**Seventh Semester B. Tech. [ELECTRICAL] Degree Examination**

(2013 Scheme- Oct/Nov 2016)

**13.706.5 DESIGN OF DIGITAL CONTROL SYSTEMS (E) (Elective III)**

Time: 3Hours Max. Marks: 100

- ***Instruction:*** *Answer* ***all*** *questions from Part* ***A****.* ***One full*** *question from* ***each*** *Module of Part* ***B****.*

**PART A (***Each carries 2 mark****)***

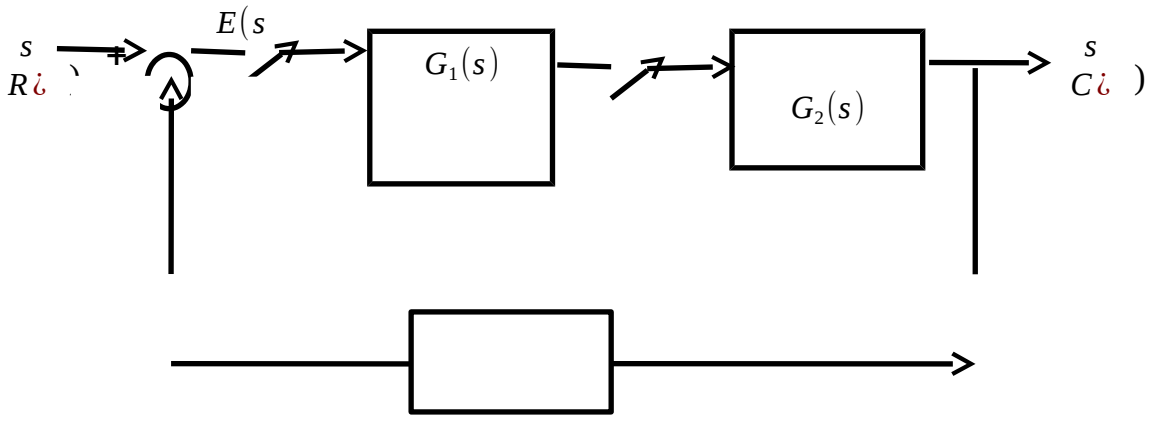
1. What are the advantages of digital control over analog control?
2. Explain Sampling theorem.
3. Define Initial value theorem and Final value theorem.
4. Explain Bilinear transformation
5. What are the different stability analysis techniques used in Digital Control systems?
6. Explain Dead beat response
7. Explain in brief about direct design method of Ragazzini.
8. What are the different canonical form representations of discrete time control systems?
9. Define controllability and stabilizability.
10. Derive the Pulse Transfer Function of a linear time invariant discrete time system

**PART B**

**MODULE 1**

11.a) Explain mapping between s domain and z domain **(10)**

b) Obtain the closed loop pulse transfer function of the given system




**(10)**

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**OR**

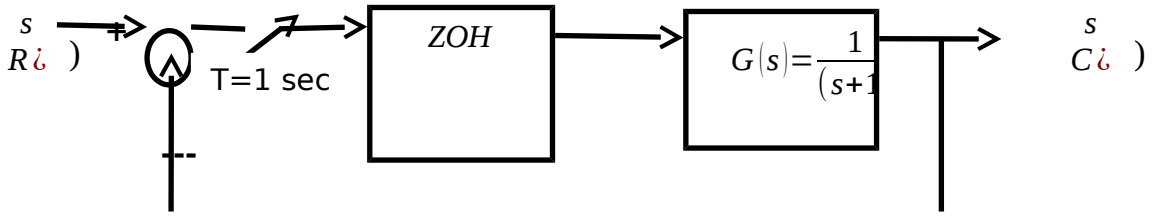
12.a) Find out the inverse Z transform

i. $F(Z)=\dfrac{1}{1-1.5z^{-1}+0.5z^{-2}}$

ii. $F(Z)=\dfrac{z^2}{z^2-z+0.5}$

**(10)**

b) Find out the step response of the system




**(10)**

**MODULE 2**

13. Design a digital controller for the plant described by $G(z)=\dfrac{K(0.01873z+0.01752)}{(z-1)(z-0.8187)}$ such that the phase margin is 50 $^{\circ}$, the gain margin is atleast 10dB and static velocity error constant $K_v=2\,sec^{-1}$. **(20)**

**OR**

14. a) With the help of neat block diagram explain Digital PID controller. **(10)**

b) Consider the discrete time unity feedback control system (with sampling period $T=1\,Sec$) whose open loop pulse transfer function is given by $G(z)=\dfrac{K(0.3679z+0.2642)}{(z-1)(z-0.3679)}$. Determine the range of $K$ for stability by use of the Jury's stability test. **(10)**

**MODULE 3**

15. Obtain a Digital Controller $D(z)$ that will give dead beat response to a unit step input for the system $G(z)=\frac{0.04837(z+0.9672)}{(z-1)(z-0.9048)}$ .Assume the sampling time $'T'$ to be 1 sec. **(20)**

**OR**

16. Consider the digital control system shown in the figure.

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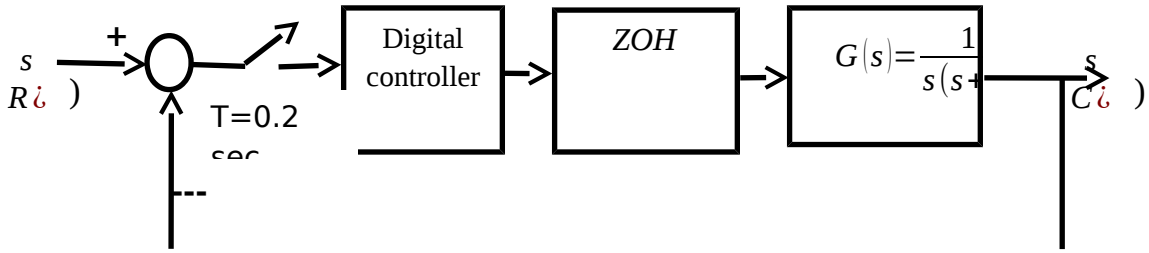


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Design a digital controller using Root Locus method such that the dominant closed loop poles have a damping ratio of $\zeta=0.5$ and a settling time of 2 sec. The sampling period is assumed to be 0.2 sec **(20)**

**MODULE 4**

17. a) Explain the computation of state transition matrix using z-transform method. **(5)**

b) Obtain the state transition matrix and Pulse transfer function of the following discrete time system.

$$x(k+1)=Gx(k)+Hu(k)$$

$$y(k)=Cx(k)+Du(k)$$

Where $G=\begin{bmatrix}0 & 1\\ -0.16 & -1\end{bmatrix}; H=\begin{bmatrix}1\\1\end{bmatrix}, C=\begin{bmatrix}1 & 0\end{bmatrix}, D=0$ **(15)**

**OR**

18. a) Define Reachability. **(2)**

b) Briefly explain Pole Placement technique for SISO systems **(7)**

c) Explain any one method to find out the feedback gain matrix $K$ **(3)**

d) Consider the system

$$x(k+1)=G\,x(k)+H\,u(k)$$

where $G=\begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}$ , $H=\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

Determine a suitable feedback gain matrix $K$ such that the system will have the closed loop poles at $z=0.5+j0.5$ and $z=0.5-j0.5$ **(8)**