COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)
SHIVAJI NAGAR, PUNE - 411 005

End Semester Examination
IE(DE) - 14003 Digital Control
Instrumentation and Control Engineering

Course: B.Tech
Semester: Sem VII
Year: 2014-2015
Time: 2 to 5 p.m.

Max. Marks: 60
Date: 28 NOV 2014 /11/2014

Instructions:

MIS No. _____

1. **All questions carry equal marks.**
2. **Mobile phones and programmable calculators are strictly prohibited.**
3. **Writing anything on question paper is not allowed.**
4. **Exchange/Sharing of anything like stationery, calculator is not allowed.**
5. **Assume suitable data if necessary.**
6. **Write your MIS Number on Question Paper.**

1. (a) Find the z transform and modified z transform of $c(t)$ if

$$C(s) = \frac{k(s+1)}{(s+2)(s+4)}$$

from the first principles.

(b) Explain what additional information is obtained from the modified $z-$ transform.

2. (a) State the conditions for stability on the roots of the characteristic equation for a continuous system and a discrete system.

(b) Given a unity feedback system with

$$G_{ho}G(z) = \frac{kz}{(z+1)(z+0.4)(z-0.4)}$$

find the range of k for stability using the transformation

$$w = \frac{z-1}{z+1}$$

3. (a) Briefly describe one method for discretization design.

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(b) For a certain system, the continuous compensator

$$D(s) = \frac{1 + 0.04s}{1 + 0.01s}$$

is to be discretized. Find $D(z)$ for sampling periods of $T = 1, 0.1$ and 0.01 sec. Comment on the implementation difficulties with reference to some digital hardware you are familiar with.

4. (a) What advantages if any can the δ operator give over the shift operator.

(b) Given

$$\begin{aligned} x_1(k+1) &= x_2(k) \\ x_2(k+1) &= x_3(k) \\ x_3(k+1) &= x_4(k) \\ x_4(k+1) &= x_1(k) - 2x_2(k) + 3x_4(k) + 2u(k) \\ y(k) &= x_1(k) \end{aligned}$$

Design a state feedback so that the closed loop poles will be at -0.1, -0.4 and 0.2. Derive the open loop and closed loop transfer functions in z- plane.

5. Write short notes on:

(a) $w-$ transform

(b) Frequency domain representation of z transform

(c) δ transform

(d) Direct digital design