School of Engineering

Beng Aerospace / Avionics Technology

STUDENT NAME:

STUDENT ID. NO.:

COURSE NAME : 308EAC Control & Instrumentation

BATCH: BEng AE/AV SEP 21

ISSUE DATE:

SUBMISSION DATE:5/12/2021

ASSIGNMENT COVER SHEET

OUTCOMES (Please tick the relevant outcomes)	
	Define and identify the essential components of a range of control systems and apply the concepts of open and closed loop control as well as feedforward and feedback control system design
	Assess the operation of a range of actuators, instrumentation sensors and transducers in current use for a range of applications and select appropriate devices for the measurement of a range of physical variables.
X	Determine measures of performance and the parameters of systems from response data and specify the performance criteria required for control systems
X	Implement the operation of the industry standard three term PID controller and evaluate its performance
X	Design and create simulations of continuous systems using appropriate computer packages (e.g. MATLAB or SIMULINK) and appreciate the configuration and application of data acquisition software

RESULT

Submission requirement:		OVERALL
1	Signed cover sheet	
2	Assignment report	
3	PowerPoint Presentation	
4	Soft / Hard copy of turnitin report	

Assesors feedback:

I certify that the work contained within this assignment is all my own work and referenced where required.

Student Signature: Date:

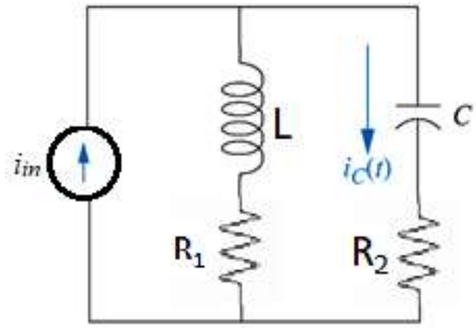
Feedback Received:
Student Signature:

Date:

Assessors Name: Dr. Mohammad Alakhras Signature Date:

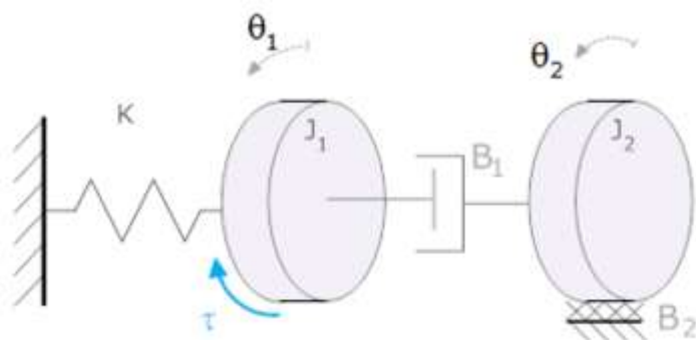
Control and Instrumentation

Q1. Find the transfer function, $G(s)=I_c(s)/I_{in}(s)$ for each network shown in the figures below.



Q2. Find the transfer function $G(s) = \theta 2\,(s)/T\,(s)$, for the rotational mechanical system shown

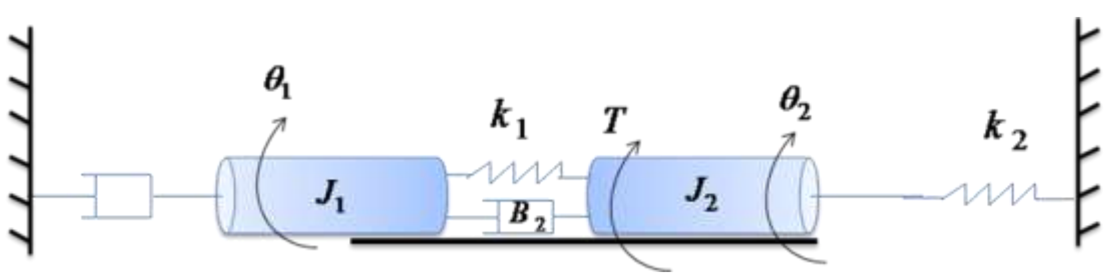
J_1=1 kg.m^2 J_2=2 kg.m^2 B_1=1 N.m.s/rad B_2=2 N.m.s/rad K=1 N.m/rad



