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MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.Tech. (I & C E) DEGREE END SEMESTER EXAMINATION
May/June 2016
SUBJECT: DIGITAL CONTROL SYSTEMS (ICE - 304)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Obtain the Z transform of $\cos \omega t$

1B. Find the inverse Z transform of $F(z) = \frac{z}{z^2 - z + 0.5}$ by any method.

1C. Find the Ramp response of the system shown in Fig. Q.1C.

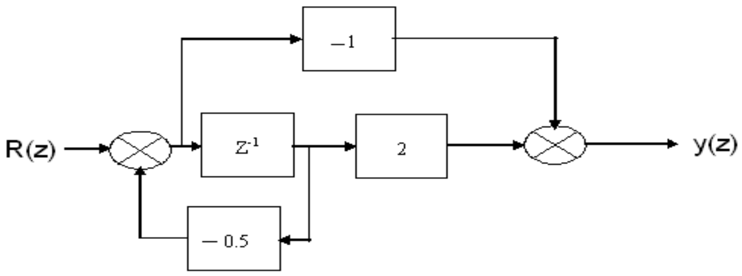

Fig. Q.1C.

(2+3+5)

2A. Determine the initial value and final value of the function $F(z) = \frac{z^2 + 2z + 1}{z^3 + 3z^2 + 3z + 1}$

2B. A discrete time system has the characteristic equation $F(z) = z^3 - 1.1z^2 - 0.1z + 0.2 = 0$. Comment on the stability of the system

2C The open loop transfer function of a unity feedback control system is given by $F(z) = \frac{0.3935Kz}{(z-1)(z-0.6065)}$. Sketch the root locus for a sampling period T=0.5 s. Determine the critical value of K

(2+3+5)

3A. With reference to Bode plot explain Gain margin and Phase margin

3B. Consider the loop transfer function $G(s)H(s) = \frac{5}{s(s+3)}$. The sampling frequency is 1s. Sketch the digital polar plot.

3C. Given the state equation $x(k+1) = \begin{bmatrix} 2 & -5 \\ 0.5 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(k);\ y(k) = 2x_1(k)$. Find (i) Pulse transfer function and (ii) Impulse response if $x(0) = \begin{bmatrix} 1 & 0 \end{bmatrix}^T$

(2+3+5)

4A. Given $F = \begin{bmatrix} 0 & 1 \\ -3 & 4 \end{bmatrix}$. Determine F^K using Cayley Hamilton method.

4B A linear discrete time system has the transfer function $\dfrac{y(z)}{u(z)} = \dfrac{2z+5}{6z^3 - 5z^2 + z}$. Obtain the state model by the cascade realization method and draw the relevant state diagram.

4C Diagonalize the system matrix $F = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -3 & -3 \end{bmatrix}$

(2+3+5)

5A. A discrete plant model is given by

$x(k+1) = \begin{bmatrix} 1 & 0.1 \\ 0 & 1 \end{bmatrix} x(k) + \begin{bmatrix} 0.005 \\ 0.1 \end{bmatrix} u(k); y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(k)$. Design a state feedback controller such that the closed loop system response has the following. Damping ratio=0.6 undamped natural frequency $\omega_n = 10\, rad/\sec$. Take T= 0.1 sec.

5B. A linear autonomous system is described by discrete time state model

$x(k+1) = \begin{bmatrix} 0.5 & 1 \\ -1 & -1 \end{bmatrix} x(k)$. Using direct method of Lyapunov, determine the stability of the equilibrium state.

(6+4)

6A. Descretize the continuous system described by the following state equation for T=1s.

$\dot{x} = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$.

6B. Consider the Control System shown in Fig. Q.6B where the plant transfer function $G(s) = \dfrac{1}{s(s+2)}$ and T = 0.2 sec. Design a lead compensator. Given $\xi = 0.5,\ \omega_n = 4\, rad/\sec$

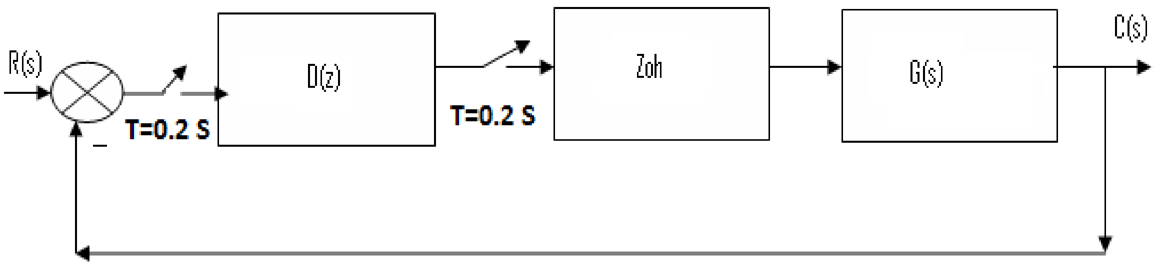

Fig. Q.6B

(5+5)

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