

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

Mid-Semester Examination
Course Number: IPE 4607
Course Title: Control Engineering and Industrial Automation

Summer Semester: 2022 - 2023
Full Marks: 75
Time: 1.5 Hours

There are 3 (THREE) questions. Answer 3 (THREE) questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in brackets. A formula sheet is provided at the end of this question paper. Show all steps and calculations.

1. a) A control system exists in abundance all around us. Select one example of a control system and elaborate on the control system that is present. Include a sketch of the system block diagram to assist your description. (15 Marks) (CO 1) (PO 1)
- b) The closed-loop control approach offers significant benefits over open-loop control. Discuss the benefits of closed-loop control using one example of your choice. (10 Marks) (CO 1) (PO 1)
2. a) A rotational system is combined with a translational system using a rack and pinion mechanism as shown in Figure 1. This mechanism converts a rotational movement to a translational movement that displaces the mass, M. Solve for the transfer function of $X(s)/T(s)$. (10 Marks) (CO 2) (PO 2)

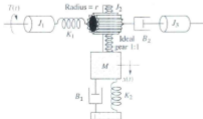


Figure 1: Rotational system combined with a translational system

- b) Determine the transfer function for the system below with the following specifications.
 - i. Find the transfer function of $\theta_2(s)/T_1(s)$ for the following Figure 2.

Given: $J_1 = 1 \text{ kgm}^2$, $J_2 = 1 \text{ kgm}^2$, $B_1 = 1 \text{ Nms/rad}$, $B_2 = 1 \text{ Nms/rad}$, $K_2 = 25 \text{ Nm/rad}$, $N_1 = 25$, $N_2 = 50$

(7 Marks)
(CO 2)
(PO 2)



Figure 2: Rotational modeling system

- ii. Find the transfer function, $G(s) = X_2(s)/T_1(s)$ for the following Figure 3.

(8 Marks)
(CO 2)
(PO 2)

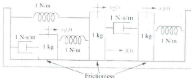


Figure 3: Translational modeling system

3. a) An electrical circuit is shown in Figure 4. Solve for the transfer function $V_2(s)/V_1(s)$ of the following circuit.

(15 Marks)
(CO 2)
(PO 2)

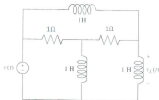


Figure 4: An electrical circuit with three-loop

- b) Determine the transfer function $V_o(s)/V_i(s)$ of the following circuit as shown in Figure 5.

(10 Marks)
(CO 2)
(PO 2)

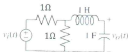


Figure 5: An electrical circuit with two-loop