



Vellore – 632014, Tamil Nadu, India
SCHOOL OF ELECTRICAL ENGINEERING
FALL SEMESTER 2023-2024
CAT-I

SLOT: G2 + TG2

Programme Name & Branch : B.Tech (EEE, EIE) Course Code: BEEE303L
Course Name : Control Systems
Faculty Members : Dr. V. Bagyaveereswaran Class Number(s): 2936, 2938
Dr. E. VinodhKumar
Date of the Examination : 16 – 09 – 2023

Duration : 90 minutes

Max. Marks : 50

General instruction(s): Answer all the questions

- | Q. No | Question | Marks |
|-------|--|-------|
| 1. | A high-precision positioning slide is shown in Figure 1. Determine the transfer function $X_p(s)/X_m(s)$ when the drive shaft friction is $b_d = 0.7$, the drive shaft spring constant is $k_d = 2$, $m_c = 1$, and the sliding friction is $b_s = 0.8$. | [10] |

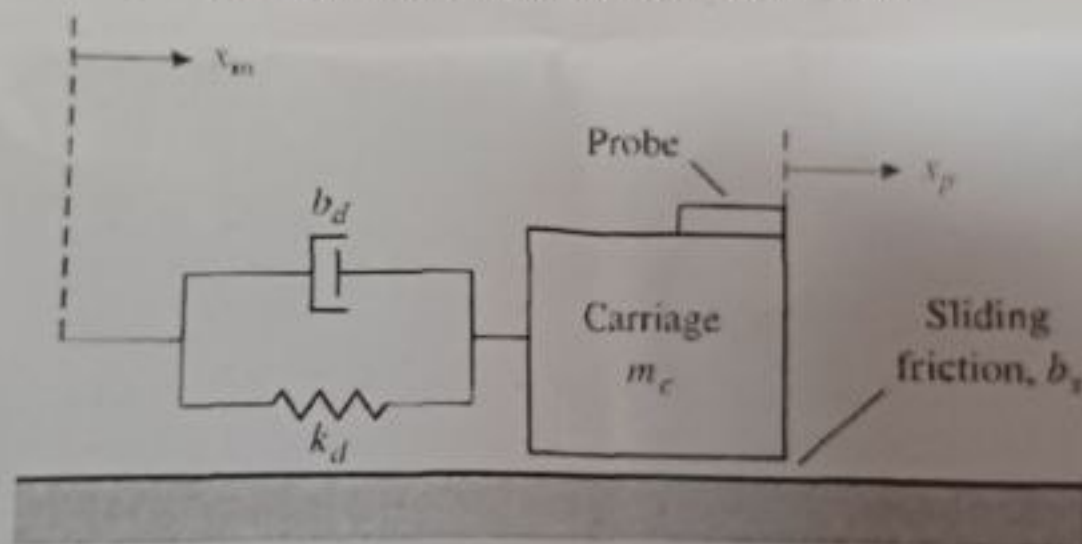


Figure 1

- | | | |
|----|--|------|
| 2. | Write the differential equations governing the rotational mechanical system shown in Figure 2. Also draw the torque-voltage and torque-current analogous circuits. | [10] |
|----|--|------|

