



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

EED 313: CONTROL SYSTEMS III

DATE: 20/01/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and any Other Two Questions

QUESTION ONE (30 MARKS)

- a) State the three linear elements that are used in system simulation in analogue computation (6 marks)
- b) Give any two advantages of closed loop diagrams (4 marks)
- c) With the aid of a diagram, derive the expression of the output voltage of a three input summing amplifier. (7 marks)
- d) State three components used to solve differential equations as applied to analogue controllers. (3 marks)
- e) Give five effects of a phase lead network and five effects of a phase lag networks in a circuit. (10 marks)

QUESTION TWO (20 MARKS)

Obtain an analogue computer flow diagram to solve the following second order simultaneous differential equations.

$$Y' = x + 8$$

$$X' = y' + 3$$

QUESTION THREE (20 MARKS)

Given the following differential equations, obtain a computer flow diagram that will solve them.

$$X'' + 3y'' + 4x' + 14x = 2$$

$$Y'' + 5x'' + 3y' + 7x' + 12y = 0$$

QUESTION FOUR (20 MARKS)

Design a phase lead network system whose transfer function is given by

$$G(s) = 20$$

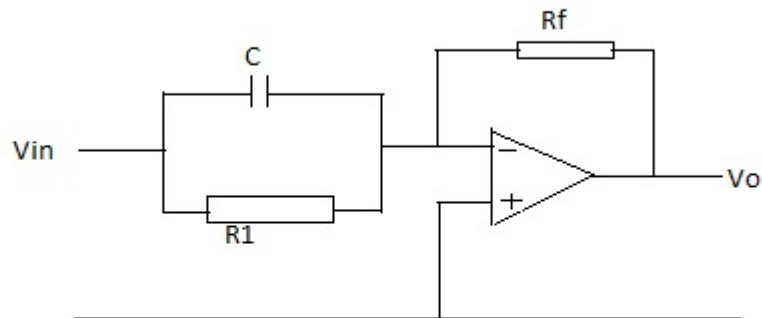
$$S(1+0.2s)^2 \text{ for phase margin of at least } 45^\circ$$

Compensating details are

$\dot{\omega}(\text{rad/sec})$	1	2	3	4	5	10	20
angle	-112	-136	-152	-167	-180	-217	-242

QUESTION FIVE (20 MARKS)

Figure below shows an analogue electronic process controller.



State what type of the controller it is and derive the equation of its output voltage.