

TECHNICAL UNIVERSITY OF MOMBASA
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
DIPLOMA IN ELECTRICAL POWER ENGINEERING (BASE TITANIUM CLASS)

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) Define the following terms used in control system:

- (i) Controller
- (ii) Process
- (iii) Stability
- (iv) Error

(8 marks)

(b) Distinguish between linear and non linear systems and give ONE advantage and ONE disadvantage in each case.

(8 marks)

(c) State any FOUR examples of control systems

(4 marks)

QUESTION TWO

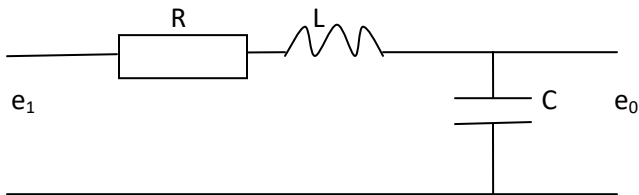
(a) (i) State any FOUR rules for block diagram reduction

(ii) Distinguish between closed loop and open loop systems

(8 marks)

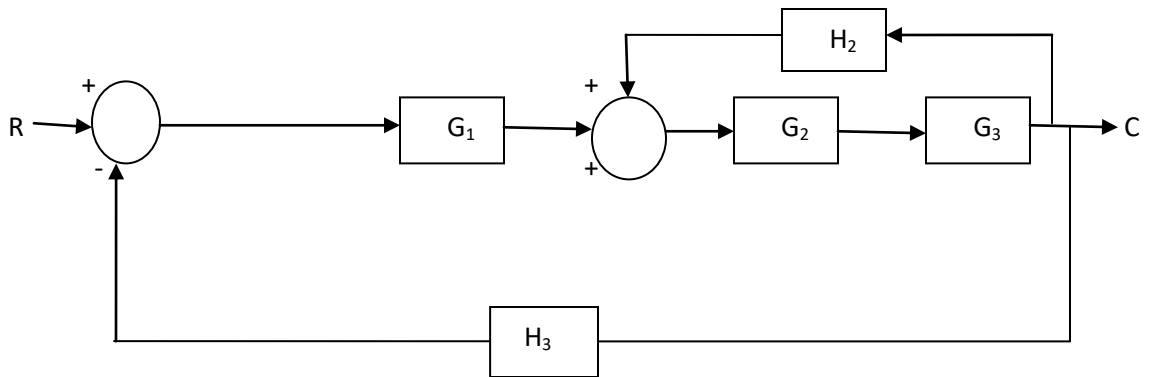
(b) For the circuit of figure Q2a, draw the block diagram and determine the transfer function.

(6 marks)



(c) Use block diagram algebra to simplify the block diagram of figure Q2c.

(6 marks)



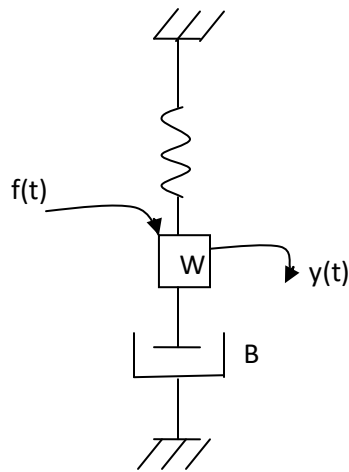
QUESTION THREE

(a) A system has its transfer function given by $\frac{Y(s)}{X(s)} = \frac{6}{s^2 + 25s + 4}$. 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
- (vii) The state of damping

(14 marks)

(b) For the mechanical system of figure Q3b, draw the block diagram and determine the transfer function. (6 marks)



Where: M = is the mass
 K = is the spring constant
 B = is the damping coefficient
 $f(t)$ = is the external force applied
 $y(t)$ = is the displacement by the mass

QUESTION FOUR

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

(6 marks)

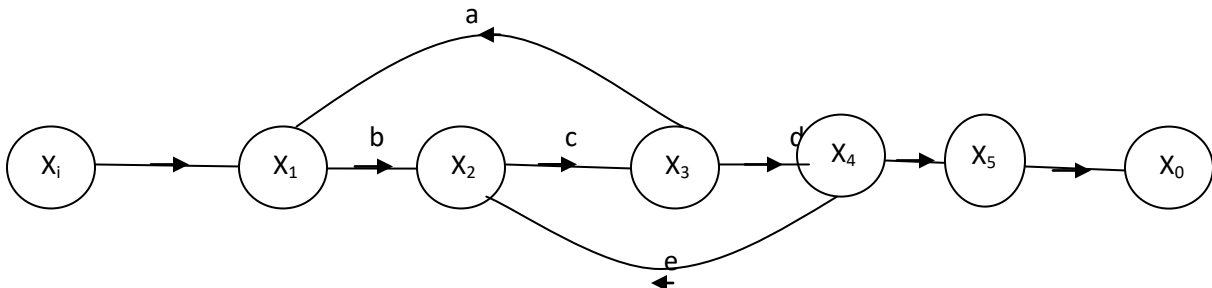
(b) Explain the following terms as used in SFG

- (i) Output node
- (ii) Input node
- (iii) Forward path
- (iv) Path

(4 marks)

(c) Use systematic reduction to solve the SFG of figure 4c (10 marks)

(10 marks)



QUESTION FIVE

- (a) (i) Explain any THREE features of signal flow graphs
- (i) Draw the symbol and state the mathematical expression for each of the following
- (I) Ramp signal
 - (II) Damp element
 - (III) Step element
- (9 marks)
- (b) Construct a signal flow graph for the following questions. (6 marks)
- $$B = 90X(s) + \frac{1}{5}C \quad C = SB + \frac{1}{s+1}D \quad D = \frac{1}{s^2}C + 10B + A$$
- $$A = S^2X_{(s)} \quad Y_{(s)} = 50A$$
- (c) Draw the corresponding block diagram for the SFG of (b) above. (5 marks)