Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

SIXTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: DIGITAL CONTROL SYSTEMS [ICE 304]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. From first principles obtain the Z transform of step function

1B. Find the inverse Z transform of $F(z)=\dfrac{z}{z^2+3z+2}$ by any one method.

1C. Find the step response of the system shown in Fig Q1C.

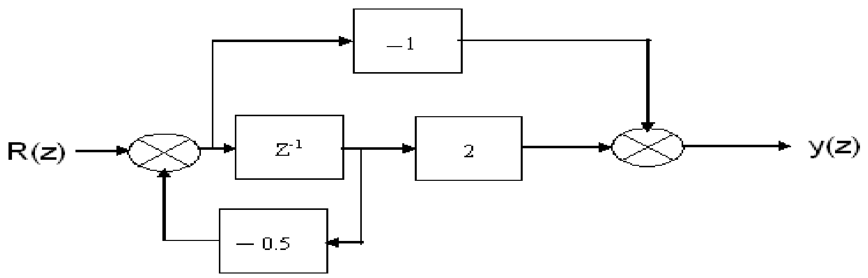

Fig Q1C.

(2+3+5)

2A. Determine the initial value and final value of the function $F(z)=\dfrac{5z^2+2z+1}{3z^2+3z+1}$

2B Solve the following difference equation by inverse $Z-$transform.

$y(k+2)+5y(k+1)+6y(k)=0; y(0)=0,\ y(1)=1$

2C. A discrete time system has the characteristic equation $F(z)=2z^4+7z^3+10z^2+4z+1=0$. Commend on the stability of the system by Jury's test

(2+3+5)

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3A. The open loop transfer function of a unity feedback control system is given by $F(z)=\dfrac{0.3935Kz}{(z-1)(z-0.6065)}$ Determine the critical value of K for a sampling period T=0.5 sec. Also sketch the root locus.

3B. 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 the Pulse transfer function

(5+5)

4A. Given $F=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}$. Determine the state transition matrix F^K when K= 3.

4B A linear discrete time system has the transfer function $\dfrac{y(z)}{u(z)}=\dfrac{z+5}{6z^3+5z^2+z+1}$. Obtain the state model in controllable canonical form and draw the relevant state diagram.

4C Diagonalize the system matrix $F=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}$

(2+3+5)

5A. A discrete plant model is given by $x(k+1)=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}x(k)+\begin{bmatrix}0\\1\end{bmatrix}u(k); y(k)=\begin{bmatrix}1 & 0\end{bmatrix}x(k)$. Is the system is controllable (ii) observable

5B. Check the sign definiteness of the following quadratic forms

(i) $V(x(k))=6x_1^2+4x_2^2+x_3^2+2x_1x_2-2x_2x_3-4x_1x_3$

(ii) $V(x(k))=2x_1^2+x_2^2+3x_3^2+2x_1x_2+2x_2x_3-4x_1x_3$

(iii) $V(x(k))=x_1^2+x_2^2+x_3^2+2x_1x_2+2x_2x_3+3x_1x_3$

5C. 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.

(2+3+5)

6A. A discrete time system is represented by $x(k+1)=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}x(k)+\begin{bmatrix}0.5\\1\end{bmatrix}u(k)$. Design a state feedback control law that makes the closed loop poles at 0.4 and 0.6

6B. Consider the Control System shown in Fig Q6B where the plant transfer function ` and T = 0.2 sec. Design a lead compensator. Given $\xi=0.5,\ \omega_n=4rad/\sec$

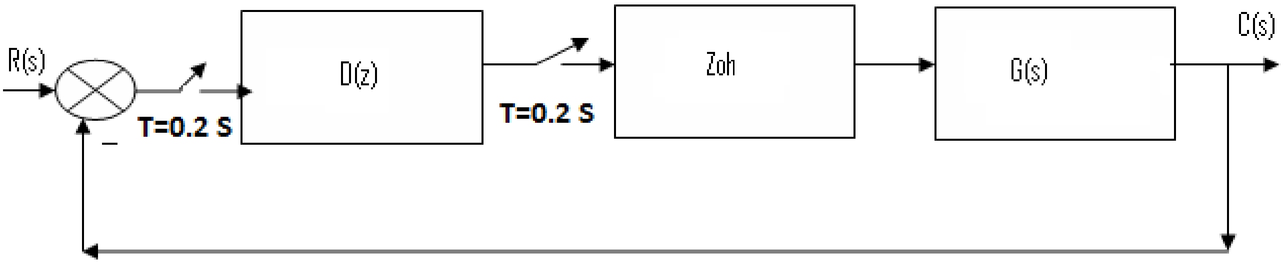

Fig Q6B

(5+5)