



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

EED 302: CONTROL SYSTEMS III

DATE: 23/10/2020

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and any Other Two Questions

QUESTION ONE (30 MARKS)

A negative unit feed back system has an open loop transfer function of

$$\frac{k}{s^4 + 6s^3 + 11s^2 + 6s}$$

- Determine the characteristic equation of the system
- Use the routh array to determine the range of values of K for which the system is stable.
- Determine the value of K that will produce self oscillations in the system.
- For (iii) above, determine the oscillating frequency of the system. (10 marks)
- state any 3 advantages of using bode diagram over nyquist diagrams in analysing stability of a system. (6 marks)
- with an aid of a diagram, explain the operation of process control system and state the function of a system (10 marks)
with respect to the nyquist polar plot, define the following
 - gain cross over frequency
 - phase cross over frequency (4 marks)

QUESTION TWO (20 MARKS)

The open loop response of servo mechanism is given below

ω radians/sec	1	2	3	4	5
Gain margin	13	4	-2	-7	-10
Phase angle	-127	-152	-168	-180	-188

Draw a nichols chart and determine

- gain margin
- phase margin
- band width
- phase cross over frequency
- gain cross over frequency

QUESTION THREE (20 MARKS)

the open loop transfer function of a system is given by

$$\frac{6}{(s+1)(s+2)(s+5)}$$

Draw a nyquist diagram and hence determine the phase and gain margin. Deduce from this values whether the system is stable or not.

QUESTION FOUR (20 MARKS)

The forward path transfer function of a unity feed back control system is given below. Plot a bode plot and hence determine the gain and phase margins of the system.

$$G(s) = \frac{1.43}{s(1+0.5s)(1+0.01s)}$$

QUESTION FIVE (20 MARKS)

- With an aid of a diagram of a control system, define the following terms
 - Overshoot
 - Delay time
 - Settling time
 - Rise time
 - Time constant (10 marks)
- With the aid of a diagram, explain how a digital computer functions as a process controller for multiple digital and analogue control. (10 marks)