and theoretical power requires to run the pump. If the actual discharge is 4.2 litre/sec, find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke. (10)

VI. Discuss the influence of Exit Blade angle on the performance and efficiency of a centrifugal pump. Assume radial flow at entrance.

A centrifugal pump running at 1200 rpm delivers oil of specific gravity 0.85 at the rate of 80 Litre/s. The internal and external diameter of the impeller are 200 mm and 400 mm respectively. The blades are curved backwards at an angle of 35°. Assume, the velocity of flow is constant at 2 m/s and the overall efficiency is 0.85. Calculate the (i) Brake power and the torque applied to the pump shaft (ii) blade angle at inlet. Also Draw Inlet and Outlet Velocity Triangle. Assume there are no fluid frictional losses in the blade passage and no shock losses at the entrance to the impeller. (3,7)

VII. a) Explain the construction, working of Hydraulic Intensifier with the help of a neat and clean diagram.

b) State Buckingham's theorem. What do you mean by repeated and non-repeated variable? Also discuss that how repeated variables are selected in dimensional analysis. (6,4)

x-x-x