LEAD CITY UNIVERSITY, IBADAN
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
SEMESTER/SESSION: 1ST SEMESTER, 2024/2025

Course Particulars
Course Code: EEE 302
Coarse Title Control Theory I
Course Units: 3
Course Status: Core

Lecturer's Details
Name: Adesina Olusegun Bola
Qualifications: B.Sc (Electronics and Computer Engineering), M.Sc (Control and Instrumentation Engineering), PhD (In view), Registered Engr. (COREN)
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Areas of Specialization
Control and Instrumentation, System Modeling and Simulation, Embedded Systems Design

Course Learning Outcomes:
At the end of the course, the students should be able to:
- Understand the fundamental concepts of control system engineering
- Use mathematical technique to formulate and solve control problems
- Appreciate issues of robustness, optimality, architecture and uncertainty in control problems
- Identity practical challenges in posing control problems

This course will expose engineering students to:

- Mathematical Modeling of physical systems;
- Laplace Transformation method of system modelling;
- Open loop and closed loop control;
- Feedback control system;
- Signal low graph and block diagram of control systems;
- Control system stability.

Lecture Delivery Method

- Lectures with interactive sessions.
- Solutions to example problems

Course Modules
- Module 1: Introduction to Control Engineering

- Module 2: Modeling of Control Systems
- Module 3: Design and Analysis of Control System
- Module 4: Control System Stability

LECTURE PLAN

WEEK	TOPIC
Module 1: Introduction to Control Engineering	
Week 1	Introduction to Control Systems
Week 2	Types of Control Systems
Week 3	Feedback Control Systems
Module 2: Modeling of Control systems	
Week 4	Differential Equation
Week 5	Laplace Transformation
Week 6	Transfer Function
Week 7	Continuous Assessment/Test
Module 3: Design and Analysis of Control System	
Week 8	Modeling of Electrical System
Week 9	Modeling of Mechanical System
Week 10	Block Diagram of Control System
Week 11	Signal Flow Graph
Module 4: Control System Stability	
Week 12	Routh-Hurwitz criterion
Week 13	Frequency and time domain design techniques
Week 14-15	Revision

Grading/Assessment

Attendance	-	10 marks
Assignment/Term paper	-	10 marks
Mid-semester Test	-	20 marks
Examination	-	60 marks

References

1. Katsuhiko Ogata; 2010; Modern Control Engineering, *Fifth Edition, Prentice Hall*
2. Derek Atherton; 2009; Control Engineering, Ventus Publishing

EEE 302 Tutorial Questions

Q1)

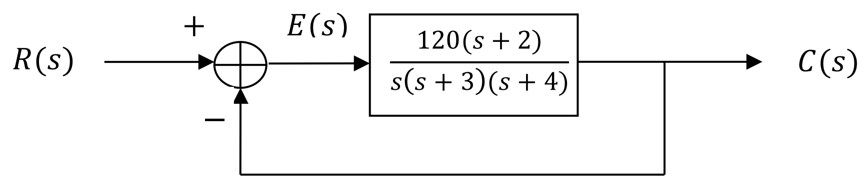
Find the time domain response of the system with the transfer function given below when exited by a unit impulse?

$$G(s) = \frac{4}{s^2(s+1)(s+2)}$$

15marks

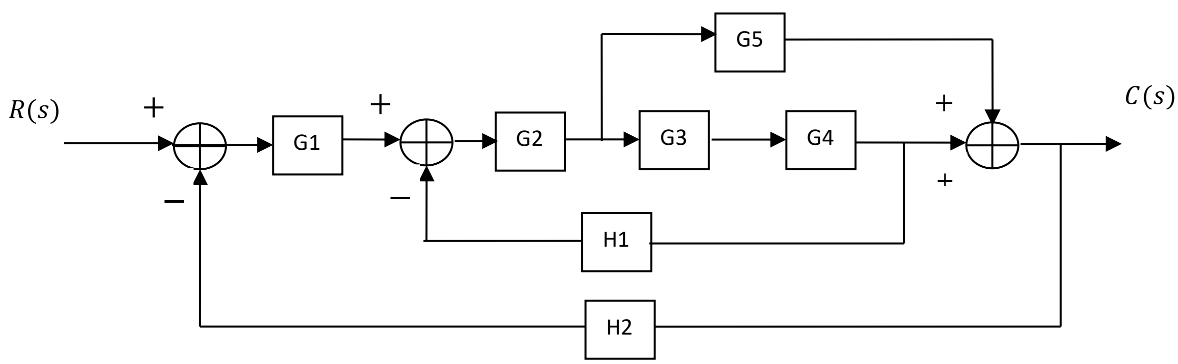
Q2)

Using the final value theorem, find the steady state error of the system depicted by the block diagram below for the inputs (i) $r(t) = 4u(t)$ (ii) $r(t) = t^2u(t)$ (iii) $r(t) = 12tu(t)$



15marks

Q3)
Using block diagram reduction method, find the transfer function of the system below?



