(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID :120661 Roll No. | | | | | | | | | | |

B.TECH.

Theory Examination (Semester-VI) 2015-16

DIGITAL CONTROL SYSTEM

Time : 3 Hours *Max. Marks : 100*

Section-A

Q.l Attempt all parts. All parts carry equal marks. Write answer of each part in short. (2×10=20)

(a) What are the advantages of digital control over analog control system?

(b) Disuss the importance of ROC a digital system.

(c) What are the limitations of high-gain in feedback control system?

(d) State Cayley-Hamilton theorem.

(e) What is difference between open loop and close loop system?

(f) Define State Transition matrix.

(g) Define bilinear transformation.

(h) Define Routh stability criterion for right-half s-Plane.

(i) Define poles and zeros? Explain its significance.

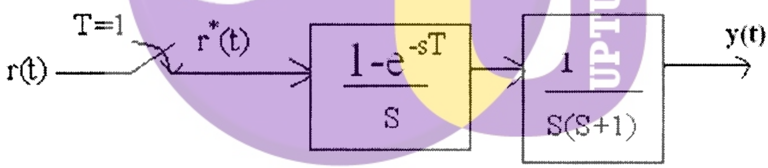
(j) Draw sample and hold circuit.

Section-B

Q2. Attempt any 5 questions from this section. (10×5=50)

(a) Describe the configuration of the basic Digital control scheme & explain the importance of each building blocks.

(b) Find the response of the system shown in figure to a unit impulse input.



(c) Write the rules for construction of root locus plot of 1+F(z) in digital compensator design.

(d) Convert the following transfer function to state variable model using (i) first companion form, (ii) second companion form and (iii) Jordan Canonical form.

$$G(S) = \frac{s+3}{S^3 + 9S^2 + 24S + 20}$$

e) Using jury stability criterion, find all the poles of the following transfer function lie inside the circle the unit circle on the z-plane.

$$G(Z) = \frac{3z^4 + 2z^3 - z^2 + 4z + 5}{z^4 + 0.5z^3 + -0.2z^2 + z + 0.4}$$

f) State the liapunov's main theorem. Examine the stability of the system described by

$$\overset{*}{X}_1 = X_2 - X_1(X_1{}^2 + X^2)$$

$$\overset{*}{X}_2 = -X_1 - X_2(X_1{}^2 + X_2{}^2)$$

g) State and explain the Max. Min. principle. Describe its performance index.

h) Find the optimal control u^* (t) for the $\dot{x} = u$; x(0)=l which minimizes $J = \frac{1}{2}x^2(4) + \frac{1}{2}\int_0^4 u^2\, dt$.

Section-C

Note: Attempt any 2 questions from this section.

(15×2=30)

Q3. Consider the digital control system shown in figure 1, the transfer function of the plant is G(s) = $\frac{1}{S(s+1)}$

Design a lead compensator D(z) in the w-plane such that the phase margin in 50°, the gain margin is at least 10 dB, and the velocity error constant K_v is 2. Assume that the sampling period is 0.2 sec.

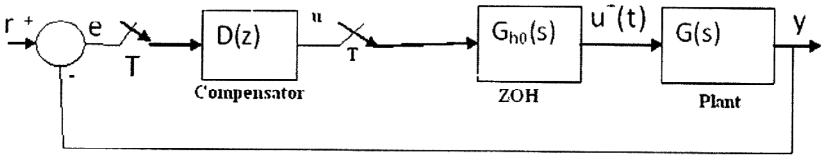


Figure 1

Q4. (a) Define stability of digital control system and discuss how is jury-stability criterion applied for stability investigation for such systems.

(b) Check stability of the digital control system shown by its block diagram in figure 2.

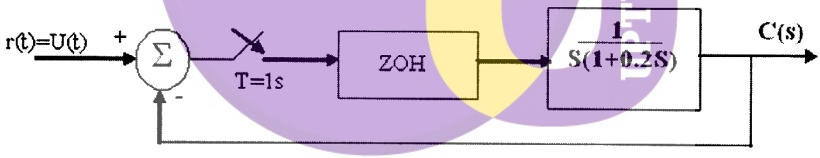


Figure 2

Q5. (a) State the principle of optimality. Also derive the dynamic programming equation.

(b) State and explain the concept of dynamic programming.