Enrollment No: ______________________ Exam Seat No:______________________

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name : Control System Design

Subject Code : 4TE07CSD1 **Branch: B.Tech (IC)**

Semester : 7 **Date : 28/03/2018** **Time : 10:30 To 01:30** **Marks : 70**

Instructions:

(1) Use of Programmable calculator & any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

Q-1 **Attempt the following questions:** **(14)**

a) Internal model principle states that the no. of ____________in forward path function is equal to the Reference function then Set-Point tracking is possible. 01
a) Zeros b) Poles c) Pole at origin d) Zeros at origin

b) The input to the Luenberger observer (estimator) is/are _____________. 01
a) Only input u of the system. b) Only output y of the system.
c) Only Estimated o/p error. d) Both b & c.

c) A computational method of approximating the integration of a function is __________ from the following. 01
a) Backward difference rule only b) Forward-rectangular integration only
c) Any one of the a) or b). d) Both a) & b) are required.

d) The process model will always be an inaccurate representation of the actual physical system because of ________________. 01
a) Parameter changes only b) Unmodeled dynamics only
c) Unmodeled time delays only d) All of the above

e) A computational method of approximating the time derivative of a function is ____________ from the following. 01
a) Backward difference rule only b) Forward-rectangular integration only
c) Any one of the a) or b). d) Both a) & b) are required.

f) Roots of the characteristic equation are equal to ______________ of the system. 01
a) Eigen values only b) Closed loop poles only c) parameters d) Any of a) or b)

g) If ‘n’ is the no. of state variables, ‘r’ be the no. of o/p variables & ‘i’ be the no. of i/p variables, then the order of the matrix C is _________ 01
a) n × r b) r × n c) n × i d) i × n

h) If ‘n’ is the no. of state variables, ‘r’ be the no. of o/p variables & ‘i’ be the no. of i/p variables, then the order of the matrix B is _________ 01
a) n × r b) i × n c) n × i d) i × i

i)	Each horizontal line in S-plane can be represented by a __________ in Z-plane. a) line-segment b) circle c) line d) Curve	01
j)	What is optimal control?	01
k)	What do you mean by compensator?	01
l)	State robust stability criteria for additive and multiplicative perturbation.	01
m)	What do you mean by robust system?	01
n)	What do you mean by mathematical modeling?	01

Attempt any four questions from Q-2 to Q-8

Q-2	**Attempt all questions**	**(14)**
a)	Explain the pseudo quantitative feedback theory (Pseudo-QFT) with suitable example.	07
b)	Explain the implementation of digital PID controller with necessary steps.	07
Q-3	**Attempt all questions**	**(14)**
a)	A process is given by G(s)= $\frac{1}{(s+1)^2}$. If cascade controller $G_c(s)=1$ then steady state error is 50% and settling time (2% tolerance band) is 3.2 second for a step input. Optimum coefficients of the characteristic equation for ITAE are given by equation $s^3+ 1.75\ \omega_n s^2 + 2.15\omega^2_n s + \omega^3_n$. Design PID controller to obtain an optimum ITAE performance for a step input and a settling time less than 0.5 second.	07
b)	Explain full-order observer design with block diagram.	07
Q-4	**Attempt all questions**	**(14)**
a)	Discuss the lead compensation technique based on frequency response (bode plot). Enlist the necessary steps to design a lead compensator.	07
b)	Find the unit impulse response for the first four sampling instants, for the system given by $Y(z)= (z^3+2z^2+1)/(z^3-1.5z^2+0.5)$.	07
Q-5	**Attempt all questions**	**(14)**
a)	A magnetically suspended steel ball described in state space by $A=\begin{bmatrix} 0 & 1 \\ 3 & 0 \end{bmatrix}$, $B=\begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Design a state feedback controller K such that system have damping ratio=1 and t_s=2 sec.	07
b)	Explain full state variable feedback theory with block diagram.	07
Q-6	**Attempt all questions**	**(14)**
a)	Consider the given system $G(s)=\frac{Y(s)}{U(s)} = \frac{1}{s^2}$ and find the feedback gain matrix K to place the closed loop poles at $-1\pm j$.	07
b)	Discuss the system having uncertainty in terms of uncertain coefficients with suitable example.	07

Q-7 **Attempt all questions** **(14)**

a) Write a note on the role of digital computers in control system design and applications. 07

b) Explain the root-locus in digital control system in z-plane with necessary steps to design it. 07

Q-8 **Attempt all questions** **(14)**

a) Discuss the lag compensation technique based on root-locus method. Enlist the necessary steps to design a lag compensator. 07

b) Explain the difference between lead and lag compensation technique. 07