



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

EED302: CONTROL SYSTEMS

DATE: 20/01/2021

TIME: 2.00-4.00 PM

INSTRUCTIONS

Answer Question One and any Other Two Questions

QUESTION ONE (30 MARKS)

- a) Explain two special cases that occurs while using routh stability creiterion (4 marks)
- b) for the systems characteristic equition below, find the values of k for stability.
 $S^4 + S^3 + KS^2 + S + 1 = 0$ (10 marks)
- c) state any 3 advantages of using bode diagram over nyquist diagrams in analysing stability of a system. (6 marks)

the transfer function of a control element is given by

$$\frac{k}{s^3 + 4s^2 + 11s + 10}$$

this element is connected to a unity feedback circuit.calculate the minimum value of k that makes the system becomes unstable. (10 marks)

QUESTION TWO (20 MARKS)

- a) the open loop response of servo mechanism is given below

$\dot{\omega}$ 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

- i. Gain margin
- ii. Phase margin
- iii. Band width
- iv. Phase cross over frequency
- v. gain cross over frequency

QUESTION THREE (20 MARKS)

A feed back control system has an open loop transfer function

$$G(s) = \frac{50}{s(1 + 0.1s)(1 + 0.5s)}$$

Draw a nyquist diagram and hence determine the phase and gain margin. Deduce from this values whether the system is stable or not. (20 marks)

QUESTION FOUR (20 MARKS)

The forwad 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)

- a) A second order system is described by the differential equation ; $1.5d''+3d'+6=0$.determine the persentage overshoot of the responce and the time taken to reach this overshoot when the system is subjected to a unit step input. (10 marks)
- b) With an aid of a diagram,of a control system,define the following terms
 - i. Overshoot
 - ii. Delay time
 - iii. Settling time
 - iv. Rise time
 - v. Time constant (10 marks)