Q3. The figure below shows a rotational mechanical system. Find:

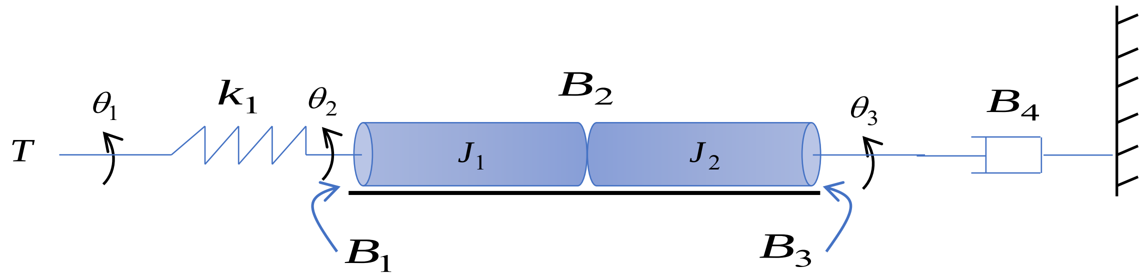
1. The transfer function $G(s) = \theta_2(s)/T\,(s)$,
2. The time response $\theta_2(t)$ When the $T(s)$ is a step function

J_1= 2 kg-m^2 J_2 = 1 kg-m^2 B_1=2 N-m-s/rad B_2=3 N-m-s/rad K_1=2 N-m/rad K_2= 3 N-m/rad

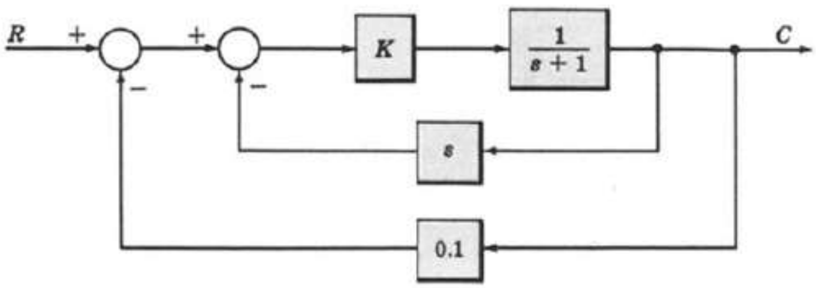


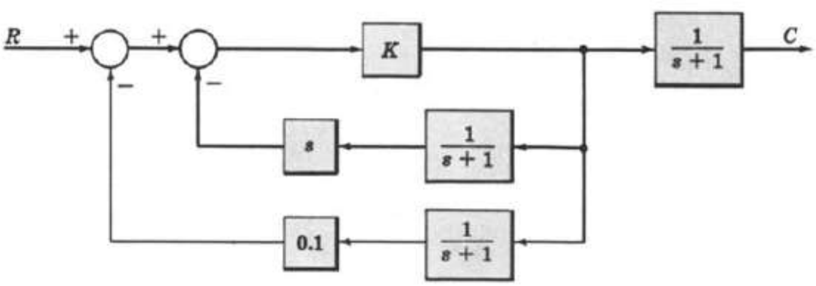
Q.4 Find the transfer function $G(s)=\theta_2(s)/T(s)$ for the rotational mechanical system shown below

