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Second Semester M.Tech. Degree Examination, December 2011
Modern Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Derive the equation of motion of a simple spring mass and damper system and devote the characteristic equation. **(10 Marks)**

b. The transfer of a system is $\frac{8}{s^2+4s+8}$

Find :

i) Natural frequency
ii) Damping ratio
iii) Damped natural frequency
iv) Peak time and peak overshoot. **(10 Marks)**

2 Sketch the root locus for : $G(s)H(s)=\frac{K(s+4)}{s(s^2+2s+2)}$ and ascertain the nature of stability. **(20 Marks)**

3 a. For a unity feedback system $G(s)=\frac{10}{s(s+1)(s+4)}$ obtain analytically, the gain margin and phase margin. **(10 Marks)**

b. Define : i) Gain Margin (G.M) ; ii) Phase Margin (PM). **(06 Marks)**

c. Define the any four advantages of Bode plots. **(04 Marks)**

4 a. Explain M and N circle. **(08 Marks)**

b. Using Nyquist stability criterion, find the range of k for closed – loop stability $G(s)H(s)=\frac{K(4s+1)}{s(s-1)}$. **(12 Marks)**

5 a. Define state – space method. Solve the following, using direct programming.
$y(t)=\frac{D+3}{(D+1)(D+2)}f(t)$ **(10 Marks)**

b. For a system represented by X = AX, the response is

$x(t)=\begin{bmatrix}2e^{-4t}\\ e^{-4t}\end{bmatrix}$ when $X(0)=\begin{bmatrix}2\\1\end{bmatrix}$ and $\dot{x}(t)=\begin{bmatrix}4e^{-2t}\\ e^{-2t}\end{bmatrix}$ when $X(0)=\begin{bmatrix}4\\1\end{bmatrix}$

Determine the system matrix A and the state transition matrix. **(10 Marks)**

6 a. Find the Z – transform of the following :
   i) $x(n) = 2^n u(n)$
   ii) $x(n) = f(n)$
   iii) $x(n) = n\,u(n)$ **(12 Marks)**

b. Find the inverse Z – transform of x(z), using the partial fraction expansion approach $x(z) = \dfrac{z+1}{3z^2 - 4z + 1}$. **(08 Marks)**

7 a. Explain with a neat sketch, computer controlled system. Obtain its controller characteristics. **(10 Marks)**

b. The transfer function for a plant is $\dfrac{(s+2)}{[s(s+1)]}$. Determine the characteristics of a digital controller, such that, the response of the system to a unit step function will be $c(t) = 5(1 - e^{-2t})$. The sampling period is T = 1.0s. **(10 Marks)**

8 a. Define node and branch, as applied to a signal flow graph.
b. Distinguish between steady state and transient response.
c. Explain state variable concepts.
d. Define the characteristic equation. **(20 Marks)**

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