TECHNICAL UNIVERSITY OF MOMBASA

FACUULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL ENGINEERING DEPARTRMENT

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY ELECTRICAL AND ELECTRONIC ENGINEERING

ECI2205: CONTROL SYSTEMS I

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE

a) The transfer function of a system is given by;

$$\frac{R(s)}{C(s)} = \frac{3200}{s^2 + 20s + 1600}$$

Find the constant K, natural frequency, damping factor, damped frequency and the steady state error for a step input.

(8 Marks)

b) For the system in (a) above:

i. determine delay time, rise rime, peak time, maximum overshoot and settling time

ii. Sketch the time response characteristic of the system

(12 Marks)

Question TWO

a)

i. A robotic arm rises quickly to pick an item from a shelf. Sketch the system and use it to explain Command input, Response, Gain and feedback

ii. For the system in a(i) above, explain:-
   i. How a positive feedback is applied
   ii. Why positive feedback must be followed eventually with a negative feedback.

(12 Marks)

b)

i. With the aid of a block diagram derive the expression of determining steady state error of a closed loop system.

ii. For the system in (i) above and given feedforward gain, G(s) = 10/s(s+5) and feedback gain, H(s) = 10/(s+1), find the steady state error corresponding to 110-unit impulse input.

iii. Sketch the time domain characteristic curve for the system in (ii) above.

(8 Marks)

Question THREE

a)

i. Write Masons's gain formula and state the denoted terms.

ii. Construct a signal flow graph for a system having the following mathematical relationships:

$$C_1(s) = G_{11}(s)R_1(s) + G_{21}(s)R_2(s) + G_{31}(s)R_3(s)$$

$$C_2(s) = G_{12}(s)R_1(s) + G_{22}(s)R_2(s) + G_{32}(s)R_3(s)$$

iii. State the type of input output system and explain its unique application.

(10 Marks)

b) Given a canonical form block diagram Figure Q2 below:

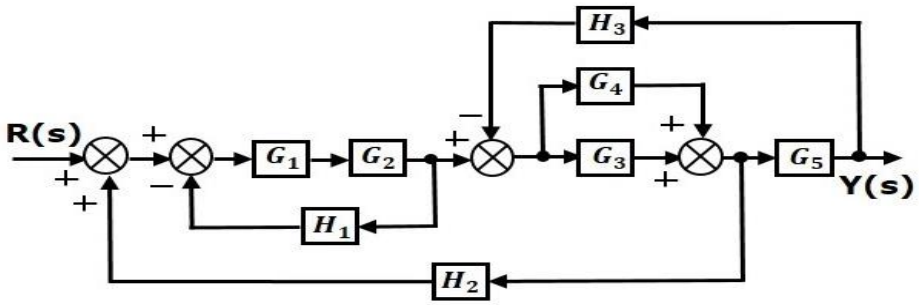

Figure Q2

Reduce the block diagram to a single block relating output to the input.

(10 Marks)

Question FOUR

a) Using suitable time domain response sketches, describe of zero order, first order, second order and higher order systems

(8 Marks)

b)

i. With aid of sketches, derive the transfer function of a thermal system having enclosure and a thermal wall.

ii. For the system above given $R_{th} = 0.05^0C/J$, $C_{th} = 20kJs/^oC$ and step input heat Qi of 0.8kJ find the thermal time constant(τ) and the value of Q_i and θ_o , at time $t = 0.2\tau$, at $t= 5\tau$ and at t= 2hours

iii. Sketch the performance characteristic of the system during and after withdrawal of heat supply.

(12 Marks)

Question FIVE

a)

i. Given a series RLC circuit with L = 200H and C = 2F and R = 5kΩ, and step input of 100V, explain with aid of calculations the natural frequency of oscillation, steady state value and damping factor of a second order system

ii. Show with characteristic curves how variation of damping factor affect a control system.

(10 Marks)

b) Consider a two tank system Fig Q4(b) below.

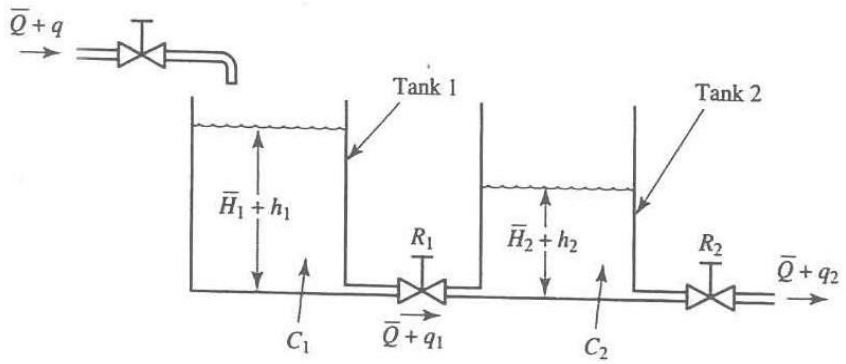

Fig Q4(b)

Derive the transfer function relating input change of discharge (q(s)) to change of output level (h(s)) of entire system

(10 Marks)