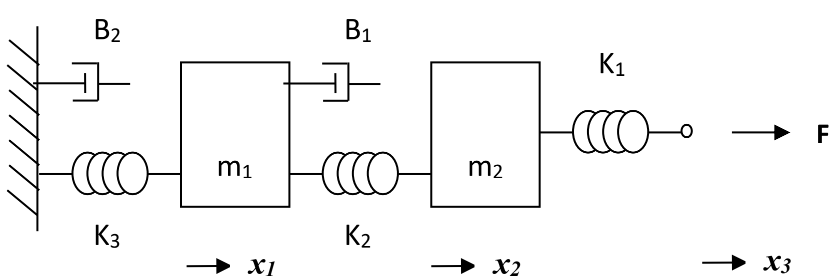
15marks

Q4)
Determine the range of values for control parameter k required for the stability of the system with given characteristic equation:

$$s^3 + 8s^2 + 2s + 4k = 0$$

15marks

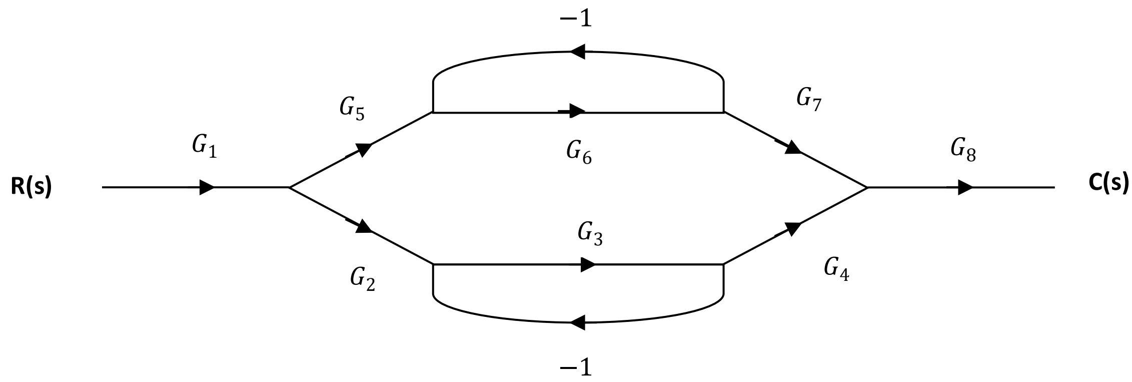
Q5)
Construct the mathematical model for the mechanical mass-spring-damper system shown below. Given that mass $m_1 = m_2 = 1$; damping constant $B_1 = B_2 = 1$; and spring constant $K_1 = K_2 = 2$.



15marks

Q6)

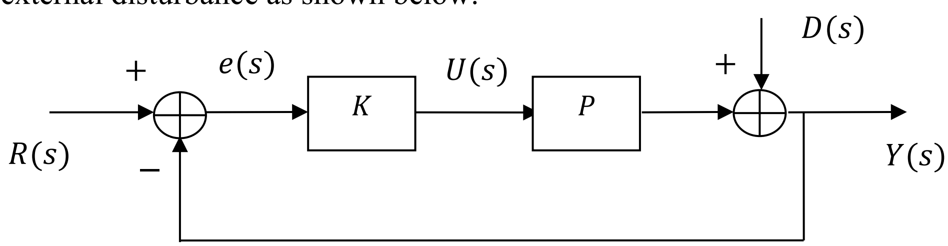
Find the transfer function of the system represented by the signal flow graph below?



15marks

Q7)

Given a feedback control system with R as reference input, U as control input, Y as measured output and D as external disturbance as shown below.



i) Show that the measure output, Y(s) is given by:

$$Y(s) = \frac{PK}{1 + PK} R(s) + \frac{1}{1 + PK} D(s)$$

ii) Explain the effects of the parameter K on the reference input R(s) and disturbance D(s)

15marks

Q8

A control system with the given transfer function is excited by a unit impulse, find the time response?

$$G(s) = \frac{1}{s(s + 1)}$$

15marks

Q9

a) Define Mason's Gain Formula?
b) Obtain the transfer function (C/R) of the system whose signal flow graph is shown in Fig.Q9b.

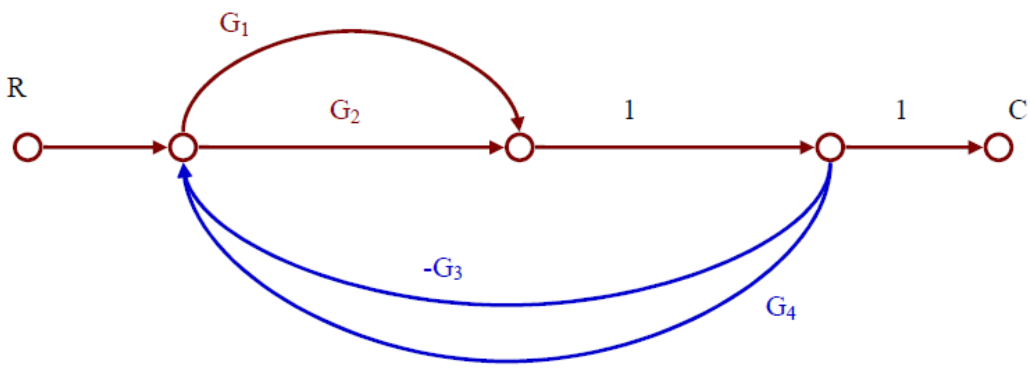


Fig.Q9.

