B.Sc Engg. (IPE)/5th Sem   Friday, 15 December, 2023

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination   Winter Semester: A.Y. 2022-2023
Course No.: ME 4555   Time: 3.0 Hours
Course Title: *Fluid Mechanics and Machinery*   Full Marks: 150

There are **06 (Six)** Questions. Answer all of them. Marks in the margin indicate full marks. Do not write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

---

1. (a) Why priming is important in pump?   [15]
                                                                            [CO1]

   (b) Discuss about the indicator diagram.   [PO1]

   (c) Discuss the significance of Darcy Weisbach Equation.

2. (a) Deduce the principles of Obstruction flowmeters and Pitot static   [15]
       tube. Write down the constructions, advantages and limitations of   [CO2]
       Venturimeter in the application of Fluid Mechanics.   [PO2]

   (b) Classify the types of pumps. Explain the construction and working   [15]
       principle of centrifugal and single acting positive displacement   [CO2]
       pump.   [PO2]

   (c) Classify the types of turbine. Explain the construction and working [15]
       principle of Pelton wheel and Kaplan turbine.   [CO2]
                                                                            [PO2]

3. (a) Consider a steady, laminar, incompressible flow of fluid with   [20]
       constant properties in the fully developed region of a straight   [CO3]
       circular pipe. By applying a momentum balance to a differential   [PO3]
       volume element, obtain the velocity profile by solving it and prove
       that the average velocity in fully developed laminar pipe flow is
       one half of the maximum velocity.

   (b) Design the best hydraulic cross section, hydraulic radius for the   [25]
       best cross section, best trapezoid angle considering liquid flow in   [CO3]
       an open channel of trapezoidal cross section of bottom width b,   [PO3]
       flow depth y, and trapezoid angle θ measured from the horizontal.

4. A 50-cm x 30-cm x 20-cm block as shown in Fig. 1 weighing 150 . N is to be moved at a constant velocity of 0.8 m/s on an inclined surface with a friction coefficient of 0.27. (a) Determine the force F that needs to be applied in the horizontal direction. (b) If a 0.4 mm-thick oil film with a dynamic viscosity of 0.012 Pa.s is applied between the block and inclined surface, calculate the percent reduction in the required force. **[15]** **[CO4]** **[PO4]**
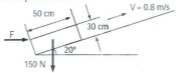

Figure 1

5. Water at 15°C is drained from a large reservoir using two horizontal plastic pipes connected in series as shown in Fig. 2. The first pipe is 20 m long and has a 10 cm diameter, while the second pipe is 35 m long and has a 4 cm diameter. The water level in the reservoir is 18 m above the centerline of the pipe. The pipe entrance is sharp-edged, and the contraction between the two pipes is sudden. Neglecting the effect of the kinetic energy correction factor, determine the discharge rate of water from the reservoir. **[15]** **[CO4]** **[PO4]**
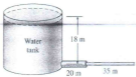

Figure 2

6. Pebbles dropped successively at the same point, into a water channel flow of depth (for case (i) 42 cm and for case (ii) 65 cm), create two circular ripples, as in Fig. 3. From this information, estimate (a) the Froude number and (b) the stream velocity for the two cases. **[15]** **[CO4]** **[PO4]**
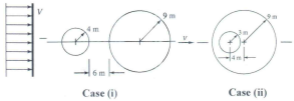

Figure 3