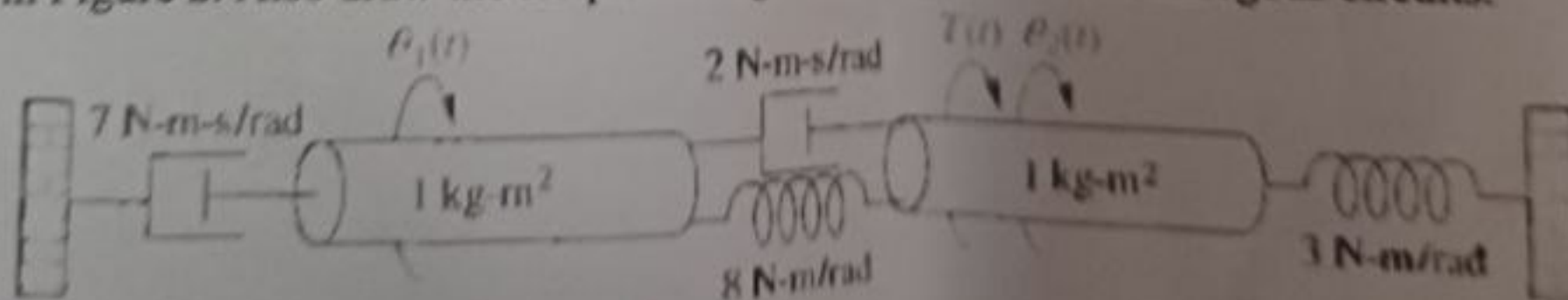


Figure 2

- | | | |
|----|--|------|
| 3. | A control engineer, N. Minorsky, designed an innovative ship steering system in the 1930s for the U.S. Navy. The system is represented by the block diagram shown in Figure 3, where $Y(s)$ is the ship's course, $R(s)$ is the desired course, and $A(s)$ is the rudder angle. Find the transfer function $Y(s)/R(s)$. | [10] |
|----|--|------|



