U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. – Electrical and Electronics Engineering

Semester End Examination; Dec - 2017 / Jan - 2018

Design of Analog Control System

Time: 3 hrs Max. Marks: 100

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.*

UNIT - I

1 a. Define the following types of compensation :

i) Cascade Compensation ii) State Feedback compensation 10

iii) Series Feedback compensation iv) Feed forward Compensation.

b. Mention the effects of P, PI, PD and PID controller on the system performance. 10

2. Design a PD controller so that a unity feedback system with open loop transfers function. $G(S)=\dfrac{20}{S(S+2)(S+4)}$ will have a damping ratio of 0.8 and natural frequency of oscillation of 2 rad/sec. Draw the corresponding plots for both the cases (Root loci). 20

UNIT - II

3. Design a PI controller for a unity feedback system with open loop transfer function of $G(S)=\dfrac{4}{(S+1)(S+2)}$ will have phase margin of 50º and natural frequency of oscillation of 1.7rad/sec. Discuss the effects. Draw Bode diagram for both the cases (with and without controllers). 20

4. Design a PID controller for a unity feedback system with open loop transfer function $G(S)=\dfrac{100}{(S+1)(S+2)(S+10)}$ so that the phase margin of system is 45º at a frequency of 4 rad/sec and the steady state error for unit ramp input is 0.1. 20

UNIT - III

5. Design a lead compensator for a unity feedback system with open loop transfer function $G(S)=\dfrac{K}{S(S+1)(S+5)}$ to satisfy the following specifications : 20

i) Velocity error constant $K_V \geq 50$

ii) Phase margin is ≥20º. Draw Bode diagram only for uncompensated system. Also determine the open loop TF of compensated system.

6 a. Discuss the effects of Phase lead compensation. 10

b. Explain the design procedure of phase lag control using the Bode plot. 10

UNIT - IV

7 a. Explain the control system design via pole placement technique by state feedback and determine the state feedback gain matrix K by any one method. 10

b. For the system with $A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 0\\ -1 & -5 & -6\end{bmatrix}$, $B=\begin{bmatrix}0\\0\\1\end{bmatrix}$ Determine State feedback gain matrix K with $u=-Kx$ so that the closed loop poles are placed at $S=-1\pm j2,\ S=-10$. 10

8 a. Explain the design of type-I Servo system. When the plant has an integrator. 10

b. Design a type-I servo system for a plant having the transfer function with an integrator $\frac{Y(S)}{U(S)}=\frac{1}{S(S+1)(S+2)}$. The Desired closed loop poles are $S=-2\pm j3.4$ and $S=-10$. Obtain the unit step response of the designed system. 10

UNIT - V

9 a. Define the following: 10

i) State observer

ii) Full order state observer

iii) Reduced order state observer

iv) Minimum order state observer.

b. Design a full order state observer if the desired eigen values of the observer matrix are $-2\pm j2\sqrt{3}$ and -5 where $A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}$, $B=\begin{bmatrix}0\\0\\1\end{bmatrix}$ and $C=\begin{bmatrix}1 & 0 & 0\end{bmatrix}$. 10

10 a. Write a short note on Quadratic Optimal Regulator systems with Riccatti equation. 10

b. Determine the optimal feedback gain matrix K for the performance index J for $A=\begin{bmatrix}0 & 1\\ 0 & -1\end{bmatrix}$, $B=\begin{bmatrix}0\\1\end{bmatrix}$ and $Q=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$, $R=[1]$ Using Riccatti equation in the design of Optimal control system. 10

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