Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH (EE)/SEM-2/CAM-204(C)/2013

2013

DIGITAL CONTROL SYSTEM

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) What are the methods of testing the stability of digital control system ? Explain any one.

   b) Consider the characteristic polynomial :

   $$F_1(Z) = 2Z^4 + 7Z^3 + 10Z^2 + 4Z + 1.$$

   Test the stability by Jury. 6 + 8

2. Find the *Z*-transform of the following : 4 + 5 + 5

   a) $k^2 a^k$

   b) $e^{-at} \cos \omega t$

   c) $H(s) = \frac{a}{s(s+a)}$.

3. A discrete system is described by state equation :

$$X_1(K+1) = \frac{1}{4}x_1(K) + u(K)$$

$$X_2(K+1) = \frac{1}{8}x_1(K) + \frac{1}{8}x_2(K) + u(K)$$

and the output $y(K) = \frac{1}{2}x_1(k)$.

Solve for the output $y(K)$ when $u(K)$ is unit impulse and $x(0) = 0$.

4. Find the inverse Z-transform of the following : 5 + 5 + 4

a) $\dfrac{2Z^2}{(Z+2)^2(z+1)}$

b) $\dfrac{\left(3Z^2 + 2Z + 1\right)}{\left(Z^2 - 3Z + 2\right)}$

c) $\dfrac{(Z-4)}{(Z-1)(z-2)^2}$

5. a) Determine the first few terms of the sequence by infinite power series method of the sequence $f(K)$ when

$$F(Z) = \frac{\left(z^2 + z\right)}{\left(z^2 - 2z + 1\right)}$$

b) Let $C(z) = \dfrac{AT}{Z-(1-AT)}\ R(Z)$

Find $C(K)$ if input is discrete step. 7 + 7

6. a) State the properties of state transition matrix in digital control.

   b) Obtain state transition matrix of the following system :

$$A = \begin{bmatrix} 0 & 1 \\ -12 & 7 \end{bmatrix}.$$

4 + 10

7. A discrete time system is described by the state equation

$$y(K+2) + 5y(K+1) + 6y(K) = u(K)$$

$$y(0) = y(1) = 0, \quad T = 1 \text{ sec.}$$

   a) Determine a state model in canonical form.

   b) Find state transition matrix. 7 + 7

8. Write short notes on any *two* of the following : 2 × 7

   a) Digital PID controller

   b) Transfer function of hold circuit

   c) Digital compensator design using frequency response plot

   d) Digital control system.