END SEMESTER/ RE-TEST EXAMINATION, 2020

Semester: 5th

Subject Code CAI-501

Subject: CONTROL SYSTEMS

Full Marks – 70 (Part A -25 + Part B -45)

Duration – Three hours

Instructions:

(1) Questions on Part A are compulsory.

(2) Answer any Five Questions from Part B

PART –A

Marks - 25

1. **Fill in the blanks**: 11 x 1=11

(a) An electric iron is an example of a _____.

(b) The Error signal is an algebraic difference or sum of _____.

(c) The MASS of a system is mathematically related to _____.

(d) The Steady State error in First order system (1/sT) for a Ramp input test signal is _____.

(e) A large time constant corresponds to a _____ system

(f) For an over damped system the damping factor is _____.

(g) Steady state time response is obtained by the use of _____.

(h) The Equivalent analogy of SPRING in electrical Forcevoltage system is _____.

(i) The Laplace transform of RAMP function is _____.

(j) Steady State error is a measure of system _____.

(k) The factor 1/jω corresponds to a phase angle of _____.

2. **Multiple Choice**: 10 x 1=10

(a) The Laplace transform of $e^{+2t}\sin 5t$ is:

(i) $5/(s+2)^2+25$

(ii) $5/s^2+25$

(iii) $5/s^2+10s+25$

(iv) $5/(s-2)^2+25$

(b) Consider the following Input and System types.

Input Type	System Type
Unit Step	Type '0'
Unit Ramp	Type '1'
Unit Parabolic	Type '2'

Which are the following statements are correct?

(i) Unit step input is acceptable to all the three types of system

(ii) Type '0' system cannot accept unit parabolic input

(iii) Unit Ramp input is acceptable to Type '2' system only.

(c) With negative feedback, the system stability and system gain respectively:
(i) increases and increases
(ii) increases and decreases
(iii) decreases and increases
(iv) decreases and decreases.

(d) Consider the following statements in connection with feedback in control system.
(i) With an increase in forward gain, the output value approaches the input value in the case of negative feedback closed loop system.
(ii) A negative feedback closed loop system when subjected to an input of 5 V with forward gain of 1 and a feedback gain of 1 gives output of 4.999 V.
(iii) The transfer function is dependant only upon its internal structure and components and is independent of the input applied to the system.
(iv) The overall gain of the block is 10.

Which of the statements is correct:

Only i and ii, Only ii and iii, Only iii and iv, Only i and iii.

(e) The Initial Slope of the Bode Plot for a Transfer Function having one ZERO at the origin is:
(i) -10 db/decade
(ii) 10 db/decade
(iii) +20 db / decade
(iv) - 20 db/ decade

(f) The Gain margin in frequency domain analysis, if it is is negative then the system is

(i) unstable
(ii) stable
(iii) Semi stable
(iv) none of the above

(g) The first element of each of the rows of a Routh Hurwitz stability test showed the signs as follows

ROW	I	II	III	IV	V
SIGN	+	+	-	+	-

Consider the following statement:

(i) The system has three roots in the right half of s plane
(ii) The system has three roots in the left half of s plane
(iii) The system is stable
(iv) The system is unstable.

Which are the above statements correct?

i and iii, i and iv, ii and iii, i and iv.

(h) Which one of the following is the most likely reason for large overshoot in a control system?
(i) High Gain in a system
(ii) Presence of a dead time delay in a system.
(iii) High positive correcting torque
(iv) None of the above

(i) Consider the following statements about root locus:
(i) The root locus is symmetrical about real axis
(ii) If a root locus branch moves along the real axis from an open loop to zero or to infinity,
This root locus branch is called real root branch.
(iii) The breakaway point of the root locus are the solutions of dK/ds =0
Which of the above statements are correct?

i and ii, i and iii, ii and iii, i ii and iii

(j) The STEP input is mathematically defined as:
(i) Zero level at t< 0, Magnitude is ∞ at t>0
(ii) Zero level at t< 0, Magnitude is A at t>0
(iii) Zero level at t< 0, Magnitude is t at t>0
(iv)none of the above

3. **Match the Following**: 4 x 1=4

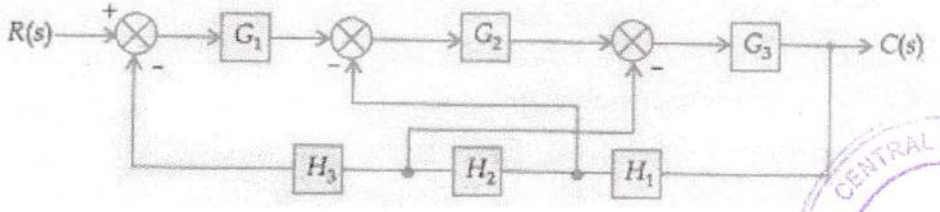
(i) Oscillatory (Sustained Oscillation)	(a) $\zeta < 1$
(ii) Critical damping	(b) $\zeta > 1$
(iii) Oscillatory with decreasing amplitude	(c) $\zeta = 0$
(iv)Over damped	(d) $\zeta = 1$

PART B

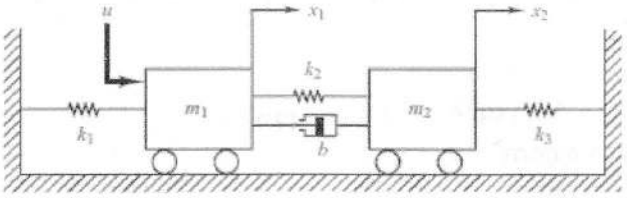
Marks 45

Answer any Five Questions:

4. Reduce the Block Diagram and find the overall transfer function C(s)/ R(s). (9)



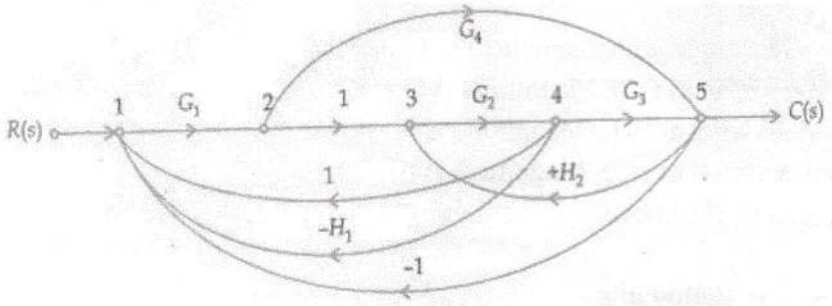
5. a)For the mechanical system, write down the Equations of motion. (4.5+4.5)
   b) Draw the equivalent electrical circuit.



6. a) The Open loop transfer function of an unity feedback control system is (4.5+4.5)
   G(s) =K/ s(s+2).Peak overshoot is specified at 5%. Find the peak time t_p.

   b) A thermometer requires 1 minute to indicate 98% of the response to a step input. Assuming the thermometer to be a first order system, find the Time constant.

7. Find the transfer function C(s)/ R(s) of the signal flow graph using Mason's gain formula. (9)



8. Write down the step by step method to draw a Root locus diagram. (9)
9. Draw the rough sketch of a Bode plot G(s)= 20(s+2) / s (s+ 0.05) (9)

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