THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DIPLOMA IN TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING
2ND YEAR/2ND SEMESTER EXAMINATIONS

INSTITUTIONAL-BASED PROGRAMME

EEC 2204: CONTROL SYSTEMS II

SERIES: JULY 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non programmable calculator*

Answer question **ONE** and any other **TWO** questions

This paper consists of **THREE** printed pages

Question 1 (Compulsory)

a) The open loop transfer function of a unity feedback control system is give by

$$G(S) = \frac{K}{(S+2)(S+4)(S^2+6S+25)}$$

Using Rooth Hurwitz stability, determine

i) Range of values of K for stability to occur
ii) Values of K which will cause sustained oscillations in the closed loop.
iii) The corresponding oscillation frequency (13 marks)

b) From first principles derive the equation for a;
i) Constant M circle showing co-ordinates of centre and radius
ii) Constant N circle showing co-ordinates of centre and radius (10 marks)

c) (i) With the aid of a sketch explain the Nyguist stability outerion
(ii) With reference to Nyguist Polco plot define the following

I. Gain margin
II. Phase margin (7 marks)

Question 2

A unity feedback system has an open loop transfer function

$$G_{(S)} = \frac{K(S+2)}{(S+1)^2}$$

Determine

i) Position and number of open loop poles (n) an open loop zeros (m)
ii) Number of separate root loci and asymptotes
iii) Assymptots angles
iv) The centroid
v) Breakaway points
Hence sketch the root lows plot for system (20 marks)

Question 3

a) Explain
i) The Rooth Hurwith stability oriterion
ii) The two unique or special cases that are encountered when using the method in axis and how this special cases are dealt with (11 marks)

b) Using Rooth Hurwitz oriterion evaluate stability for system represented by characteristic equation shown

$S^S + S^4 + 25^3 + 25^2 + 3S + 5 = 0$ (9 marks)

Question 4

a) State any **TWO** advantages of Nichol's chart over the Nyguist diagram(2 marks)

b) The results from Table 1 were obtained from an open-loop frequency response test on an automatic control system

W(rad/s	2	4	6	8	10	15	19
Gain (dB)	13.3	5.8	0.5	-3.7	-7.2	-13.9	-18
Phase (degrees)	-114	-133	-147	-157	-164	-178	-186

i) Plot the response test information on a Nichols chart and determine the:-
   I. Gain margin
   II. Phase margin (6 marks)

ii) Assuming the system to have unity feedback, sketch the closed loop response and determine

   I. Peak magnitude, M_{pf}
   II. The frequency, w_{rf} at which the peak magnitude occurs (12 marks)

Question 5

a) State any **THREE** advantages a Bode Plot has over a Nyguist diagram (3 marks)

b) Draw the bode plot of

$$G_{(S)} = \frac{300\left(S^2 + 2S + 4\right)}{S\left(S + 10\right)\left(S + 20\right)}$$

and determine Gain Margin and Phase Margin if possible $0.1 \leq w \leq 100$ (17 marks)