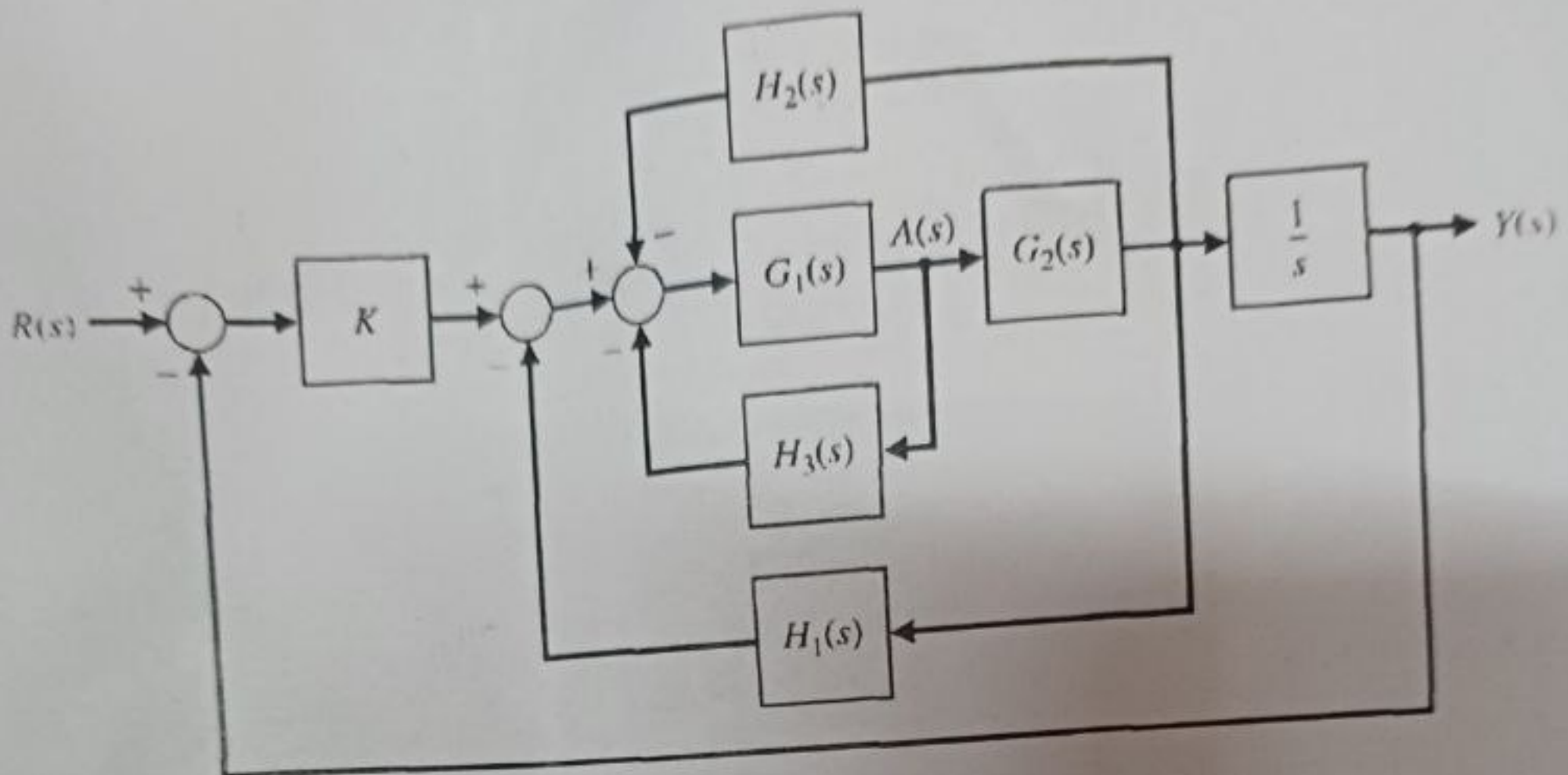


Figure 3

4. Determine the closed-loop transfer function $T(s) = X_5(s)/X_1(s)$ for the system of Figure 4. [10]

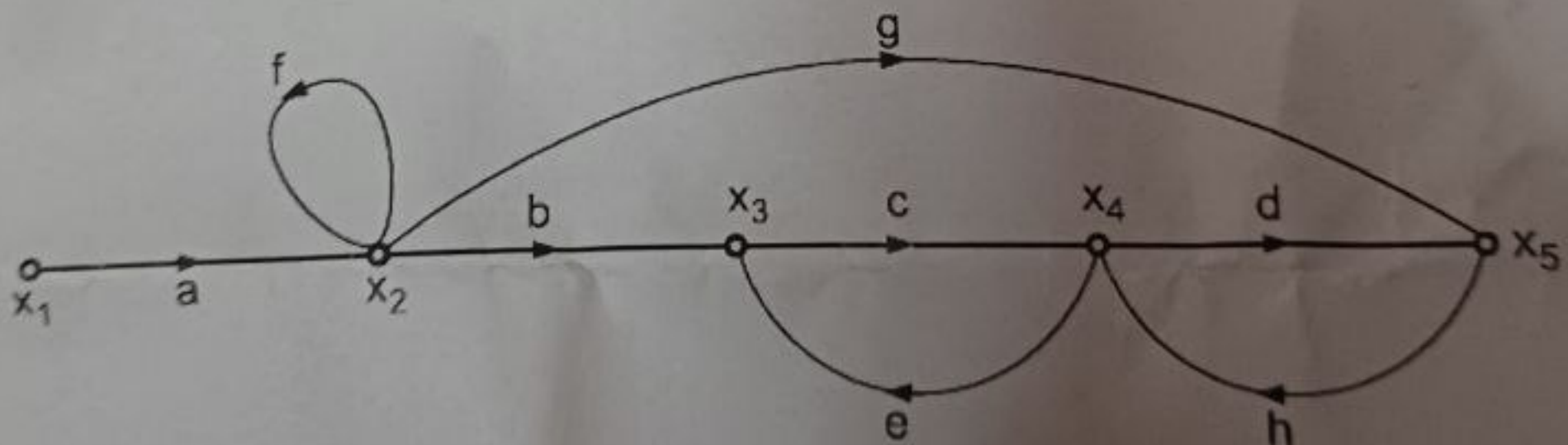


Figure 4

5. A unity feedback system is characterized by an open loop transfer function $G(s) = K/(s(s+10))$. Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K , determine settling time, peak overshoot and time to peak overshoot for a unit step input. [10]