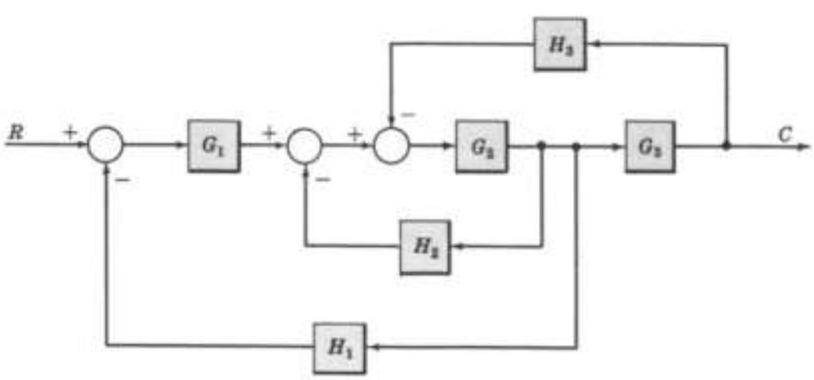
$J_1 = 1$ kg-m^2 $J_2 = 2$ kg-m^2 $B_1=2$ N-m-s/rad $B_2=3$ N-m-s/rad $B_3=2$ N-m-s/rad $B_4=1$ N-m-s/rad $K_1=2$ N-m/rad



Q.5 For each of the following systems, derive an equation relating the inputs with the output:





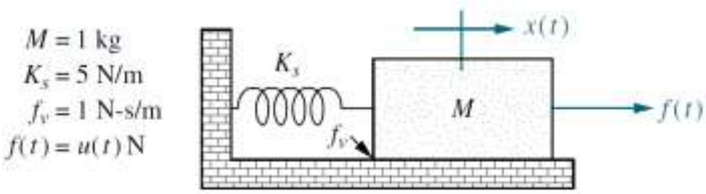


Q.6 - For each of the transfer functions find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on).

$$T(s) = \frac{10(s+7)}{(s+10)(s+20)}$$

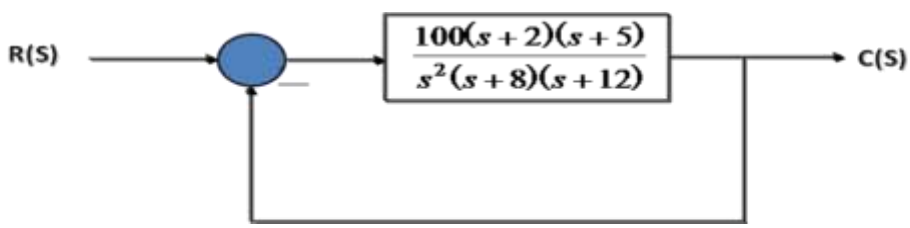
$$T(s) = \frac{20}{s^2 + 6s + 144}$$

Q.7 - Solve for x(t) in the system shown in Figure 5 if f(t) is a unit step.

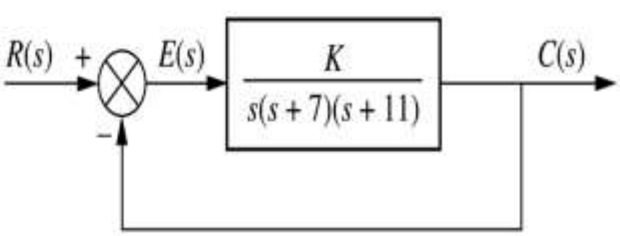


Figur 5

Q.8- For the system shown in figure below, evaluate the static error constants and find the expected steady state errors for the standard step, ramp and parabolic inputs.



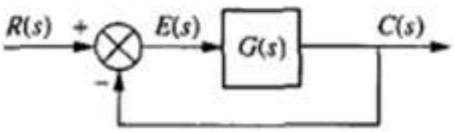
Q.9- Find the range of gain, K, for the shown system that will cause closed-loop system to be stable, unstable, and marginally stable



Q.10- For the system shown in Figure 5 with

$$G(s) = \frac{K(s+5)}{(s+3)(s-3)}$$

Find the range of gain, K, which will cause the system to be stable.



