MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SUPPLEMENTARY EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

SUPPLEMENTARY EXAMINATION

EEE 303: CONTROL 1

DATE: 30/8/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer Question One Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) State any ONE advantages of open loop systems. (3 marks)

b) A unity feedback system has an open loop transfer function:

$$G_{(s)} = \frac{K}{S^4+2S^3+6S^2+10S}$$

(i) Determine the characteristic equation of the system.

(ii) Use Routh array to determine the range of values of K for which the system is stable.

(iii) Given K=5, determine the oscillating frequency. (8 marks)

c) Obtain transfer function of the network in fig1. (10 marks)

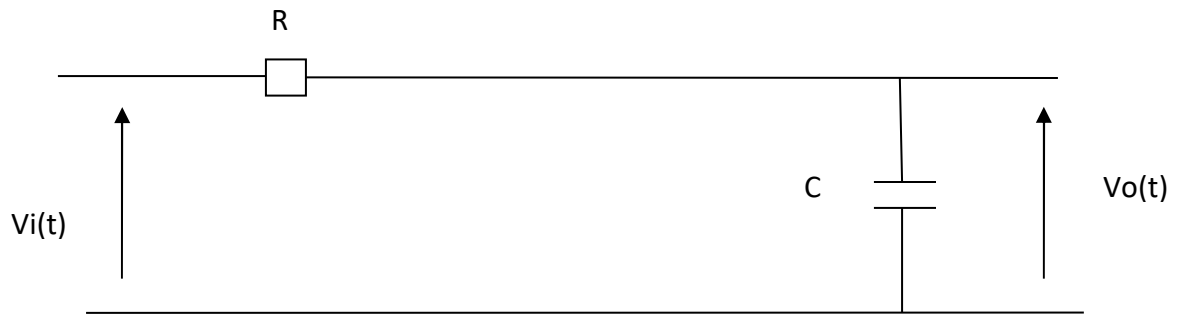


Fig. 1

d) A second order system is represented by the differential equation:
$G_{c(s)} = \frac{8}{2S^2+4S+8}$. For the system determine:
(i) Natural frequency.
(ii) Damping factor.
(iii) Damped frequency

(9 marks)

QUESTION TWO (20 MARKS)

a) Define the following terms with reference to signal flow graphs:
(i) Loop gain
(ii) Input node.
(iii) Loop (6 marks)

b) For the network in fig.2 derive the transfer function and hence show that it is a second order system. (8 marks)

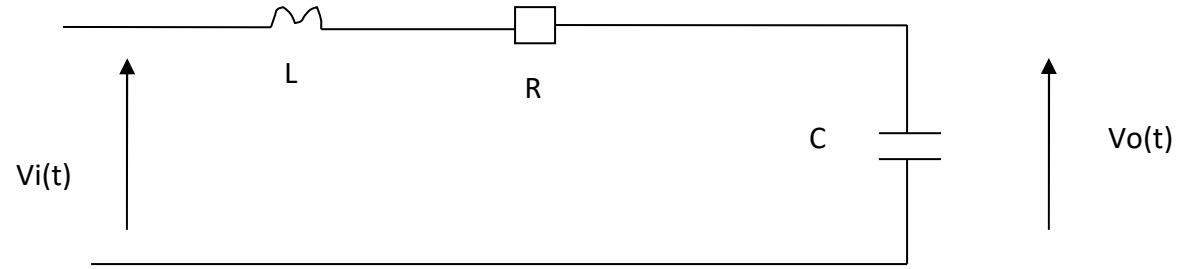


Fig. 2

c) Define the following terms for a second order system.
i) Maximum overshoot
ii) Rise Time
iii) Peak overshoot time (6 marks)

QUESTION THREE (20 MARKS)

a) With aid of diagrammatical representation briefly describe any THREE standard test signals. (6 marks)

b) Using block diagram reduction techniques to derive the transfer function of the block diagram in fig.3. (8 marks)

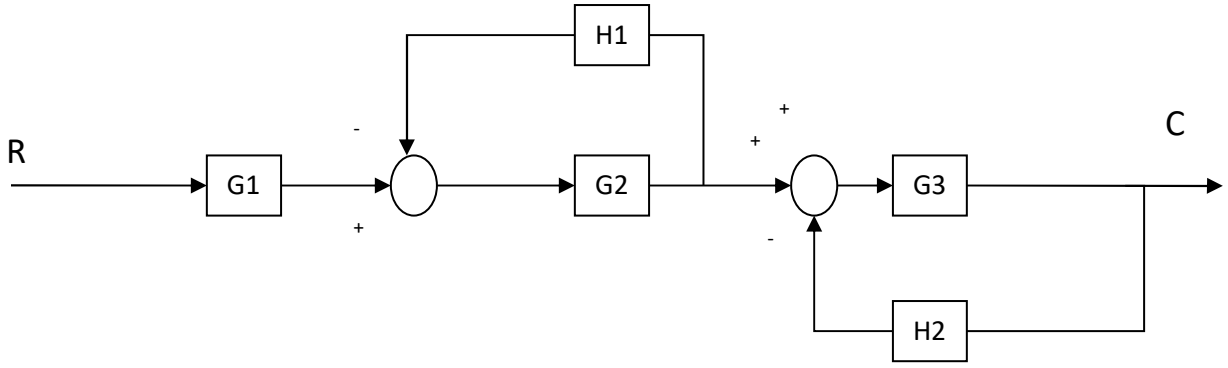


Fig.3

c) A system has a transfer function:

$$G_{(s)} = \frac{40}{S(1+0.05S)(1+0.005S)}$$

Draw the Bode plots and hence determine the phase and gain margins. (6 marks)

QUESTION FOUR (20 MARKS)

a) State Nyquist stability criteria. (3 marks)

b) A system open loop transfer function is given by:

$G_{(S)}H_{(s)} = \frac{120}{S(S+2)(S+10)}$

(i) Calculate the phase cross over frequency and gain margin.

(ii) Sketch the Nyquist plot. (8 marks)

c) The Open loop frequency response of a control system is given by:

ω(rad/sec)	0.1	0.5	1	1.5	2.5	3.5	4.5	5.5
GH(dB)	34	19.7	12.6	7.8	0.7	-4.72	-9	-12.7
Phase(^{o})	94	109	127	140	160	174	184	192

Use Nichols chart to determine:

(i) Gain margin

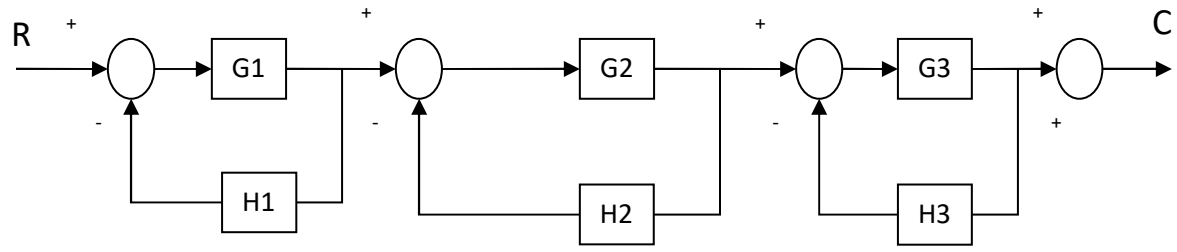
(ii) Phase margin

(iii) Whether the system is stable or unstable. (9 marks)

QUESTION FIVE (20 MARKS)

a) Define the term transfer function. (3 marks)

b) Convert the block diagram below into a signal flow graph. (10 marks)



c) From the signal flow diagram obtained above, use Mason's rule to determine the transfer function. (7 marks)