(10)

Name of the Program: B. Sc. in Mechanical Engineering/B.Sc. TE
Semester:6th (Summer)

Date: 28 May, 2024

Time: 10:00 am – 01:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination
Course Number: ME 4611
Course Title: Fluid Machinery

Summer Semester : 2022 - 2023
Full Marks: 150
Time : 3.0 Hours

There are **06 (Six)** questions. Answer **all** questions. The symbols have their usual meanings.

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1. Explain Specific speed of a centrifugal pump and derive an expression for the same. **(25) CO4, PO3**

A two stage centrifugal pump is designed to discharge 55 l/s at a head of 70 m. If the overall efficiency is 76% and specific speed per stage about 38, Calculate-

a. the running speed in rpm and
b. the power required to run pump.

If the actual manometric head developed is 65% of the theoretical head, assuming no slip, the outlet angle of the blades 28^0, and radial velocity at exit 0.14 times the impeller tip speed at exit, determine the required diameter of the impeller for given condition.

2. An inward flow Francis turbine, having an overall efficiency of 86%, hydraulic efficiency of 90%, and radial velocity of flow at inlet $0.28\sqrt{(2gH)}$. The turbine is required to develop 5000kW when operating under a net head of 30 m, specific speed is 270, assume guide vane angle 30^0, find **(25) CO3, PO4**

a. rpm of the wheel,
b. the diameter and the width of the runner at inlet, and
c. the theoretical inlet angle of the runner vanes.

3. A single jet Pelton wheel turbine runs at 305 rpm against a head of 515 m. The jet diameter is 200 mm, its deflection inside the bucket is 165^0 and its relative velocity is reduced by 12% due to friction. Find **(25) CO3, PO4**

(1) the waterpower,
(2) resultant force on the bucket,
(3) shaft power if the mechanical losses are 4% of power supplied, and
(4) overall efficiency. Assume necessary data.

4. A 1:10 scale model of a Kaplan turbine working under a head of 5 m. The prototype develops 8500 kW at 150 rpm under a head of 10 m. The overall efficiency of prototype is 86%. Calculate required speed and discharge for the model. Also obtain the specific speed of the turbine. **(25) CO3, PO4**

5. a. Find a mathematical expression for acceleration pressure head for reciprocating pump. **(12+13) CO2, PO2**

   b. The bore and stroke of a single acting reciprocating pump are 140 mm and 280 mm, respectively. The pump lifts water against a total head of 26 m at 60 rpm. If the actual discharge is 4.0 l/s, find the theoretical discharge, theoretical power required to dive the pump and the percentage of slip. Also determine the acceleration head at the beginning and middle of the delivery stroke. The delivery pipe is 110 mm diameter and 25 m long.

6. Show that the Euler-pump equation can be written as **(25) CO2, PO2**

$$E = \frac{1}{2g}\{(V_2^2 - V_1^2) + (U_2^2 - U_1^2) + (V_{r1}^2 - V_{r2}^2)\}$$

Where the notations have their usual meaning. Also explain each of the three parts of this equation

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