May 22, 2024 02:30 pm - 05:30 pm 1T00836 - T.E.(Electrical Engineering)(SEM-VI)(Choice Base Credit Grading System) (R- 19) (C Scheme) / 89303 - Control System Design QP CODE: 10055075

Time:3 Hrs **Marks:80**

Note: 1. Q.NO. 1 is compulsory. Solve any three questions from rest.
2. Make any suitable assumption wherever applicable
3. Figure to the right indicates full Marks
4. Use of graph paper and semilog paper are compulsory wherever applicable

Q.1 Attempt any four from the following 20

a. Why a compensator is required in a system. Explain why there is more improvement in steady state if a PI controller is used instead of a lag network.

b. What is a feedback compensator. Explain the design techniques of feedback compensator.

c. Realize the lead compensator $Gc(s)=\frac{(s+4)}{(s+20.09)}$ using passive components.

d. With reference to the frequency response explain why is the phase margin increased above that desired when designing a lag comensator

e. What is an observer? Draw a block diagram of state space representation with observer.

f. Explain the region of stability in z-plane.

Q.2 a. The unity feedback system with $G(s) = \frac{K}{(s+2)(s+3)(s+8)}$ is operating with 10% overshoot. Find the transfer function of a lag network so that the appropriate static error constant equals 4 without appreciably changing the dominant poles of the uncompensated system. Use Root locus technique. 10

b. The unity feedback system with $G(s) = \frac{K}{s(s+4)(s+6)}$ is given. Design an ideal derivative compensator to yield a 16% overshoot, with a threefold reduction in settling time. Use root locus technique. 10

Q3. a Design a lag-lead compenstor for a unity feedback system with forward transfer function $G(s)=\frac{K}{s(s+8)(s+30)}$ to meet the following specifications: %OS=10%, Tp=0.6 sec and Kv=10. Use frequecny response technique. 10

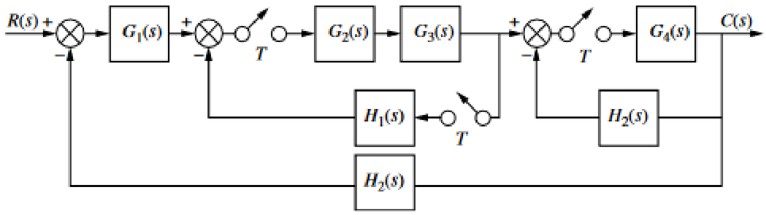
b Explain the steps involved in the design of lag compensator using Bode-plot. 10

Q4. a. Given the following open loop plant $G(s) = \frac{20}{(s+2)(s+4)(s+8)}$. Design a state feedback controller to obtain a 15% overshoot and a settling time of 0.75 second. Place the 3rd pole 10 times as far from the imaginary axis as the dominant pole pair. Use the Phase variable representation for the state variable feedback design. 10

b. Design an observer for the plant $G(s)=\frac{10}{(s+3)(s+7)(s+15)}$ operating with 10% overshoot and a 2 sec peak time. Design the observer to respond 10 times as fast as the plant. Place the observer 3rd pole 20 times as far from the imaginary axis as the observer dominant poles. Assume the plant is represented in observer canonical form. 10

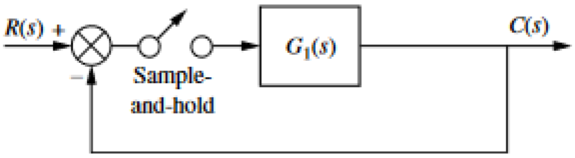
Q.5 a. Given a zero order hold in cascade with $G_1(s)=\frac{(s+2)}{(s+1)}$. Find the sample data transfer function G(z), if the sampling time T=0.5 sec. 10

b. 10



Find C(z)/R(z) for the given system.

Q.6 a. For a digital system shown in the figure 10



Where $G_1(s)=\frac{K}{s(s+1)}$ find the range of K for stability. T=0.1 second

b. Explain the process of implementation of digital compensator. 10

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