



# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

**THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE DIPLOMA IN  
ELECTRICAL AND ELECTRONIC ENGINEERING**

SEE 1302 – CONTROL ENGINEERING I

DURATION: 2 HOURS

DATE: 24<sup>TH</sup> APRIL, 2018

TIME: 9.00 – 11.00 A.M.

### **Instructions to Candidates:**

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

## SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

### QUESTION ONE

a) Define the following terms:

i. Control system

ii. Disturbances

(4 marks)

b) Explain any two advantages and two disadvantages of a closed loop system.

(4 marks)

c) i. Define the transfer function of a system

ii. Highlight the procedure of determining the transfer function of a control system. (6 marks)

d) Using Routh Hurwitz Criterion, ascertain stability for each of the systems represented by the following characteristics equations

i.  $4S^4+8S^3+5S^2+5S+2=0$

ii.  $S^6+3S^5+5S^4+9S^3+8S^2+6S+4=0$

(5 marks)

e) With the aid of diagrams, explain the meaning of the following terms when applied to response of a control system.

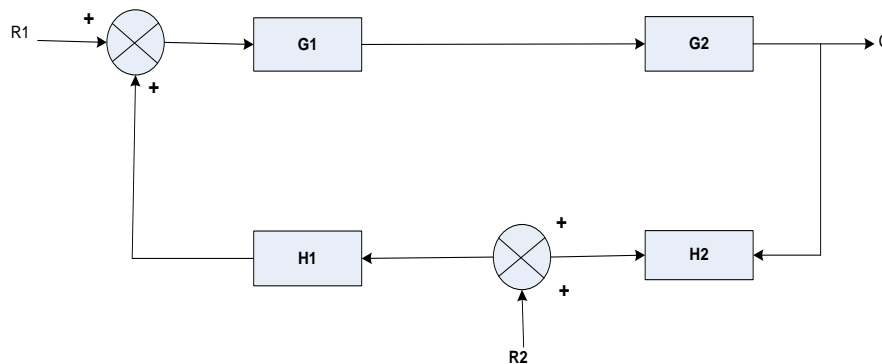
i. Peak overshoot

ii. Rise time

iii. Settling time

(5 marks)

f) Derive the expression for the output C, of the multiple-input control system shown in the figure below



(6marks)

## SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

### QUESTION TWO

- a) Explain the Routh Hurwitz stability criterion (2 marks)
- b) Explain for Routh Hurwitz criterion any two limitations and their remedies (6 marks)
- c) An open loop transfer function of a unity feed back is given by

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

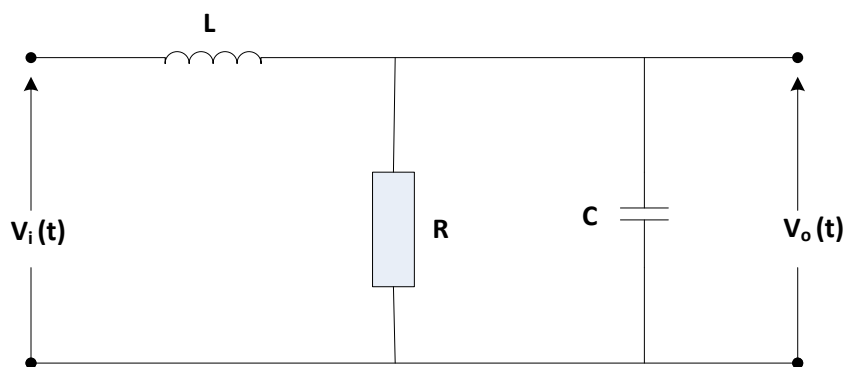
Determine

- i. The characteristic equation
- ii. The range of K for which the system remains stable using Routh Hurwitz Criterion.

(12 marks)

### QUESTION THREE

- a) With the aid of a diagram describe the following standard test signals.
- i. Ramp input
- ii. Parabolic input (4 marks)
- b) Determine the transfer function of the network shown in the following figure



(6marks)

c) A second order position control system has a damping ratio of 0.5 and undamped natural frequency of 6 rad/sec, determine

- i. Output response as a function of time
- ii. Percentage peak overshoot
- iii. Settling time

(10 marks)

#### QUESTION FOUR

a) State the Mason's gain formula with respect to signal flow graphs (2 marks)

b) With the help of a diagram describe the 'superposition' theorem as applied to multiple input control systems. (4 marks)

c) For the block diagram figure 2;

- i. Draw its signal flow graph (2 marks)
- ii. Determine the control ratio by block diagram algebra technique (7 marks)
- iii. Determine the overall output by Mason's gain formula (5 marks)

