CHAPTER-9. CONTROL SYSTEM

[1] An open loop system represented by the transfer function G(s) = (s-1) / (s+2)(s+3) is
A. stable and of the minimum phase type
B. stable and of the non-minimum phase type
C. unstable and of the minimum phase type
D. unstable and of the non-minimum phase type
[2] The open loop transfer function G(s) of a unity feedback control system is given as,

$$G(s) = [\, k(s+2/3) \;/\; s^2(s+2) \,]$$

From the root locus, it can be inferred that when k tends to positive infinity,
A. three roots with nearly equal real parts exist on the left half of the s-plane
B. one real root is found on the right half of the s-plane
C. the root loci cross the jω axis for a finite value of k; k≠0
D. three real roots are found on the right half of the s-plane
[3] Given that

$$A = \begin{bmatrix} -5 & -3 \\ 2 & 0 \end{bmatrix} \text{ and } I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix},$$

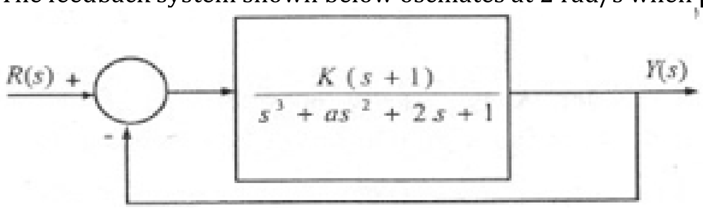
then the value of A^3 is **[GATE2012]**
A. 15A+12I
B. 19A+30I
C. 17A+15I
D. 17A+21I
[4] The matrix **[A]**=

$$\begin{bmatrix} 2 & 1 \\ 4 & -1 \end{bmatrix}$$

is decomposed into a product of a lower triangular matrix **[L]** and an upper triangular matrix **[U]**. The properly decomposed**[L]** and **[U]** matrices respectively are............The options A,B,C,D are given below.

A	B	C	D
$\begin{bmatrix} 1 & 0 \\ 4 & -1 \end{bmatrix}$ and $\begin{bmatrix} 1 & 1 \\ 0 & -2 \end{bmatrix}$	$\begin{bmatrix} 2 & 0 \\ 4 & -1 \end{bmatrix}$ and $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 \\ 4 & 1 \end{bmatrix}$ and $\begin{bmatrix} 2 & 1 \\ 0 & -1 \end{bmatrix}$	$\begin{bmatrix} 2 & 0 \\ 4 & -3 \end{bmatrix}$ and $\begin{bmatrix} 1 & 0.5 \\ 0 & 1 \end{bmatrix}$

Ans: none of the above
[5] The input x(t) of a system are related as $y(t) = \int_{-\infty}^{t} x(\tau)\cos(3\tau)d\tau$. The system is **[GATE2012]**
A. time-invariant and stable
B. stable and not time-invariant
C. time-invariant and not stable
D. not time-invariant and not stable
[6]The feedback system shown below oscillates at 2 rad/s when **[GATE2012]**



A. k=2 and a=0.75
B. k=3 and a=0.75
C. k=4 and a=0.5
D. k=2 and a=0.5

[7] The Fourier transform of a signal h(t) is $H(j\omega) = (2\cos\omega)(\sin 2\omega)/\omega$. The value of h(0) is **[GATE2012]**

A. 1/4
B. 1/2
C. 1
D. 2

[8] The state variable description of an LTI system is given by

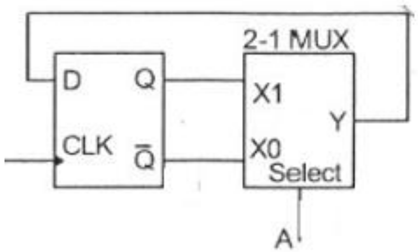
$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} 0 & a_1 & 0 \\ 0 & 0 & a_2 \\ a_3 & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u$$

