APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

08 PALAKKAD CLUSTER

6252(C)-APRIL17-1 **(pages: 3)** **Name:**

Reg No:

SECOND SEMESTER M.TECH. DEGREE EXAMINATION MAY

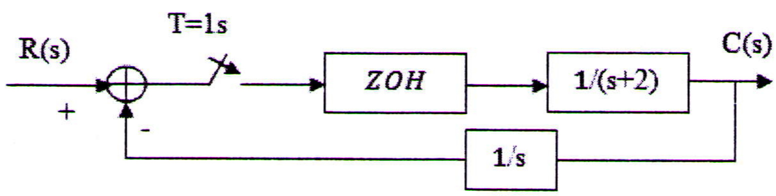
08EE6252(C) DIGITAL CONTROL SYSTEMS

Time: 3 hours **Max. marks: 60**

Answer all six questions. Part 'a' of each question is compulsory.

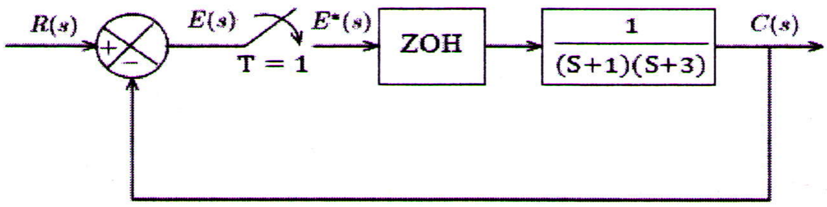
Answer either part 'b' or part 'c' of each question

Q.no.	Module 1	Marks
1.a	Write down in detail the necessity of Digital control system design with help of a block diagram. Point out the difference of such control system over conventional control system.	3
	Answer b or c	
b	Solve the following difference equation by use of the Z transform method $$x(k+2)+3x(k+1)+2x(k)=0, \quad x(0)=0 \text{ and } x(1)=1$$	6
c	Define pulse transfer function and derive the overall pulse transfer function of the system represented by following block diagram.	6

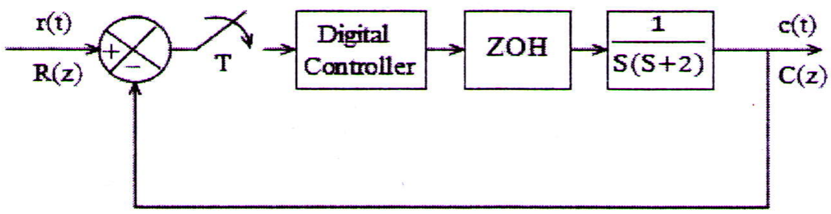


Q.no.	Module 2	Marks
2.a	Explain, with proof, how Routh's stability criterion can be extended for discrete time systems	3
	Answer b or c	
b	i. Comment on the stability of the system with loop transfer function, $GH(z)=\frac{Z+1}{2Z^4+7Z^3+10Z^2+3Z}$. using Jury's stability test ii. Determine the stability of the following characteristic equation by using Routh's stability criterion. $$P(z) = z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$$	6

Q.no.		Marks
c	Calculate the steady state errors of unit step, unit ramp and unit parabolic inputs for the system shown in Figure.	6



Q.no.	Module 3	Marks
3.a	State Nyquist stability criterion in the Z – Plane.	3
	Answer b or c	
b	Consider the digital control system shown in figure in the Z plane, design a digital controller such that the dominant closed loop poles have a damping ratio of 0.5 and a settling time of 2 sec. The sampling period is assumed to be 0.2 sec or T = 0.2. Obtain the response of the designed digital control system to a unit step. Also obtain the static velocity error constant Kv of the system.	6



Q.no.		Marks
c	Realize the lead and lag compensators using active electronic components and compare both using their transfer functions.	6

Q.no.	Module 4	Marks
4.a	Draw the state space representation (block diagram representation) of discrete time systems.	3
	Answer b or c	
b	Derive an expression to obtain transfer function from state model.	6
c	Obtain a state space representation of the following pulse transfer function system such that the state matrix is diagonal	6

$$\frac{Y(Z)}{U(Z)} = \frac{Z^3 + 8Z^2 + 17Z + 8}{(Z+1)(Z+2)(Z+3)}$$

Q.no.	Module 5	Marks
5.a	Write the discrete time representation of state models in Observable Canonical Form (OCF).	4

Answer b or c

b Obtain the discrete time state and output equation and the pulse transfer function (when the sampling period T = 1) of the following **8**

$$G(S) = \frac{Y(S)}{U(S)} = \frac{1}{S(S+2)}$$

c Obtain the Controllable Canonical Form (CCF) of the given state space model by using transformation matrix. **8**

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 3 & 5 \\ 2 & 6 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 2 \\ 4 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 2 & 6 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

Q.no.	Module 6	Marks
6.a	Define Controllability and Observability for a linear time invariant discrete time control system?	4

Answer b or c

b Consider the system $x(k+1) = Gx(k) + Hu(k)$, Where **8**

$$G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} \qquad H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Determine a suitable state feedback gain matrix K such that the system will have closed loop poles at $z = 0.5 + j0.5$, $z = 0.5 - j0.5$

c Consider the system $x(k+1) = Gx(k) + Hu(k)$ $\quad y(k) = Cx(k)$Where **8**

$$G = \begin{bmatrix} 0 & -0.16 \\ 1 & -1 \end{bmatrix} \qquad H = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \qquad C = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

Design a full order state observer, the desired eigen values of the observer matrix are $z = 0.5 + j0.5$, $z = 0.5 - j0.5$