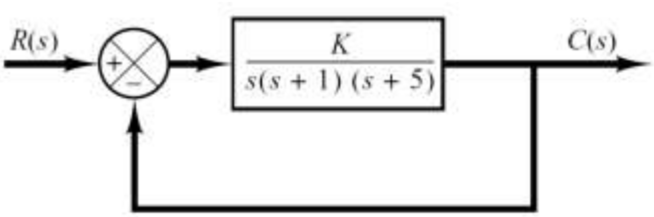
Q.11- Draw the Root Locus of the following systems. Find the points of intersection with the real and imaginary axis.

$$G(s)H(s) = \frac{K(s+1)}{s(s-2)}$$

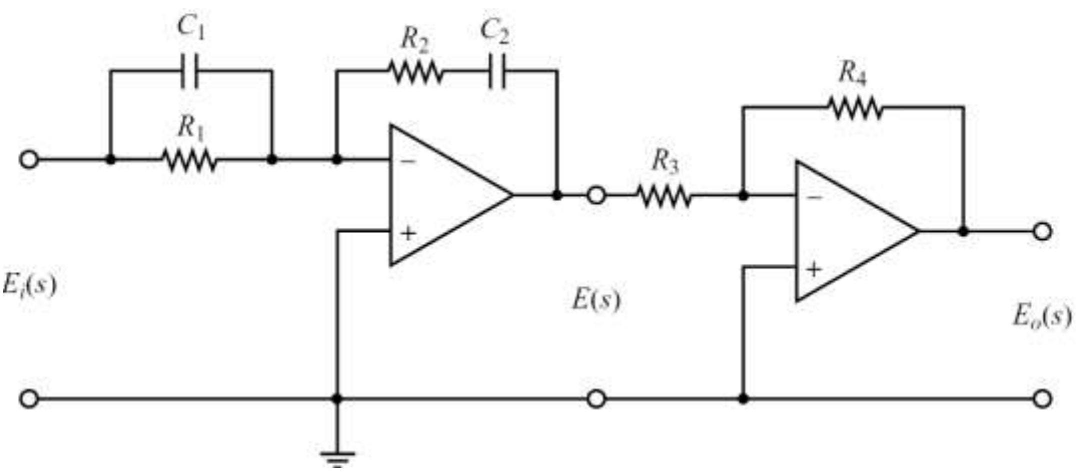
$$G(s)H(s) = \frac{K}{(s+3)(s-3)}$$

$$G(s)H(s) = \frac{K}{s^2+2s+8}$$

$$G(s)H(s) = \frac{K(s+3)}{(s+2)(s-3)}$$



Q.12- Find the transfer function of the following electronic circuit. If this circuit is to be used as a PID controller, what will be the equations of Kp, Ki, and Kd in terms of the resistors and capacitors



Q.13- Given the following mechanical system

J_1= 2 kg-m^2 B=6 N-m-s/rad K_1=1 N-m/rad K_2= 3 N-m/rad

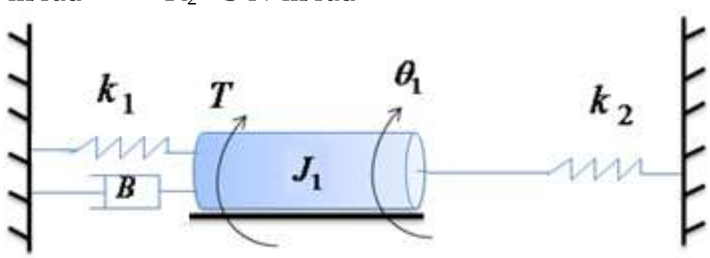


Figure 1

Using Matlab show how each of the PID controller parameters Kp, Ki, and Kd contribute to obtaining a common goal of :

a. Fast rise time
b. Minimum over shoot
c. Zero steady state error

Draw the step response without controller
Draw the closed loop response with proportion controller only
Draw the closed loop response with proportion and Integral controller only
Draw the closed loop response with proportion and derivative controller only
Draw the closed loop response with PID controller after tuning