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10MAR22

# Second Semester M.Tech. Degree Examination, June/July 2011
# Modern Control Engineering

Time: 3 hrs. Max. Marks:100

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



1 a. Write short notes on:
   i) Coulomb friction force
   ii) Viscous friction force. **(08 Marks)**

b. What restriction must be placed upon the parameter K, in order to insure that the system of the characteristic, $S^4 + 6S^3 + 11S^2 + 6S + K = 0$ is stable? **(12 Marks)**

2 Sketch the root locus of the unity feedback control system which has the open loop transfer function, $G(s)=\frac{K(s+2)}{s^2+2s+3}$ and determine the closed loop value of K, for a damping ratio of $\sqrt{3}/2$. **(20 Marks)**

3 Construct the asymptotic 'Bode plots' for a unity feedback system phase open loop transfer function is given by, $G(s)=\frac{10}{s(1+s)(1+0.02s)}$ and find,
   i) gain and phase crossover frequency
   ii) gain and phase margin
   iii) stability of the closed loop system. **(20 Marks)**

4 a. Draw the appropriate polar plot of
$G(s)=\frac{1}{s(1+\tau_1 s)(1+\tau_2 s)}$ (Assume $\tau_1$ and $\tau_2$ suitably. ) **(08 Marks)**

b. A unity feedback system is characterized by an open loop transfer function $G(s)=\frac{K}{s(s+10)}$.
Determine, i) the gain K, so that the system will have a damping ratio of 0.5. ii) for the above value of K, determine the setting time, iii) peak over shoot and iv) time to peal over shoot for a unit step input. **(12 Marks)**

5 Draw the Nyquist plot and examine the stability of the closed loop system whose open loop transfer function is $G(s)H(s)=\frac{7(s+10)^2}{s^3}$ **(20 Marks)**

6 a. Obtain the state space equation of a system whose differential equation is $\dddot{y}+6\ddot{y}+11\dot{y}+6y=3U$. Also, represent the state space model in the block diagram form. **(08 Marks)**

b. Obtain the phase variable form of state model for the system whose differential equation is given by $\dddot{y}+11\ddot{y}+6\dot{y}+20=8\ddot{u}+6\dot{u}+3u+9u$, by signal flow graph method. **(12 Marks)**

7 a. Obtain the discrete time state space representation for the differential equation $\ddot{c} + 3\dot{c} + 2c = f(t)$, evaluate the resulting discrete time representation for a sampling period $T = 0.3s$. **(08 Marks)**

b. The transfer function for a plant is $\frac{s+2}{s(s+1)}$, 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 $T = 1.0$ s. **(12 Marks)**

8 Write short notes on:

a. Controllability and observability of a system.
b. Corner frequency
c. Advantages of phase lead compensation.
d. Steady state and transient response. **(20 Marks)**

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