Paper Code: EIC-701	**Roll No.**									

B. Tech.
Back paper SEVENTH SEMESTER EXAMINATION, 2016-17
CONTROL SYSTEM-II

[Time: 3 hrs.] [Max. Marks: 100]

Note- Attempt All questions. Assume suitable data, if required. All questions carry equal marks.

1. Attempt any *four* parts of the following: - **(5x4=20)**

(a) How D/A converter is used in the sampled data control system ? Explain with suitable neat diagram.

(b) Explain the fundamental parameters of an S/H element during the working of sample and hold operation.

(c) Explain the concept of constant damping loci.

(d) Find the Z- transform of the ramp function $f(t) = t\, u_s(t)$.

(e) Explain the relationship between the s-plain and the z-plain.

(f) Consider the characteristic polynomial $\Delta(Z) = 2Z^4 + 7Z^3 + 10Z^2 + 4Z + 1$. Test the stability using Jury's criteria.

2. Attempt any *four* parts of the following: - **(5x4=20)**

(a) Derive the expression for transfer function of a given state space model in general sense.

(b) Obtain the transfer function of the systems represented by F = [1 2; -3 -4], G = [1;2], C =[1 1].

(c) Explain the pulse transfer function of the zero order hold and the relation between G (s) and G(z).

(d) What do you understand by digital PID controller?

(e) Draw the block diagram of Multirate Discrete Data System and explain in brief.

(f) Obtain the three different canonical forms of state variable models corresponding to the given transfer function $G(z) = (4Z^3 - 12Z^2 + 13Z - 7) / (Z-1)^2 (Z-2)$.

3. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Define controllability and observability. Give its necessary and sufficient conditions for a system to be controllable. Also determine the controllability and observability properties of the given system

F = [-1 0 0; 0 -2 0; 0 0 -3], G = [1 0; 1 2; 2 1], C = [1 1 2; 3 1 5].

(b) State the Cayley-Hamilton theorem. Find $\mathbf{e^{At}}$ **where A = [0 0 -2; 0 1 0; 1 0 3].**

(c) State and prove the Lyapunov's stability theorem for the digital system. Consider the system given by the equations:

$$x_1(k+1) = -1.5x_1(k) \text{ and}$$

$$x_2(k+1) = -0.5x_2(k)$$

Analyse the system stability.

4. Attempt any *two* parts of the following: - **(10x2=20)**

(a) State the theorem of Lyapunov stability function for linear autonomous system. Also investigate the stability of the given system coefficient is given by **A = [-0.5 0; 0 -0.5].**

(b) Find the optimal value of K so that $J = [e^2(k) + 0.75u^2(k)]$ is minimized. Given that F = 1, G = 1, R = 1.5, Q = 2.

(c) For the given system described by state equation

$$x(k+1) = [2\ -1;\ -1\ 1]x(k) + [4;\ 3]u(k)$$

$$y(k) = [1\ 1]x(k) + 7u(k)$$

Design a controller such that the desired close loop poles are located at $\pm (0.5)j$.

5. Attempt any *two* parts of the following: - **(10x2=20)**

(a) What is digital quantization explain in brief with proper neat diagrams.

(b) Draw the general block diagram of a microcontroller used in a digital control system. Explain taking any industrial application using a microcontroller.

(c) Draw the block diagram of a position control system based upon microprocessor and explain.