THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

EEC 2304

CONTROL SYSTEM II

SEMESTER EXAMINATION

SERIES: FEBRUARY 2011 SERIES

TIME: 2 HOURS

Instructions to Candidates:

1. You are required to have the following for this examination;
   - Answer booklet
   - 3 graph papers
   - A non-programmable calculator

2. Answer Question **ONE (COMPULSORY)** and any other **TWO** Questions.

3. Maximum marks for each question are shown.

(COMPULSORY)

Question ONE

a) Figure below shows a unity feedback system with a forward transfer function $G_{(S)}$

Let M and N be the closed loop magnitude and argument at any frequency. Show that lines can be drawn in a complex plane of constant magnitude M having

$Radius = \frac{m}{m^2 - 1}$ and Centers $\frac{m^2}{m^2 - 1}, 0$ (12marks)

b) For the system shown in figure, determine the range of K for stability. (8 marks)

c) The pole zero configuration of a closed loop transfer function is as shown in the figure below. Determine:

i) the transfer function
ii) magnitude (db) when w = 5.
iii) phase in degrees when w = 10 (10marks)

(ANSWER ANY OTHER TWO QUESTIONS)

Question TWO

a) i) Sketch a Nyqvst diagram and define the following:
- I) Gain margin
- II) Phase margin
- III) Gain cross-over frequency
- IV) Phase cross-over frequency (6 marks)

b) For the control system with transfer function

$$G_{(S)}\,H_{(S)} = \frac{(4s+1)}{S^2(1+S)(1+2S))}$$

Apply Nyqvist stability criterion to ascertain its stability. (14marks)

Question THREE

A system has an open loop transfer function:

$$G_{(S)}\,H_{(S)} = \frac{k}{S(S+3)(s^2+2S+2))}$$

a) Obtain the number of separate root line

b) Determine the:
- i) Asumptotic angles
- ii) Centroid
- iii) Breakaway point and point where plot cuts imaginary axis flence. Sketch the root lows plot for the system. (20marks)

Question FOUR

a) i) State any THREE advantages of Bode plots over Nygvist plots.
- ii) Determine the transfer function of the Bode plot shown in figure. (11marks)

b) On the same plane plot the magnitude plot and phase plot of the system and use it to determine.
- i) Gain crossover frequency.
- ii) Phase margin (9 marks)

Question FIVE

The open loop transfer function of a unity feedback system is

$$G_{(S)} = \frac{24}{S(S+2)(S+6)}$$

Using the Nicholas chart method obtain values for:

i) Peak magnitude M_{pf}

ii) Gain margin

iii) Phase margin

Range $0.1 < 10 < 5.0$ (20marks)