EEE502

(Following Roll No. to be filled by candidate)

Roll No.

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B.Tech.

FIFTH SEMESTER EXAMINATION 2015-16

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CONTROL SYSTEM

Time: 3 hours **Max Mark: 100**

Note

Attempt all questions.

Marks and number of question to attempt from the section is mentioned before each section.

1. Attempt any **four parts** of the following: [4x5]

a. What do you mean by closed –loop control system? Give its examples. Also mention its advantages.

b. How the response of second order system subjected to unit step function are changes with the variation of damping ratio?. Explain with neat response characteristics.

c. Derive the transfer function of a.c servomotor stating the assumption made.

d. Explain the rules for sketching the root locus of a higher order systems.

e. Discuss the concept of controllability of state space based system in view of Kalman's test.

f. Discuss the nature of Bode plot for
(i)Poles at origin (ii) simple pole (iii) simple zero

2. Attempt any **four parts** of the following: [4x5]

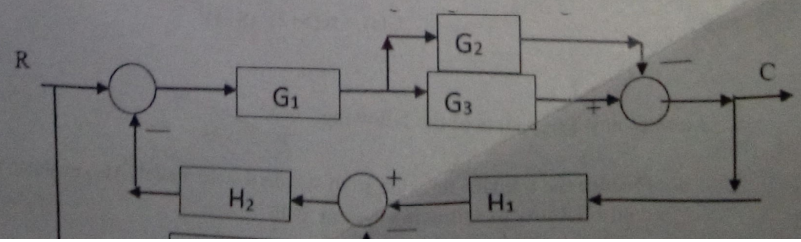
a. State the applications of following: (i) Stepper motor (ii) Servomotor.

b. Define the following terms with suitable discussion: (i) Critically stable system(ii) Conditionally stable system.

c. Using Routh criterion, determine stability of following system given by the characteristics equation

$$S^6+3S^5+5S^4+9S^3+8S^2+6S+4=0$$

d. Determine the C/R for the block diagram given in fig. 1.



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c. The open loop transfer function of a unity feedback system is given by

$G(s) = K/ S(S+1)(S+2)$

Find the minimum value of 'K' for which the steady state error is less than 0.2 for a unity ramp input.

f. For the system represented by the following equations, find the transfer function $X(s)/U(s)$ by signal flow technique.

$$X = X_1 + \alpha_3 U \quad , \quad X_1 = \beta_1 X_1 + X_2 + \alpha_2 U \quad ,$$

$$X_2 = -\beta_2 X_1 + \alpha_1 U$$

3. Attempt any **Two parts** of the following:

a. Define the following systems by sketching their output wave form subjected to unit step input: (i) Underdamped system (ii) Undamped System
The open loop transfer function of a unity feedback system is given by
$G(s) = K/ S(\tau S+1)$, where τ is time constant.
By what factor should the gain 'K' be multiplied so that the damping ratio is increased from 0.25 to 0.75.

b. Derive the expressions for peak time and rise time for a second order system when subjected to unit step input.

c. The open loop transfer function of a unity feedback system is
$G(s) = K(S+a)/ S(S+b)$
Find 'K' 'a' and 'b' to yield a peak overshoot of 16.3% , settling time is 0.8 second and velocity error constant of 50 S^{-1}.

4. Attempt any **Two parts** of the following:

a. The open loop transfer function of a unity feedback system is
$G(s) = 100/ S(S+8)$
Determine the frequency domain specifications.

b. Draw the asymptotic bode plot and phase plot of unity feedback system with open loop transfer function $G(s) = 10/ S(S+2)(S+5)$

c. Sketch the root locus of open loop transfer function
$G(s) = K(S+2)/ (S+1)^2$

5. Attempt any **Two parts** of the following:

a. Deduce the transfer function from standard state model. Also evaluate the controllability of following system with

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(3)

$$A=\begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{bmatrix}$$ 3×3

$$B=\begin{bmatrix} 4 & 2 \\ 0 & 0 \\ 3 & 3 \end{bmatrix}$$ 3×2

b. What do you understand by Lead and Lag network? Explain in view of bode plot. Also determine the state transition matrix of the following system.

$$A=\begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix}$$

c. Obtain the state- space representation of the system given by

C(s)/R(s) = 1/(S+1)(S+2)(S+3)

Also differentiate between transfer function approach and state space technique.