Code No: 127CG **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech IV Year I Semester Examinations, February/March - 2022
DIGITAL CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Answer any Five Questions
All Questions Carry Equal Marks

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1.a) What are the advantages and disadvantages of digital control systems?
b) Give any one typical example of digital control systems and explain its operation. [7+8]

2.a) Given the z transform $X(z) = \frac{(1-e^{-aT})}{(z-1)(z-e^{-aT})}$, Where 'a' is a constant and 'T' is the sampling period, determine the inverse z transform x(kT) by use of the partial fraction expansion method.
b) The input output of a sampled data system is described by the difference equation y(k+2) +3y(k+1)+4y(k) =r(k). Determine the pulse transfer function, the initial conditions are y(0) =0, y(1) =1. [7+8]

3. Consider the discrete control system represented by the following transfer function $G(z) = \frac{1+0.8z^{-1}}{1-z^{-1}+0.5z^{-2}}$. Obtain the state representation of the system in the observable canonical form. Also find its state transition matrix. [15]

4. Obtain the state model of the following difference equation y(k+2)+2y(k+1)+3y(k)=u(k+1)+4u(k). Also determine its state transition matrix. Assuming initial conditions are zero. [15]

5.a) Explain the mapping between S-plane and Z-plane with necessary diagrams and equations.
b) Test the stability conditions of the digital systems that are represented by the characteristic equation $Z^4 - 4z^3 + Z^2 - 3Z + 2 = 0$. [7+8]

6.a) Determine the stability of the following characteristic equation by using suitable tests. $z^4 - 1.7z^3 + 1.04z^2 - 0.268z + 0.024 = 0$.
b) With an example explain the stability analysis using Modified Routh's stability criterion. [8+7]

7. Explain the design procedure for Lag –Lead compensator in ω-plane. [15]

8.a) Derive the sufficient conditions for design of state feedback controller through pole placement?
b) Consider the following system $X(k+1) = GX(k) + Hu(k)$
Where $G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}$, $H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Determine a state feedback controller K to place the closed loop poles at z=0.5±j0.5. [7+8]

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