Code No: **RT42021** **R13** **Set No. 1**

IV B.Tech II Semester Supplementary Examinations, July/August - 2017

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B

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PART–A *(22 Marks)*

1. a) Explain the zero order hold device. [3]
   b) What are the limitations of z-transform method? [4]
   c) Explain the concept of state transition matrix? [3]
   d) What are the conclusions from the general mapping between the s and z planes by the z transform? [4]
   e) What are the steady state specifications? Explain in brief. [4]
   f) State the necessary condition for design of state feedback controller through pole placement? [4]

PART–B *(3x16 = 48 Marks)*

2. a) Explain the following examples of digital control system
   (i) A step motor control system (ii) Microprocessor controlled system [8]
   b) List out the advantages of digital systems? [5]
   c) State the sampling theorem? [3]

3. a) The input-output of a sampled data system is described by the difference equation $y(k+2)+3y(k+1)+4y(k)=r(k+1)-r(k)$ Determine the pulse transfer function. [8]
   b) Find the inverse z-transform function of $\frac{z-0.4}{z^2+z+2}$ [8]

4. Define controllability and observability of discrete time systems. For the following system,

$$\frac{Y(z)}{U(z)}=\frac{z^{-1}(1+0.8z^{-1})}{1+1.3z^{-1}+0.4z^{-2}}$$

Determine whether the system is observable and controllable. [16]

5. Check if all the roots of the following characteristic equations lie within the unit circle
   (i) $5z^2-2z+2=0$
   (ii) $z^3-0.2z^2-0.25z+0.05=0$
   (iii) $z^4-1.7z^3+1.04z^2-0.268z+0.024=0$ [16]

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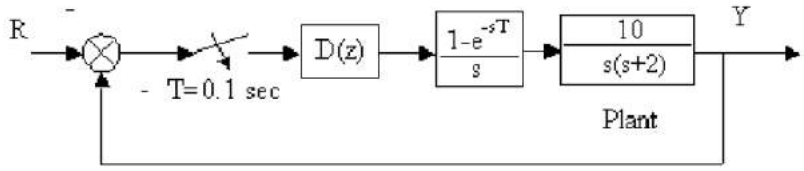
6. A block diagram of a digital control system is shown in Figure 1. Design a compensator D(z) to meet the following specifications:
(a) Velocity error constant, Kv ≥ 4 Sec.,
(b) Phase margin ≥ 400 and
(c) Band width =1.5 rad./sec.



[16]

Figure.1

7. a) Derive the necessary condition for the digital control system
X(k + 1) = AX(k) + Bu(k)
Y(k) = CX (k) to be Controllable. [10]

b) Derive the sufficient conditions for design of state feedback controller through pole placement? [8]