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Reg. No. : ....

Name : ....

First Semester M.Tech. Degree Examination, March 2014
(2013 Scheme)
Branch : Electrical & Electronics Engineering
Streams : Control Systems, Guidance & Navigational Control
ECC 1002 : DIGITAL CONTROL SYSTEMS

Time : 3 Hours Max. Marks : 60

Instruction : *Answer **any two** questions from **each** Module.*

Module – I

1\. a) Derive the transfer function of zero order hold circuit. 4

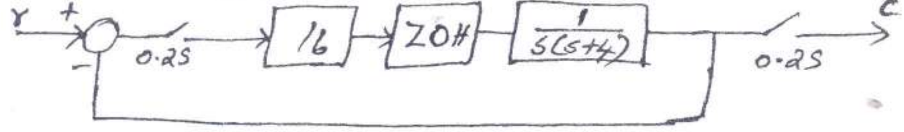
b) State sampling theorem. 2

c) Based on sampling theorem determine the maximum value of sampling interval T that can be used to enable us to reconstruct e(t) from its samples if $E(s) = \frac{10(s+2)}{(s^2+2s+2)}$. 4

2\. a) Explain the mapping between s plane and z plane. 5

b) Apply Jury's test to determine the stability of the system with characteristic equation $z^4 - 0.6z^3 - 0.81z^2 + 0.67z - 0.12 = 0$. 5

$z^4 - 0.6z^3 - 0.81z^2 + 0.67z - 0.12 = 0$

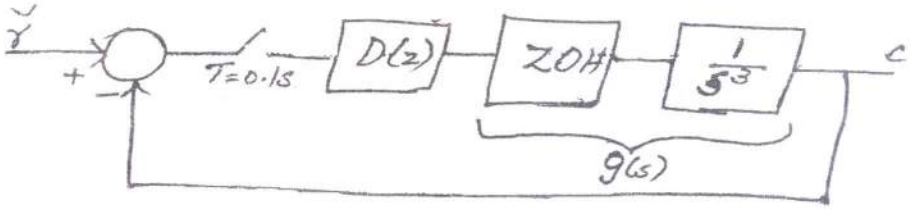
3\. 

Apply Routh Hurwitz criterion to determine the stability of the system represented by block diagram above. 10

P.T.O.

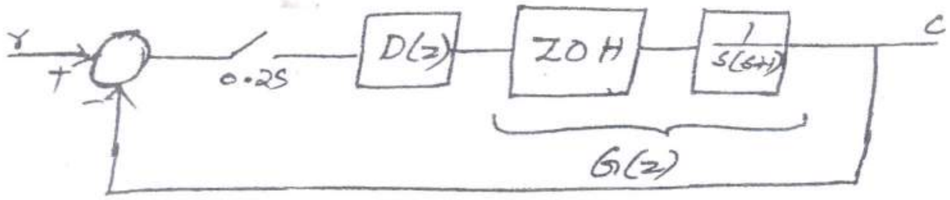
Module – II

4. Consider the digital control system shown in figure



Design a digital controller D(z) such that the phase margin in w plane is 50° and gain margin is atleast 10dB. $G(z) = \frac{0.005\,(z+1)}{(z-1)^2}$. 10

5. Consider the digital control system shown in figure



Design a digital controller D(z) such that the closed loop system has a damping ratio 0.5 and number of samples per cycle of damped sinusoidal oscillation to be 8. 10

6. a) Explain the effect of sampling period on controllability of a system. 4

b) Obtain any two canonical forms of state space representation of the system with pulse tranfer function. 6

$$\frac{Y(z)}{U(z)} = \frac{1+6z^{-1}+8z^{-2}}{1+4z^{-1}+3z^{-2}}.$$

Module – III

7. Consider a plant described by

$x(k+1) = Ax(k) + bu(k),\ y(k) = cx(k)$

Where $a = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -0.5 & -0.2 & 1.1 \end{bmatrix}$, $b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $c = [1 \quad 0 \quad 0]$.

Design a prediction observer for the estimation of the state vector x; the observer poles are required to be placed at $-0.6, -0.5 \pm j\,0.25$. 10

8. State separation principle. Apply separation prnciple to design a controller to place the poles at $-0.5 \pm j\,0.5, 0$ for the system.

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k);\ y(k) = [1 \quad 0 \quad 0]\,x(k).$$

Assume any additional data required. 10

9. Convert the following system in to controllable companion form.

$$x(k+1) = \begin{bmatrix} 0.5 & 1 & 0 \\ -1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} x(k) + \begin{bmatrix} 1 & 4 \\ 0 & 0 \\ -3 & 2 \end{bmatrix} u(k).$$

$$y(k) = [1 \quad 0 \quad 0]\, x(k) + [0 \quad 4]\, u(k).$$ 10