15marks

Q10

Obtain the transfer function of C(s)/R(s) of the system whose signal flow graph is shown in Fig. Q10.

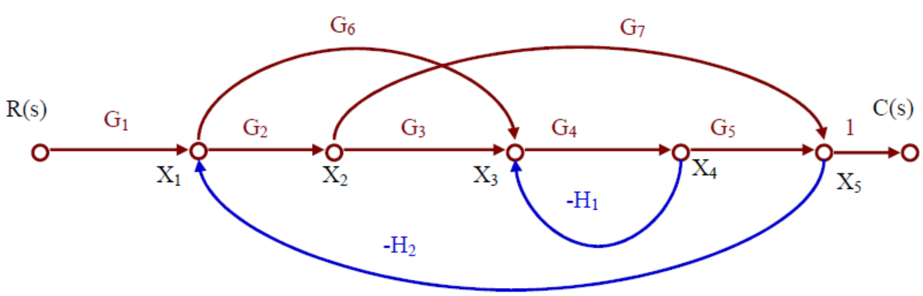


Fig. Q10.

15marks

Q11

Develop the transfer function representation of the RCL circuit shown.

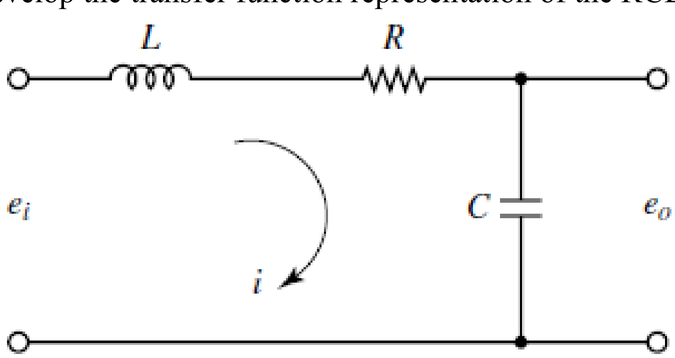


Fig Q11

15marks

Q12

Develop the transfer function representation of the RC circuit shown in Fig Q12.

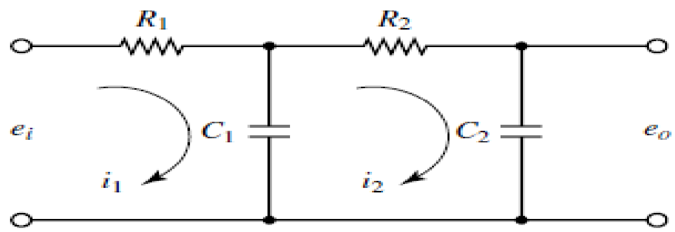
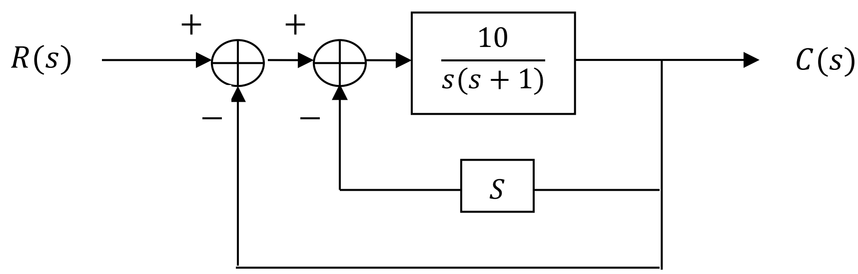


Fig Q12

15marks

Q13

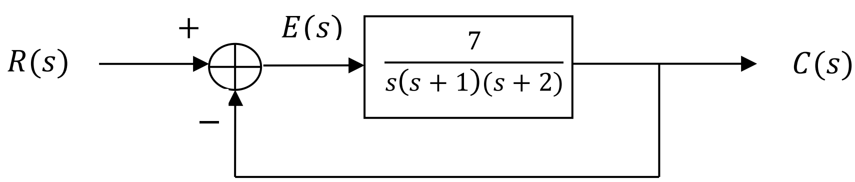
Find the transfer function of the system below?



15marks

Q14)

Determine if the system below is stable or not?



15marks

Q15

Show that the sensitivity S, of the system below is given by:

$$S = \frac{1}{1 + G(s)H(s)}$$