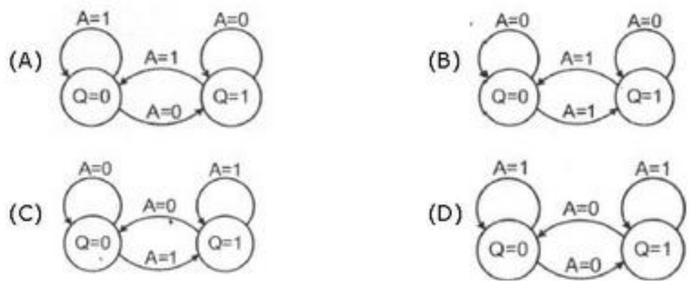
$$y = \begin{pmatrix} 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

where y is the output and u is the input.The system is controllable for, **[**GATE2012**]**

A. $a_1 \neq 0, a_2 = 0, a_3 \neq 0$
B. $a_1 = 0, a_2 = 0, a_3 \neq 0$
C. $a_1 = 0, a_2 = 0, a_3 = 0$
D. $\mathbf{a_1 \neq 0, a_2 \neq 0, a_3 = 0}$

[9] The state transition diagram for the logic circuit shown is **[**GATE2012**]**





Ans: D

[10] Given that

$$A = \begin{bmatrix} -5 & -3 \\ 2 & 0 \end{bmatrix} \text{ and } I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix},$$

then the value of A^3 is **[**GATE2012**]**

A. 15A+12I

B. 19A+30I
C. 17A+15I
D. 17A+21I

[11] A system is described by the following state and output equations

[$dx_1(t)/dt$**]** $=-3x_1(t)+x_2(t)+2u(t)$

[$dx_2(t)/dt$**]**$=-2x_2(t)+u(t)$

$y(t)=x_1(t)$

where u(t) is the input and y(t) is the output

The system transfer function is **[**GATE 2009**]**

A. $(s+2)/(s^2+5s-6)$

B. $(s+3)/(s^2+5s+6)$

C. $(2s+5)/(s^2+5s+6)$

D. $(2s-5)/(s^2+5s-6)$

Ans: C

[12] A two-port network is defined by the relation: **[**IES 2010**]**

$I=5V_1+3V_2$

$I_2=2V_1-7V_2$The value of Z_{12} is

A. 3

B. -3

C. 3/41

D. 2/31

Ans: C

[13] The Z-transform of x(K) is given by **[**IES 2010**]**

$x(Z)= \{(1-e^{-T})z^{-1}\} / \{(1-z^{-1})(1-e^{-T}z^{-1})\}$

The initial value of x(0) is

A. Zero

B. 1

C. 2

D. 3

Ans: A

[14] Consider the following statements with reference to the phase plane:

1. They are general and applicable to a system of any order.
2. Steady state accuracy and existence of limit cycle can be predicte**D.**
3. Amplitude and frequency of limit cycle if exists can be evaluate**D.**
4. Can be applied to discontinuous time system.

Which of the above statements are correct? **[**IES2010**]**

A. 1,2,3 and 4

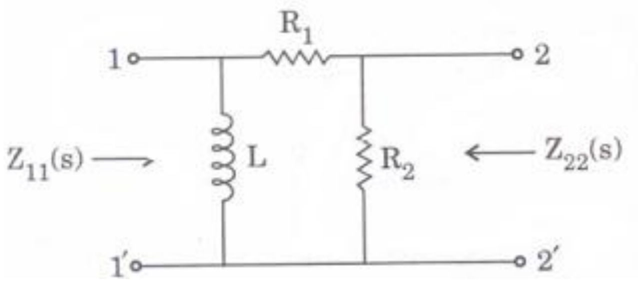
B. 2 and 3 only

C. 3 and 4 only

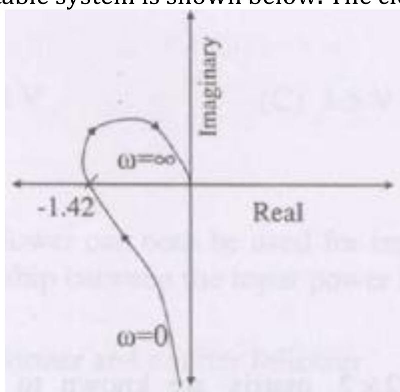
D. 2,3 and 4 only

Ans: B

[15] For the circuit shown below, the natural frequencies at port 2 are given by s+2=0 and s+5=0,without knowing which refers to open-circuit and which to short-circuit. Then the impedences Z_{11} and Z_{22} are given respectively by **[**IES2010**]**



