Roll No. .... Total Pages : 4

206606

May 2019

B.Tech. VI Semester

DIGITAL CONTROL SYSTEM

(El-312C)

Time : 3 Hours] [Max. Marks : 75

Instructions :

(i) It is compulsory to answer all the questions (1.5 marks each) of Part-A.

(ii) Answer any four questions from Part-B in detail. Part (a) is of 8 marks and Part (b) is of 7 marks.

(iii) Different sub-parts of a question are to be attempted adjacent to each other.

of

PART–A

1. Answer in brief of the following :

   (a) What is the meaning of the term canonical in Diagonal canonical form?

   (b) Describe mathematically a LTV system.

   (c) Describe Shannon's sampling theorem.

   (d) If $Zf(t) = F(z)$ then prove that $Z[f(t - nT) \cup (t - nT)] = z^{-n}F(z)$.

(e) State and prove the final value theorem.

(f) Find $Z^{-1}[\{(z-1)^2-1\}/(z-1)^2-3z\}]$.

(g) Solve $y(k+2)+0.5y(k+1)+0.2y(k)=u(k)$ where $u(k)=1$ for $k=0.1.2\ldots$

(h) Give a mathematical model of ZOH.

(i) Given a second order characteristic equation in Z plane how can one determine the percentage overshoot, settling time and peak time.

(j) Draw signal flow graph of the transfer function

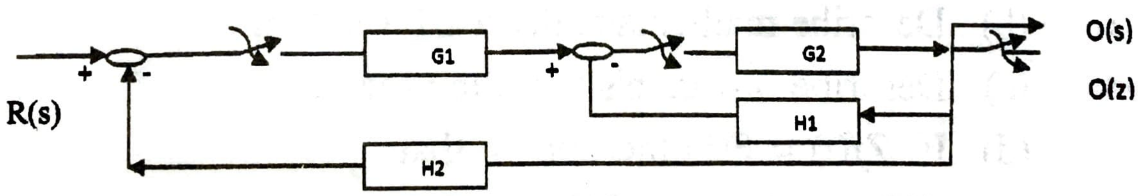
$$\frac{5}{(z+1)(z+2)}.$$

PART–B

2. (a) The characteristic equation of a feedback system is $z^2+0.2z-0.1k=0$; sketch a root loci for $0<k<\infty$ and thus obtain the range of k for which the system is stable.

(b) Using trapezoidal rule of integration find the difference equation model for PID controller.

3. (a) Find the transfer function of the given system

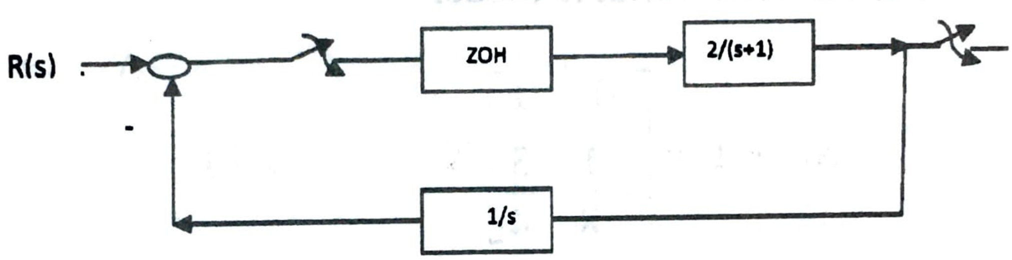


(b) Prove that if $Z[f(t)] = F(z)$, then $Z(tf(t)) = -Tz\frac{dF(z)}{dz}$.

4. (a) Check the stability of the system described by the characteristics equation as

$$Q(z) \Rightarrow z^4 - 1.7z^3 + 1.04z^2 - 0.268z + 0.024 = 0.$$

(b) Find the unit step response of the given system



5. A discrete time regulator system has the plant

$$X(k+1) = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} X(k) + \begin{bmatrix} 4 \\ 3 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 1 & 1 \end{bmatrix} \times (k).$$

(a) Design a state feedback control algorithm $u(k) = k\,X(k)$ which places the closed loop characteristic roots at $\pm j\frac{1}{2}$.

(b) Design a state observer which has both the characteristic roots at $z = 0$. Give the relevant observer equation.

6. A discrete time system has the transfer function

$$T(z)=\frac{4z^3-12z^2+13z-7}{(z-1)^2\,(z-2)}$$

Determine the state model of the system in

(a) Phase variable form.

(b) J C F.

7. For the state variable model

$$X(k+1)=\begin{bmatrix}0 & 1\\ -\frac{1}{8} & \frac{3}{4}\end{bmatrix}X(k)+\begin{bmatrix}0\\1\end{bmatrix}u(k)$$

$$y(k)=\begin{bmatrix}-\frac{1}{2} & 1\end{bmatrix}X(k)$$

(a) Obtain the eigen values and the transfer function.

(b) Comment upon the controllability and observability of the system.
