TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DIPLOMA IN ELECTRICAL POWER ENGINEERING

DEPE4

ECI2205 CONTROL SYSTEMS I

SERIES: MAY, 2016

INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
    - Answer booklet
    - Electronic calculator
2. This paper consists of FIVE questions.
3. Answer ANY THREE Questions
4. All questions carry equal marks

QUESTION ONE

(a) (i) Distinguish between open loop and closed loop control systems

(ii) State ONE advantage and ONE disadvantage for each of the systems in (i).   (6 marks)

(b) Explain any FOUR rules for block diagram reduction and give the equation for each case.

(4 marks)

(c) For the circuit of figure Q2a, draw the block diagram and determine the transfer function.

(6 marks)
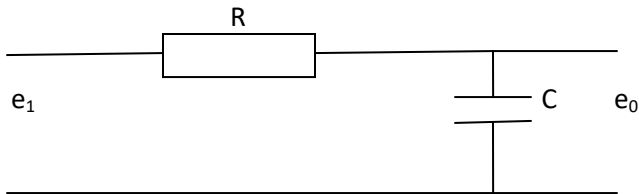
(d) Distinguish between settling time and response time   (4 marks)

QUESTION TWO

(a) Define the following terms used in control system:

(i)   Controlled variable

(ii)   Controller

(iii)   Measured variable

(iv)   Disturbance   (8 marks)

(b) Use block diagram algebra to simplify the block diagram of figure Q2c.   (6 marks)
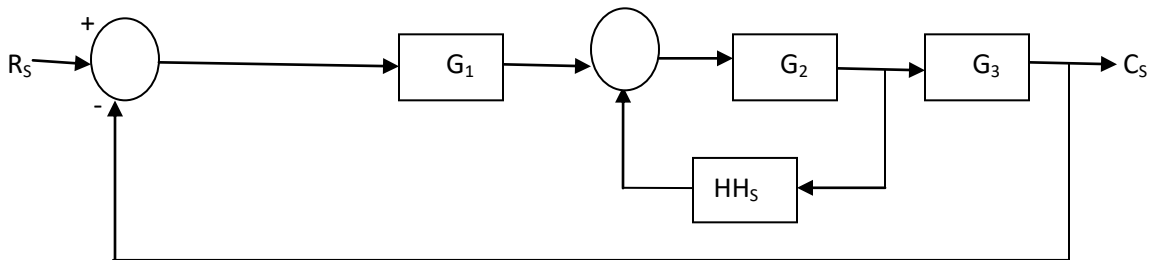
(c) Distinguish between linear and non linear control systems   (4 marks)
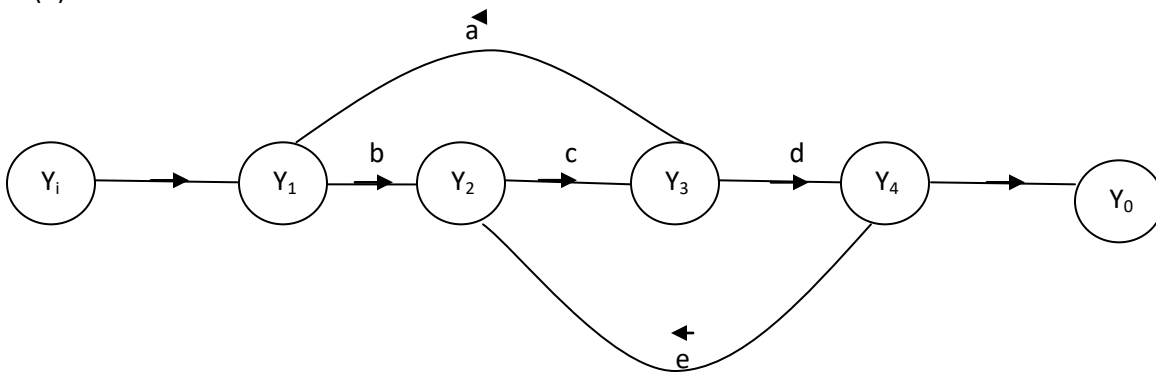
QUESTION THREE

(a) A system has its transfer function given by $\frac{Y(s)}{X(s)} = \frac{4}{S2+25+4}$. Determine:

(i)   Natural frequency, ω_n

(ii)   Damping ratio, D

(iii)   Damped natural frequency, ω_d

(iv)   Peak time, T_p

(v)   Setting time, T_s

(vi)   Maximum overshoot, P_0 (12 marks)

(b) A system is described by the differential equation $\frac{d2y}{dx2}$ +4 $\frac{dy}{dx}$ + 3y = 2r(t)

(i)   Assuming zero initial conditions determine the transfer function of the system

(ii)   Draw the block diagram   (6 marks)

QUESTION FOUR

(a) State mason's gain formula and explain each element in the formula   (6 marks)

(b) Explain the following terms as used in SFG

(i)   Input node

(ii)   Path

(iii)   Forward path

(iv)   Path gain

(v)   Sink   (5 marks)

(c)   Use systematic reduction to solve the SFG of figure 4c   (9 marks)

(d)

QUESTION FIVE

(a) (i)   Distinguish between Damp element and Ramp element

(ii)   Explain any THREE properties of SFG

(10 marks)

(b) Construct a signal flow graph for the following questions.   (6 marks)

B = 85X(s) + $\frac{2}{5}$C   C = SB + $\frac{1}{S+1}$D   D = $\frac{1}{S2}$C + 15B + A

A = S^2X$_{(s)}$ Y$_{(s)}$ = 55A

(c) Draw the corresponding block diagram for the SFG of (b) above.   (4 marks)