MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

THIRD YEAR **SECOND** SEMESTER EXAMINATION FOR, DIPLOMA IN AUTOMOTIVE/PLANT ENGINEERING

SEE 1308 - CONTROL ENGINEERING II

DURATION: 2 HOURS

DATE: 11/12/2018

TIME: 2.00 – 4.00 P.M.

Instructions to candidates:

1. Answer question One 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 (30 MARKS)

a. Explain the following terms as used in control engineering:

   i. Gain margin

   ii. Phase margin

   iii. Stability

b.

   i. Highlight any TWO advantages of Bode plot over Nyguist Stability criteria (2 Marks)

   ii. Using diagrams describe Nyquist Stability criterion (6 Marks)

c. Explain with the aid of a diagram how a digital computer may be used to control a process (6 Marks)

d.

   i. Explain the need for compensation in control systems (2 Marks)

   ii. In a test on a servomechanism, the open-loop response in the following table was obtained

W (Rad/s)	0.05	0.1	0.3	0.5	1	2	3	5	10	20
Gain (dB)	36	30	21	17	10	0	-8	-20	-39	-57
Phase angle (Ø)	-94	-98	-110	-120	-145	-186	-208	-230	-250	-260

Plot the response on a Bode diagram and determine;

   i. The phase margin

   ii. The gain margin

   iii. Whether the system is stable or not giving reasons (8 Marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a. Highlight any TWO differences between analogue and digital computers (2 Marks)

b. Explain why it is an advantage in some application to use a controller which gives;

   i. Integral action

   ii. Integral and derivative action, in addition to proportional control action (6 Marks)

c. The open loop transfer function of a control system is given by;

$$G(jw) = \frac{5}{JW\ (1+015jw)(1+01jw)}$$

i. Draw the Nichol's chart over the frequency range of $1 \leq w \leq 5$ rad/sec

ii. Determine phase margin an gain margin

iii. Is the system stable or unstable? (12 Marks)

QUESTION THREE (20 MARKS)

a. Distinguish between two position control and floating control (4 Marks)

b. Explain how a frequency response test is carried out and how the data obtained can be used to assess the stability of a control system (4 Marks)

c. A feedback control system has an open loop transfer function;

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

Prepare the Nyguist diagram and hence determine the phase and gain margins. Deduce from these values whether the system is stable, stating the reasons for your answer (12 Marks)

QUESTION FOUR (20 MARKS)

a. Explain the following terms as used in process control;

i. Analogue signal

ii. Digital signal

iii. Dead time (6 Marks)

b. A plant is controlled by digital inputs from FOUR sensors A, B, C and D. It produces an output F, when;

i. The output of sensor A is present and output from sensor B is absent

ii. The output of sensor B is present and either of sensors C or D is present. Otherwise, no output. Assume sensor output present = 1, plant output present = 1, otherwise sensor absent = 0, and plant output absent = 0

For the plant;

i. Obtain the truth table of the digital computer

ii. Obtain logic expression of the controller output

iii. Draw the logic circuit diagram for the controller (14 Marks)