Code: 13A02402

R13

B.Tech III Year I Semester (R13) Regular Examinations December 2015

CONTROL SYSTEMS ENGINEERING

(Common to ECE and EIE)

(Use of ordinary graph sheets, semi log graphs and polar graphs are permitted in the examination hall)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What is the effect of positive feedback on stability?

(b) What are the differences between Synchro transmitter and control transformer?

(c) The closed loop transfer function of a second order system is $\frac{C(S)}{R(S)} = \frac{10}{S^2+6S+10}$. What is the type of damping in the system?

(d) Why derivative controller is not used alone in control systems?

(e) What is the necessary and sufficient condition for stability in Routh's stability criterion?

(f) What is meant by damping pole in Root locus diagram?

(g) Define Gain margin and Phase margin.

(h) In minimum phase system, how the start and end of polar plot are identified?

(i) State various properties of state transition matrix.

(j) What are the advantages of state space analysis over transfer function analysis?

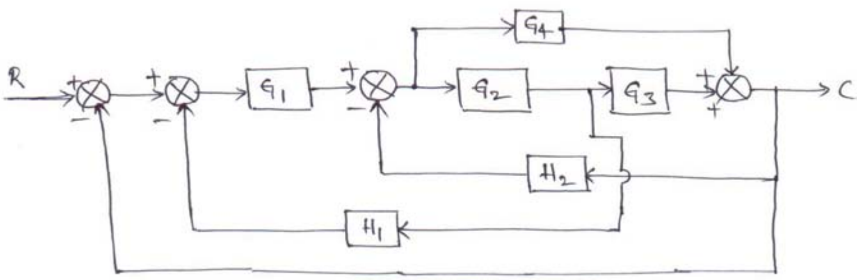
PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) What is meant by open loop and closed loop control systems? Differentiate them.

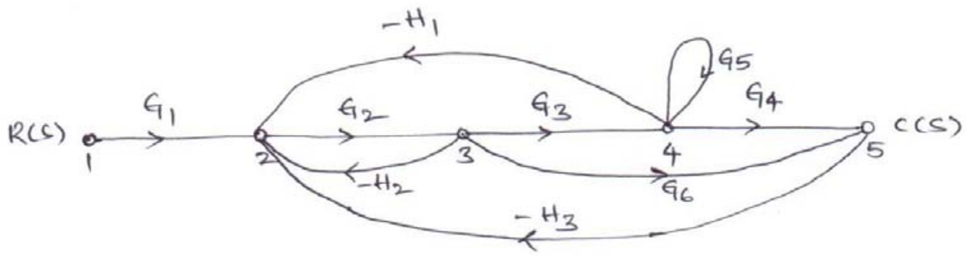
(b) Find the closed loop transfer function of the following block diagram using reduction technique.



OR

3 (a) Define transfer function and also derive transfer function for AC Servo motor.

(b) With the help of Mason's gain formula find the overall transfer function of the following signal flow graph.



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UNIT – II

4 (a) Obtain the response of a first order system $\frac{C(S)}{R(S)} = \frac{1}{1+Ts}$ for unit step input.

(b) A closed loop servo is represented by the differential equation: $\frac{d^2c}{dt^2} + 8\frac{dc}{dt} = 64e$. Where 'c' is the displacement of the output shaft, 'r' is the displacement of the input shaft and e = r – c. Determine un damped natural frequency, damping ratio and percentage maximum overshoot for unit step input.

OR

5 (a) What is meant by transient response and steady state response? Explain in detail about various time domain specifications.

(b) Find the various static error constants for a unity feedback control system whose open loop transfer function is: $G(s) = \frac{10(s+2)}{s^2(s+1)}$.

UNIT – III

6 With the help of Routh's stability criterion find the stability of the following systems represented by the characteristic equations:

(i) $s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$.

(ii) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.

(iii) $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$.

OR

7 A negative feedback control system has the forward path transfer function: $G(s) = \frac{K(s+1)}{s(s-1)(s^2+6s+25)}$. Draw the root locus for $0 \le K \le \infty$.

UNIT – IV

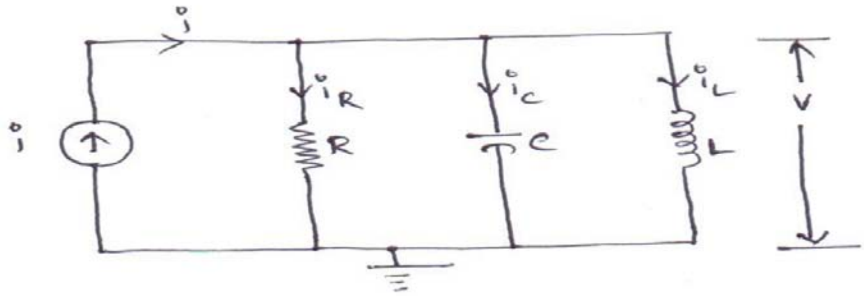
8 Sketch the bode plot for the following transfer function and determine phase margin and gain margin: $G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$.

OR

9 The open loop transfer function of a unity feedback system is given by: $G(s) = \frac{1}{s^2(1+s)(1+2s)}$. Sketch the polar plot and determine the gain margin and phase margin.

UNIT – V

10 (a) Write the state variable formulation of the following parallel RLC network. The current through the inductor and voltage across the capacitor are the output variables.



(b) Compute the resolvent matrix and state transition matrix of the state matrix: $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$.

OR

11 (a) Obtain the state model of the transfer function: $\frac{Y(s)}{U(s)} = \frac{s^2+3s+4}{s^3+2s^2+3s+2}$

(b) Diagonalize the system matrix, $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$.

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