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Reg. No. : .....

Name : .....

Eighth Semester B.Tech. Degree Examination, April 2015
(2008 Scheme)
08.801 : ADVANCED CONTROL THEORY (E)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

1. What are the properties of state transition matrix ?
2. Represent the following differential equation in state variable form.

$$\frac{d^2y}{dt^2} + \frac{5dy}{dt} + 2y = 4u(t).$$

3. What is similarity transformation ? Explain.
4. Write the diagonal form of state model of n^{th} order system ? What are its merits ?
5. What are the advantages of sampled data control system ?
6. Discuss the criteria for selecting sampling frequency.
7. Write the properties of Z-transform.
8. What is zero order hold ? Obtain its transfer function.
9. Distinguish between stable limit cycle and unstable limit cycle.
10. Derive the describing function of relay.

P.T.O.

PART – B

Answer **one full** question from **each** Module. **Each** question carries **20** marks.

Module – 1

11. a) Obtain the state model of an armature controlled dc motor.

b) $\frac{v(s)}{u(s)} = \frac{s^3 + 5s^2 + 3s + 4}{s^3 + 7s^2 + 12s}$; obtain the state space model in phase variable form and diagonal form.

12. a) Obtain the step response of the system

$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u$ with the initial conditions $\begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$;

output $y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$.

b) $\frac{v(s)}{u(s)} = \frac{10}{s(s+1)(s+2)}$. Design a state feedback controller with a state feedback so that the closed loop poles are placed at $-2, -1 \pm j1$.

Module – 2

13. a) Find the inverse Z-transform of

i) $F(z) = \frac{1 + z^{-1} + 2z^{-2} - z^{-3} + 3z^{-4}}{1 + 2z^{-1} + 3z^{-2}}$

ii) $F(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$.

b) Find the z-transform of

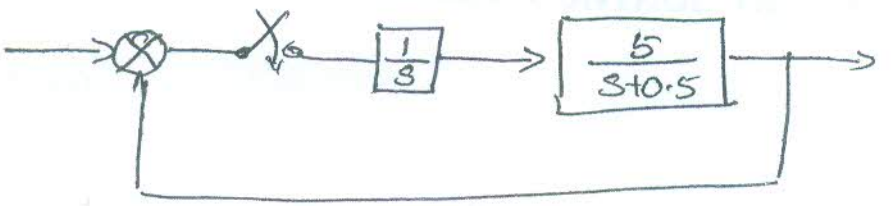
i) $e^{-at} \sin \omega t$

ii) $k^2 a^k$.

14. a) Solve the difference equation

$c(k+2) + 3c(k+1)+2c(k) = u(k)$. Given that $c(0) = 1$, $c(1) = -3$, $c(k) = 0$ for $k < 0$.

b) Determine the pulse transfer function of the system shown in fig. Is the system stable for sampling time T = 1sec.



Module – 3

15. a) Explain the terms stable, asymptotically stable and asymptotically stable in the large.

b) Explain Liapunov stability theorems.

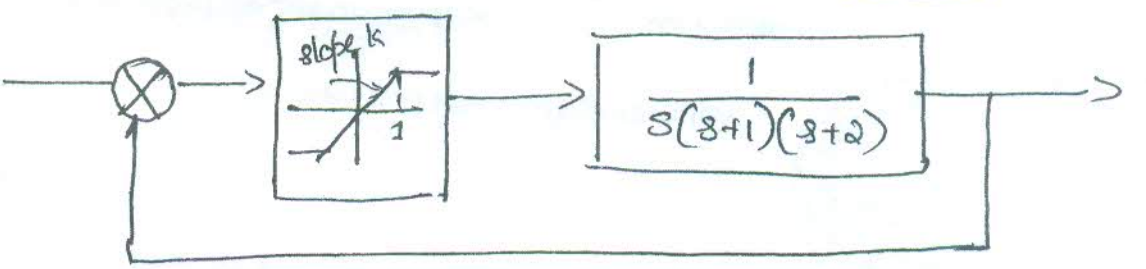
c) Consider a non-linear system governed by the equations

$\dot{x}_1 = -x_1 + 2x_1^2 x_2$

$\dot{x}_2 = -x_2$

Check stability using Liapunov method.

16.



For the unity feedback system shown in fig : having a saturation amplifier with gain k, determine the maximum value of k for the system to be stable. What would be magnitude, frequency and nature of limit cycle for a gain of k = 3.