



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A constituent College of JKUAT)
FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING
DIPLOMA IN MECHANICAL ENGINEERING (PLANT)
DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOTIVE)

ECI 2231: CONTROL SYSTEM II

YEAR II SEMESTER II

SPECIAL/SUPPLEMENTARY EXAMINATION
MAY 2012 SERIES
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination:

- Answer Booklet
- Drawing Instruments

This paper consists of **FIVE** questions

Attempt **ANY THREE** questions. Maximum marks for each part of a question are as shown.

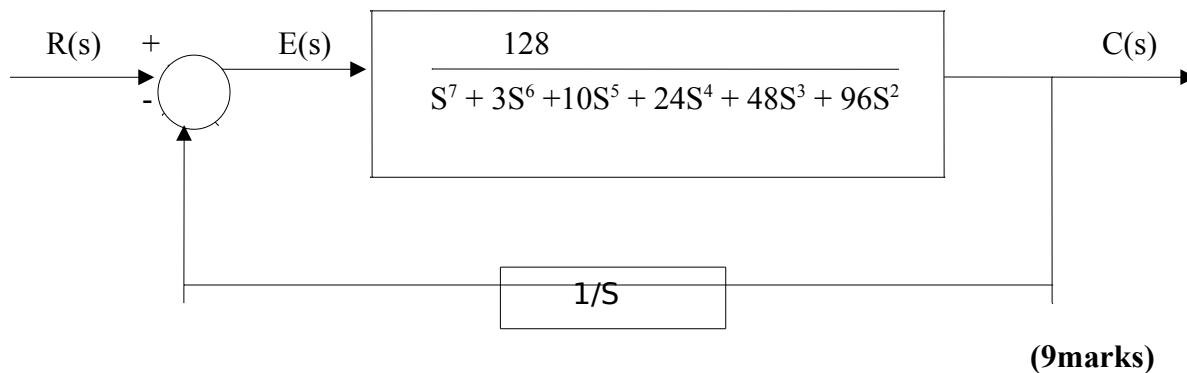
This paper consists of 3 printed Pages

Question ONE

- a) i. Define the following terms used control system:
 (i) Stable system
 (ii) Unstable system
 (iii) Marginally stable system **(3marks)**
- b) Determine the number of right-half plane poles in the closed loop transfer function.

$$T(S) = \frac{10}{S^5 + 2S^4 + 3S^3 + 6S^2 + 5S + 3}$$
(8marks)

- c) For the system in figure I
 i. Determine the stability
 ii. Determine the number of right-half-plane poles



Question TWO

For unity feedback system with the open loop function

$$G(s) = \frac{K}{S(1+0.2S)(1+0.02S)}$$

- i) For $K = 1$ Construct bode log – magnitude and phase plots
 ii) Evaluate the gain margin and phase margin.

(20marks)

Question THREE

For the system

$$G(s) = \frac{200}{\underline{\hspace{2cm}}}$$

$$(1 + 2S)(3 + S)(5 + S)$$

- i) Produce a polar plot for $W=3$ to $W=10$.
- ii) Determine the phase margin and gain margin **(20marks)**

Question FOUR

- a) Define the following terms
 - i) Poles of a transfer function
 - ii) Zeros of a transfer function. **(2marks)**

b) Given $F(s) = \frac{(S + 2)(S + 4)}{S(S + 3)(S + 6)}$

Find $F(s)$ at the point $S = -7 + j9$. **(8marks)**

- c) For the closed loop transfer function

$$T(s) = \frac{0.25JK(S + 0.435)}{S^4 + 3.46S^3 + 3.457S^2 + (0.719 + 0.25K)S + (0.0416 + 0.109K)}$$

Find the range of gain K that will cause the system to be stable. **(10marks)**

Question FIVE

For the system

$$G(s) = \frac{K(S + 10)(S + 20)}{(S + 1)(S - 10)}$$

Construct the root locus and hence determine

- i) Poles
- ii) Zeros
- iii) Angle of Asymptotes
- iv) Root locus on the real axis
- v) Break away points
- vi) Points where the root locus crosses imaginary axis
- vii) The value of K limiting the stability **(20marks)**