TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

Department of Electrical and Electronic Engineering

UNIVERSITY EXAMINATION FOR:

Diploma in Electrical Power Engineering

ECI 2205: Control systems 1

END OF SEMESTER EXAMINATION

SERIES: JULY 2025

TIME: 2 HOURS

DATE: APRIL 2025

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Attempt question **ONE (COMPULSORY)** any other **TWO** Questions.

Do not write on the question paper.

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1. (a) Explain the following terms as used in Control System.
   i. Controller
   ii. Process
   iii. Control system
   iv. Disturbance. (8 marks)

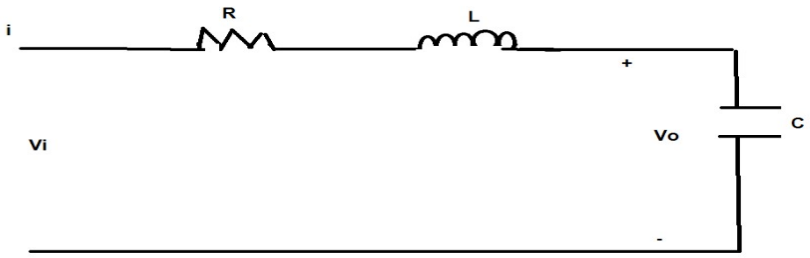
   (b) State and explain any **FOUR** areas where control systems find applications in industries. (8 marks)

   (c) Differentiate between time-variant and time-invariant control systems. (4 marks)

2. (a) (i) Explain the term system modelling.

   (ii) Figure 1 shows an RLC series Network.

Fig. 1

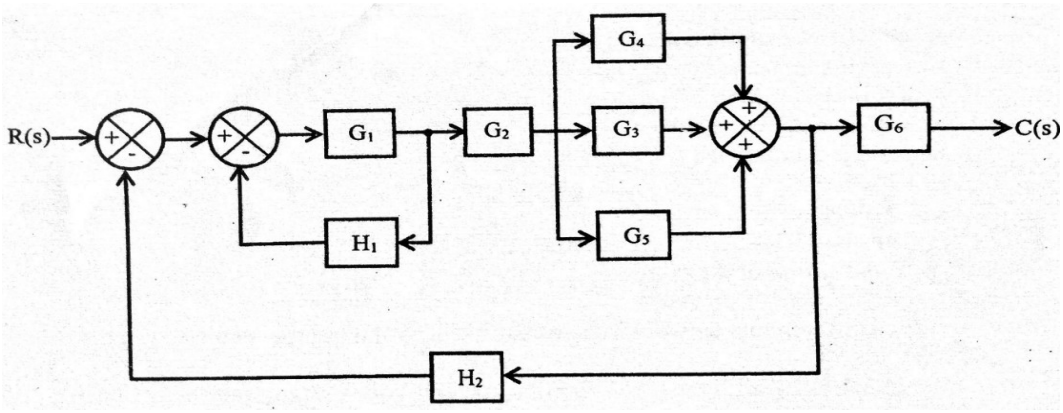


i. Determine the differential equation of the system.

ii. Find the transfer function of the electrical system. (12 marks)

(b) **Figure 2** shows a block diagram of a control system

Fig. 2



By using block diagram reduction techniques, determine the transfer function of the system. (8 marks)

3. (a) (i) Distinguish between positive and negative feedback with respect to control systems

(ii) With aid of a block diagram, show that the transfer function of a negative feedback is given by;

$$\frac{C(s)}{R(S)}=\frac{G(S)}{1+G(S)H(S)}$$ (12 marks)

(b) Explain any **FOUR** differences between open loop and closed loop control systems. (8 marks)

4. (a) (i) Explain the term steady state response

(ii) A second order control system is subjected to a unit-step input. Draw its response curve, hence

define each of the following;

i. Peak overshoot
ii. Rise time
iii. Delay time
iv. Peak time. (10 marks)

(b) The open loop transfer function of a control system is given as;

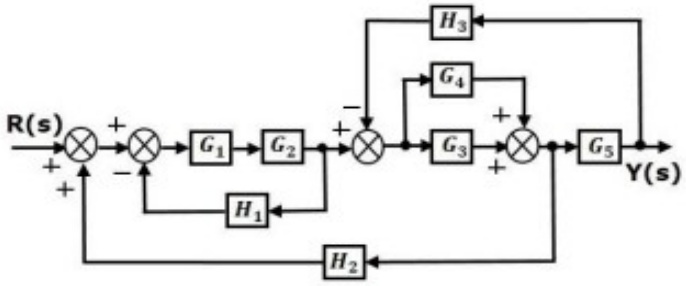
$$G(s)=\frac{2s}{(s+1)(s+2)}$$

Expand the equation of Laplace transform in terms of its partial fractions and obtain its time-domain response. (10 marks)

5. (a) Explain the following with respect to signal flow graphs.
   i. loop
   ii. Source node
   iii. Sink node
   iv. Forward path (4 marks)

(b) The figure below shows a block diagram of a control system.

Fig. 3



i. Convert the block diagram to its equivalent signal flow graph.
ii. Use Masons gain formular to obtain the transfer function of the control system. (16 marks)