A. $K_1\{(s+5)/(s+2)\}$, $K_2\{(s+2)/(s+5)\}$
B. $K_1\{(s+2)/(s+5)\}$, $K_2\{(s+5)/(s+2)\}$
C. $K_1\{(s)/(s+2)\}$, $K_2\{(s+2)/(s+5)\}$
D. $K_1\{(s+2)/(s+5)\}$, $K_2\{(s+2)/(s+5)\}$
Ans: C
[16] Consider the following statements in connection with two-position controller:
1.If the controller has a 4% neutral zone,its positive error band will be 2% and negative error band will be 8%.
2.The neutral zone is also known as dead ban**D.**
3.The controller action of a two-position controller is very similar to that of a pure on-off controller.
4.Air-conditioning system works essentially on a two-position control basis.
Which of the above statements are correct? **[**IES2010**]**
A. 1,2 and 3 only.
B. 2,3 and 4 only.
C. 2 and 4 only.
D. 1,2,3 and 4
Ans:B
[17] The polar plot of an open loop stable system is shown below. The closed loop system is **[**GATE 2009**]**



A.Always stable
B.Marginally stable
C.Unstable with one pole on the RH s-plane
D.Unstable with two poles on the RH s-plane
Ans:C
[18] The open loop transfer function of a unity feedback system is given by $G(s) = (e^{-0.1s})/s$.The gain margin of this system is
[GATE 2009**]**
A. 11.95 dB
B. 17.67 dB
C. 21.33 dB
D. 23.9 dB
Ans: D

[19]The first two rows of Routh's tabulation of a third order equation are as follows.

s^3 2 2

s^2 4 4

This means there are **[**GATE 2009**]**

A.Two roots at s =± j and one root in right half s-plane

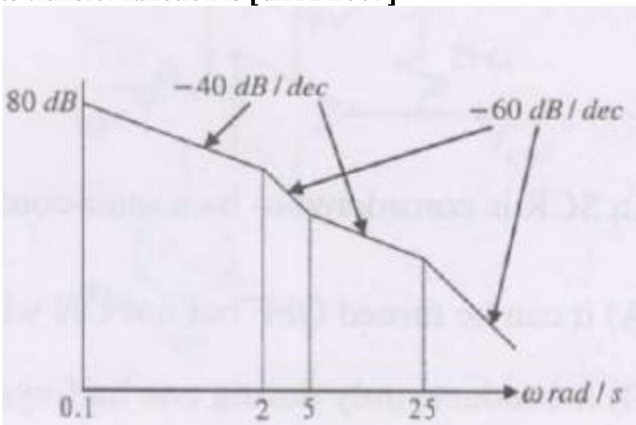
B.Two roots at s =± j2 and one root in left half s- plane

C.Two roots at s = ±j2 and one root in right half s-plane

D.Two roots at s =± j and one root in left half s-plane

Ans:D

[20]The asymptotic approximation of the log magnitude vs frequency plot of a system containing only real poles and zeros is shown. Its transfer function is **[**GATE 2009**]**



A.[10(s+5)**]**/**[**s(s+2)(s+25)**]**

B.[1000(s+5)**]**/**[**s^2(s+2)(s+25)**]**

C.[100(s+5)**]**/**[**s(s+2)(s+25)**]**

D.[80(s+5)**]**/**[**s^2(s+2)(s+25)**]**

Ans:B

[21]The trace and determinant of a 2x2 matrix are known to be -2 and -35 respectively. Its eigen values are **[**GATE 2009**]**

A.-30 and -5

B.-37 and -1

C.-7 and 5

D.17.5 and -2

Ans:C

[22]A Linear Time Invariant system with an impulse response h(t) produces output y(t) when input x(t) is applie**d.** When the input x(t-τ) is applied to a system with impulse response h(t-τ), the output will be **[**GATE 2009**]**

A.y(t)

B.y(2(t-τ))

C.y(t-τ)

