Code: R7 420203

R7

B.Tech IV Year II Semester (R07) Advanced Supplementary Examinations, June 2012

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours Max Marks: 80

Answer any FIVE questions

All questions carry equal marks

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1 (a) With neat block diagram explain various components of digital data control systems.

(b) With neat circuit diagram explain sample and hold operation.

2 (a) Solve the following difference equation using z-transform method.

$C(K+2) - 0.1C(K+1) - 0.2C(K) = r(K+1) + r(K)$

Where, $r(K) = u_s(K)$ for K= 0, 1, 2…..,C(0)=0 and C(1)=0.

(b) Find inverse z-transform f(k) of $F(z) = \frac{2z}{z^2 - 1.2z + 0.5}$.

3 State and prove the following theorems of z-transform.

(a) Initial value theorem.

(b) Final value theorem.

(c) Real convolution theorem.

4 (a) Obtain state transition equation by solving non-homogeneous state equation.

(b) Discuss in detail various properties of state transition matrix.

5 (a) Discuss in detail Kalman's tests for controllability and observability.

(b) Check whether the following system is observable or not.

The system is: $X[(K+1)T] = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} X(KT) + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u(KT)$ and $Y(KT) = [1 \quad 1 \quad 1] X(KT)$

6 Obtain the stability of the following characteristic equations by using Routh's criterion.

(a) $F(Z) = Z^3 - 1.25Z^2 - 1.375Z - 0.25 = 0.$

(b) $F(Z) = Z^3 + 3.3Z^2 + 3Z + 0.8 = 0.$

(c) $F(Z) = Z^3 + Z^2 + Z + 1 = 0.$

7 The digital controlled process of a unity-feedback control system is described by the transfer function: $G_{no}.G_P(Z) = \frac{K(Z+0.5)}{(Z-1)(Z-0.5)}$.

Design a cascade phase-lag controller with the transfer function: $D(Z) = K_C \cdot \frac{Z-Z_1}{Z-P_1}$, so that the following specifications are satisfied.

(i) The ramp-error constant, K_V = 6. (ii) The dominant roots of the closed loop characteristic equation are approximately at Z = 0.71 + j0.19 and 0.71 - j0.19. (iii) The maximum overshoot is $\leq 15\%$.

8 Explain in detail state feedback controller design through pole-placement.

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