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Total No. of Questions :10] *[Total No. of Printed Pages :4*

Roll No ....

EC - 502

B.E. V Semester

Examination, December 2012

Control Systems

Time : Three Hours

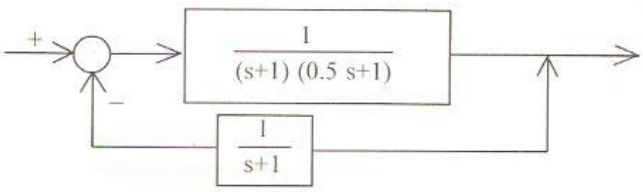
Maximum Marks : 70/100

Note : 1. Attempt any one question from each unit.
2. All questions carry equal marks.

Unit-I

1. a) What is a control system? What are open and closed loop control systems? Enlist some applications of control systems.

b) Define transfer function. Determine the overall transfer function of the following closed loop control system.



OR

2. a) Draw the signal flow graph for the following feedback control system.

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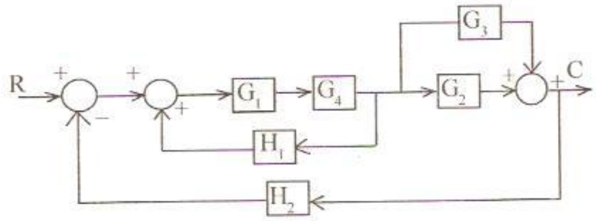

b) What are the advantages of using feedback in control systems? What is regenerative feedback?

Unit-II

3. a) Analyse the system response of first order systems to unit ramp input.

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b) Enlist and explain the different steady state, errors and error constants.

OR

4. a) A unity negative feedback control system has an open loop transfer function consisting of two poles, two zeros and a variable gain k, the zeros are located at -2 and -1 and the poles at 0.1 and +1.

Using Routh-Stability criterion, determine the range of values of k for which the closed loop system has 0, 1 or 2 poles in the right half S-plane.

b) List and explain the rules for sketching Root locus.

Unit-III

5. a) For the following feedback system find the value of k and α to satisfy the following frequency domain specifications $M_r = 1.04$ and $W_r = 11.55$ rad/sec.

b) What are polar and inverse polar plots? How do they differ from Bode plot?

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OR

6. a) State and explain Nyquist stability Criterion. Using Nyquist Criterion determine whether the following system is stable or not?

$$G(s)\,H(s) = \frac{1+4s}{s^2(1+s)(1+2s)}$$

b) A unity feedback system has the following open-loop frequency response.

ω	2	3	4	5	6	8	10
$\lvert G(j\omega)\rvert$	7.5	4.8	3.15	2.25	1.70	1.00	0.64
$\angle G(j\omega)$	−118	−130	−140	−150	−157	−170	−180

Evaluate the gain margin and phase margin of the system.

Unit-IV

7. a) What are the approaches to the control system design problem?

What are the preliminary considerations of classical design? What is compensation? Name the different types of compensators.

b) A unity feedback control system has an open loop transfer function of $G(s) = 1/s^2$.

Design a suitable compensating network such that a phase margin of 45° is achieved without sacrificing system velocity error constant.

OR

8. a) Find the inverse z-transform of

$$\frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}$$

b) Solve the difference equation

$c\,(k+2)+3c\,(k+1)+2c\,(k)=4(k);$

$c\,(0)=1 \;\; c\,(k)=0$ for $k<0$

$c(1)$ needed in the solution can be obtained by $k=-1$

$c\,(1)+3c\,(0)+2c\,(-1)=r\,(-1)$ or $c\,(1)=-3.$

Unit - V

9. a) A feedback system is characterised by the closed loop transfer function

$$\tau(s)=\frac{s^2+3s+3}{s^3+2s^2+3s+1}$$

Draw a suitable signal flow graph and form construct a state model of the system.

b) For a system represented by the state equation $x(t)=Ax(t)$

The response of $x(t)=\begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$

When $x(0)=\begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $x(t)=\begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$

When $x(0)=\begin{bmatrix} 1 \\ -1 \end{bmatrix}$. Determine the system matrix A and the state transition matrix.

OR

10. Write short notes on:

a) State, state variables and state model.

b) Controllability and observability.

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