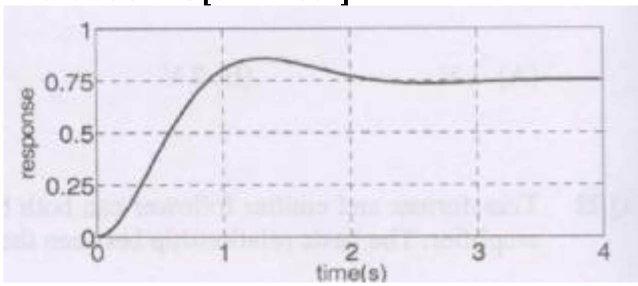
D.y(t-2τ)

Ans:D

[23]For the Y-bus matrix of a 4-bus system given in per unit, the buses having shunt elements are **[**GATE 2009**]**

$$Y_{BUS} = j\begin{bmatrix} -5 & 2 & 2.5 & 0 \\ 2 & -10 & 2.5 & 4 \\ 2.5 & 2.5 & -9 & 4 \\ 0 & 4 & 4 & -8 \end{bmatrix}$$

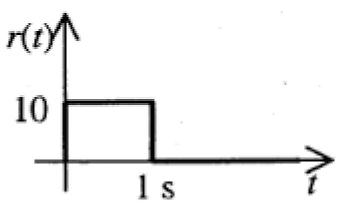
A. 3 and 4
B. 2 and 3
C. 1 and 2
D. 1,2 and 4
Ans:C
[24]The unit step response of a unity feedback system with open loop transfer function G(s) = K / ((s+1)(s +2)) is shown in the figure. The value of K is **[**GATE 2009**]**



A. 0.5
B. 2
C. 4
D. 6
Ans: D
[25] For the driving point impedance function, Z(s)=**[**as^2+7s+3**]**/**[**s^2+3s+b**]**, the circuit realization is shown below. The values of 'a' and 'b' respectively are **[**IES2010**]**
A. 4 and 5
B. 2 and 5
C. 2 and 1
D. 2 and 3
Ans: C
[26] For the following driving point impedance functions, which of the following statements is true? **[**IES2010**]**

$Z_1(s)=(s+2)/(s^2+3s+5)$
$Z_2(s)=(s+2)/(s^2+5)$
$Z_3(s)=(s+2)/(s^2+2s+1)$
$Z_4(s)=(s+2)(s+4)/(s+1)(s+3)$

A. Z_1 is not positive real
B. Z_1 is positive real
C. Z_3 is positive real
D. Z_4 is positive real
Ans: D
[27] The steady state error of a unity feedback linear system for a unit step input is 0.1. The steady state error of the same system, for a pulse input r(t) having a magnitude of 10 and a duration of one second, as shown in the figure is **[**GATE2011**]**

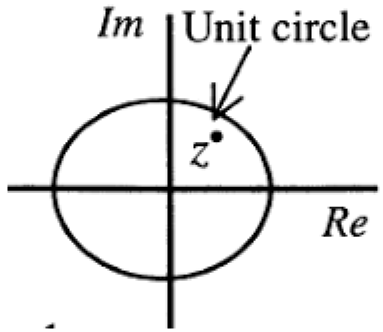


A. 0
B. 0.1
C. 1

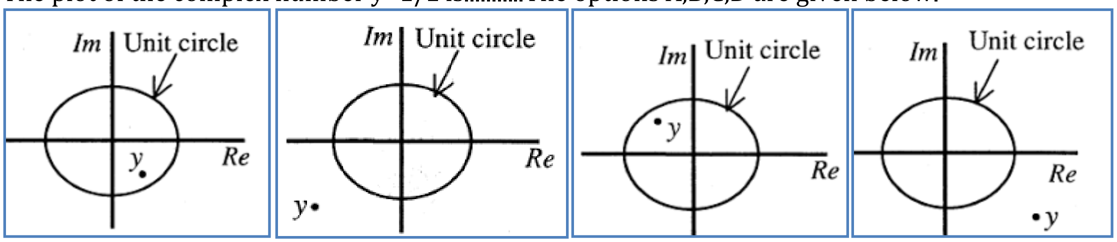
D. 10

Ans:A

[28] A point z has been plotted in the complex plane, as shown in figure below **[GATE2011]**



The plot of the complex number y=1/z is..........The options A,B,C,D are given below.



A. B. C. **D.**

Ans:D

[29] The system represented by the input-output relationship $y(t)=\int_{-\infty}^{5t} x(\tau)d\tau$, t>0 is

- **A.** Linear and casual
- **B. Linear but not casual**
- **C.** Casual but not linear
- **D.** Neither linear nor casual

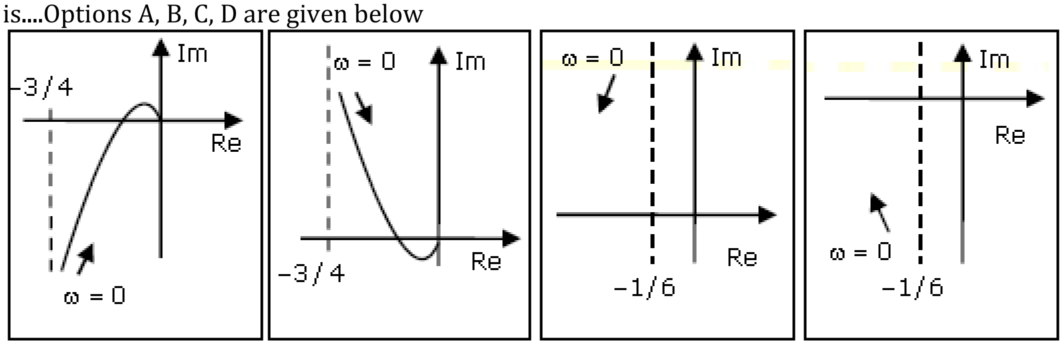
[30] For the system 2/(s+1), the approximate time taken for a step response to reach 98% of its final value is

- **A.** 1s
- **B.** 2s
- **C. 4s**
- **D.** 8s

[33] Given the finite length input x**[**n**]** and the corresponding finite length output y**[**n**]** of an LTI system as shown below, the impulse response h**[**n**]** of the system is

- **A.**h**[**n**]**={1,0,0,1}
- **B.**h**[**n**]**={1,0,1}
- **C.h[n]={1,1,1,1}**
- **D.**h**[**n**]**={1,1,1}

[34] The frequency response of G(s)=1/**[**s(s+1)(s+2)**]** plotted in the complex G(jω) plane (for 0< ω<∞) is....Options A, B, C, D are given below



A. B. C. D.

Ans:A

[35] The system x=Ax+Bu with

A= $\begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix}$ B= $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$

is

A. stable and controllable
B. stable but uncontrollable
C. unstable but controllable
D. unstable and uncontrollable

[36] The characteristic equation of a closed-loop system is a(s+1)(s+3)+k(s+2)=0,k>0. Which of the following statements is true?

A. Its roots are always real
B. It cannot have a breakaway point in the range -1<Re**[**s**]**<0
C. Two of its roots tend to infinity along the asymptotes Re[s]=-1
D. It may have complex roots in the right half plane

[37] The frequency response of a linear system G(jω) is provided in the tabular form below

|G(jω)|	1.3	1.2	1.0	0.8	0.5	0.3
∠G(jω)	-130°	-140°	-150°	-160°	-180°	-200°

A. 6dB and 30°
B. 6dB and -30°
C. -6dB and 30°
D. -6dB and -30°

[38] An openloop system represented by the transfer function G(s) = **[**(s+1)/(s+2)(s+3)**]** is

A. stable and of the minimum phase type
B. stable and of the non-minimum phase type
C. unstable and of the minimum phase type
D. stable and of the non-minimum phase type

[39] The open loop transfer function G(s) of a unity feedback control system is given as, G(s)=**[** k(s+2/3) / s^2(s+2) **]** From the root locus, it can be inferred that when k tends to positive infinity.

A. three roots with nearly equal real parts exist on the left half of the s-plane
B. one real root is found on the right half of the s-plane
C. the root loci cross the jω axis for a finite value of k; k not equal to 0
D. three real roots are found on the right half of the s-plane

[40] The response h(t) of a linear time invariant system to an impulse δ(t), under initially relaxed condition is h(t) = $e^{-t}+e^{-2t}$. The response of this system for a unit step input u(t) is

A. u(t)+$e^{-t}+e^{-2t}$
B. ($e^{-t}+e^{-2t}$) u(t)
C. (1.5-e^{-t}-0.5e^{-2t}) u(t)
D. e^{-t}δ(t)+e^{-2t}u(t)